ATMAE 2010 Conference Proceedings

- Review Process & Statistics
- Presentation Abstracts
- Proceedings Papers

“Bridging the Gulf”

Wednesday October 27 - Saturday October 30, 2010
Edgewater Beach Resort - Panama City Beach, Florida
Review Process & Statistics for Presentations and Papers

This CD-ROM of the ATMAE 2010 Conference Presentation Abstracts and Proceedings Papers is the result of the work of many authors in technology, technology management, and applied engineering degree programs throughout the United States who gathered to share their work at the 2010 Annual ATMAE Conference, “Bridging the Gulf,” in Panama City Beach, Florida, October 27 - 30, 2010. This CD-ROM includes all of the conference presentation abstracts that were accepted through peer-review for presentation and publication (except those withdrawn by the authors), and the Conference Proceedings Papers (that are based on accepted presentations) which were accepted through a secondary peer-referee process.

The reviews of presentation proposals and conference papers were led by ATMAE Membership Division Presidents or their designees or Membership Focus Group Chairs. The proposals and papers were reviewed in a double-blind process by a panel of at least three ATMAE members with expertise in the topical area. Using the review criteria (posted on the ATMAE website), panelists evaluated and ranked each paper, and a cumulative rank-ordering system was used to help select the presentations and papers.

The ATMAE 2010 Conference Presentation Abstracts were subject to a double-blind peer review process. In 2010, the peer-review process led to acceptance of 65% of presentation proposals, 196 accepted of 302 proposals submitted. Some proposals were withdrawn after acceptance and are not published in the Proceedings

The ATMAE 2010 Conference Graduate Student Research Presentation Abstracts were chosen by a blind-review process led by ATMAE members who are University faculty. Eight abstracts were submitted, and four were chosen for presentation, an acceptance rate of 50%.

The ATMAE 2010 Conference Proceedings Papers went through a similar process. Authors of accepted conference presentations were invited to submit full papers based on their presentation abstracts; the Conference Proceedings Papers were selected in a double-blind peer review process, with panels of at least three reviewers involved in reading and reviewing each paper. In 2010, of XXX accepted conference presentations, 45 were expanded into longer papers and were submitted for the peer-review process. The double-blind peer review process led to acceptance of 51% of the papers submitted, for a total of 23 “ATMAE 2010 Conference Proceedings Papers.” These 23 Conference Papers represent 11.7% of the proposals accepted for presentation at the 2010 ATMAE Conference, and only 7.6% of proposals submitted.

Best 2010 ATMAE Conference Proceedings Paper: “Results, Findings, and Recommendations from a Needs Assessment Study Focusing on Niche Manufacturing Companies in a Rural Area with No Major Industrial Base” (Community Colleges track), by Mr. Mike Peterson, College of the Redwoods

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Conference Presentation Abstracts (by track):

- Administration: Chair, Randy Peters; William Brauer, John Irwin, Ahmad Zagari
- Community Colleges: Chair, Argie Nichols; David Edward, Susan Horne, Bobby Jones,
- Construction: Chair, Denise Gravitt; Ben Cranor, John Kugler, Clair Roudebush, Keith Touchet, Musibau Shofaluwe
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- Manufacturing: Chair, Mark Miller; Ahmed ElSawy, Verna Fitzsimmons, Terry Leeper
- Safety: Chair, Ernie Sheldon; Jim Collier, Ben Cranor, Farman Moayed, Keith Touchet, Pao-Chiang Yuan
- Teaching Innovations: Chair, Randy Peters; Gordon Minty, Michelle Surerus, Kim Travers

Graduate Student Research Presentation Abstracts:

- Randy Peters; Marion Schafter, Shawn Strong

Conference Proceedings Papers (by track):

- Administration: Randy Peters, Chair; Michael Ayokanmbi, Jyotirmay Gadewadikar, Mitchell Henke, Mahyar Izadi, Samson Lee
- Community Colleges: David Edward, Chair; Bobby Jones, John Martini, Argie Nichols
- Construction: Denise Gravitt, Chair; Sanjeev Adhikari, Suzanne Horne, Richard Miller, Loren Niemeyer, Claire Roudebush, Keith Touchet
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- Safety: Ernest Sheldon, Chair; Jessica Buck, Keith Touchet, Doug Ullrich
- Teaching Innovations: Randy Peters, Chair; Jerry Cloward, Michael Dyrenfurth, Sudershans Jetley, Orla LoPiccolo, Shawn Strong

Best Paper Process:

- Ivan Mosley, Sergio Sgro, Philip Weinsier

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Administration
Recruitment and Retention of Upward Bound Students in Science, Engineering, and Technology: Experiences at Alcorn State University

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Need: Upward Bound, is a federally funded program, designed to prepare high school students for a college education. It serves high school students from low-income families; and high school students from families in which neither parent holds a bachelor’s degree. The goal of program is to increase the rate at which participants complete secondary education and enroll in and graduate from institutions of postsecondary education. Every year, more high school seniors take advantage of the Upward Bound program for tutoring, college applications, college credits and motivational support. These services help students who may have never before thought about going to a university, become acquainted and enthusiastic about the experience. Published studies from universities and colleges across the nation show that many of these institutions use the Upward Bound Program as a pipeline for recruiting new students into their programs.

Overview: Alcorn State University’s Department of Advanced Technology is not an exemption. Each year, the Department takes advantage of the more than sixty students supported by Alcorn State University Upward Bounds Program in four high schools (Port Gibson High School, Jefferson High School, Natchez High School and Wilkinson County High School) across Southwest Mississippi to recruit into its Science, Engineering, and Technology programs. Large proportion of these students population are from disadvantaged groups i.e. families that are 150% below poverty and are potentially first-generation, post secondary education students. The purpose of this presentation or paper is to examine recruitment and retention of Upward Bounds Students into Department of Advanced Technology and show case some of the successes.

Major Points:
• Role of Upward Bounds Program
• Examine some of the socio-economic characteristics of the source area
• Highlight some of the recruitment, retention and successes of Upward Bounds Students

Summary: The presenters will share their experiences, findings, and strategic plans regarding recruitment and retention of Upward Bound Students into engineering, science and technology programs at minority colleges and universities with the attendees or participants.
A Novel Use of Data Mining on College Students’ Withdrawals from Registered Courses

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Need: Each semester of an academic year, a substantial proportion of students withdraw partially or entirely from their registered courses. The major consequences of withdrawals are lengthening the total time for graduation, wastage of university resources in terms of faculty underload, computing and library facilities, and other support services. Many college staffs opine that the university is failing to meet the needs of such students. Other views it as the student’s own problem. There is a complicated mixture of variables that cause students to drop courses within weeks of beginning. Withdrawal may occur in various ways - failure to follow the lecture, transfer to other institution, switching course within department or institution, reducing the total course load etc. However, it is necessary to investigate the root causes considering various important attributes of a college student. Data mining technique can be an effective tool in this investigation.

Overview: This work reports a novel use of data mining technique to study the comparable and contrasting effects of seven most widely used variable measures: 1) age, 2) gender, 3) high school grade point average, 4) American College Test or Scholastic Aptitude Test (ACT/SAT) score, 5) credit hours taken, 6) credit hour passed, and 7) course(s) withdrawn of a college student. It provides a methodology for predicting the cause(s) of college students’ course withdrawal from registered hours at a university of the United States.

Major Points:
- Predicting a student’s success is a process of determining in which group a student belongs.
- A student must have certain academic skills in order to have acceptable performance and stay in a course. Effective cognitive traits such as persistence in achievement and motivation are also important. A desire to complete is often cited as an important drive to avoid withdrawal. However, the seven common attributes of a student listed in the Overview should be investigated first.
- In the past the statistical methods such as linear regression, multiple regressions, and discriminant function analysis were used to study those variables.
- Very few studies have been conducted to identify what has led students to enroll in courses and withdraw within few weeks. There is also little research on using data mining techniques to predict students’ course withdrawal habits.
- This study employed two data mining techniques (decision tree and association rule) on ten year’s (1992-2002) of data for 8,208 students. Decision tree is effective in finding the contrasting and characterizing patterns of different classes (variables). Association rule is effective in finding the patterns of highly associated attributes (variables).

Summary: This study provides knowledge on comparable and contrasting effects of seven cognitive and non-cognitive variables for predicting college students’ course withdrawal behavior. Using data mining techniques, analysis revealed that the number of credit hours enrolled dictates this behavior at college level. High school GPA and ACT/SAT scores have less significant impact. The empirical evaluations have shown that data mining algorithms can be useful tool to the college administrators for analyzing student database.
Economic and Performance Measures Used in Program Evaluation

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Need: The recent economic situation in conjunction with decreasing state appropriations have forced many higher education institutions to look more critically at academic program performance. While the cost of instruction has always been a factor, declining state subsidies and a rise in tuition and fees that has exceeded cost of living, places a greater internal and external demand on managing resources. While academic program review has generally included a variety of measures that are both qualitative and quantitative in nature, new and expanded measures are emerging that inform decisions regarding program structure, administration, and resource allocation.

Overview: Assessments, such as accreditation, primarily focus on the degree to which programs successfully attain certain goals, which tend to be qualitative in nature. The process questions if adequate resources are being deployed in a way that a program successfully meets its objectives, provides students with a desired level of competence, and those students benefit from that attainment. Program reviews, scheduled or forced by the immediacy of financial conditions, increasingly consider factors for assessing productivity that go beyond that typically found in accreditation. These additional factors guide an institution in reducing expenses, increasing revenue, or managing existing resources in a way that provides for reallocation. Resources are deployed to:
• Invest to sustain what are already highly successful programs,
• Invest in marginal programs with a goal of improvement,
• Divest in programs that are marginal, or
• Eliminate programs that are obsolete, underperforming, or have a high cost to benefit ratio.
Program review processes collect and assess comparative cost and productivity data that increasingly measure impacts across a broader spectrum of the institution, as well as benchmarking against peer institutions.

Major Points:
• Factors and economic trends resulting in increased assessment of program performance.
• Overview and discussion of assessment measures used in determining performance.
• Examples of assessment processes and measures used in evaluating program performance.
• Benchmark data from institutions having ATMAE accredited baccalaureate programs.

Summary: Academic costs tend to be a significant portion of an institutions overall expense. This presentation is intended to provide an overview and discussion of cost and productivity measures used in academic program review. The presentation will focus on examples of processes and measures used in evaluating program performance and benchmarking. Included is a discussion of participant experiences with program review processes and outcomes.
Bridging the Gulf to Education - Barriers and Solutions

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Need: A study presented to the U.S. House of Representatives in 2006 stated that America’s economic well being and ranking in the global community was contingent upon its science and technology industries (Ashby, 2006). One of the tools which has been successful in preparing students for STEM careers are the Career and Technical Education (CTE) disciplines, such as technology education. Additionally, the complexity of the new demands from the 21st Century Work Place coupled with Landmark legislation such as the Americans with Disabilities Act (ADA) and No Child Left Behind (NCLB) have made it necessary for leadership to provide a more collaborative and universal approach to effect wide spread change.

Overview: The purpose of this study is to determine the greatest barriers for educating students and the best solutions for bridging these divides. The pragmatic nature of Career and Technical Education (CTE) disciplines, such as technology education had placed these courses at the fore front for educating students from all ability groups in the 20th Century; However, the complexity associated with preparing students to compete in the 21st Century work place makes it necessary for school administrators to take the lead in interpreting, directing and monitoring adherence to governmental mandates. This qualitative study of school executives, is a homogeneous purposeful study intended to determine their perceptions of current barriers to education and potential solutions to these problems.

Major points:
- School executives from a North Carolina school district were surveyed to determine what they perceived to cause the greatest educational gulfs.
- These principals were also asked to recommend potential solutions to bridging these gaps.

Summary: The survey revealed that 100% of school executives surveyed identified the greatest barrier to education originated from sources outside of their schools perimeter and ability to control. Additionally, 75% of respondents identified federally mandated testing as the greatest barrier to educating students. The variety of items labeled as barriers to educations and potential solutions could be affected by environmental factors inside or outside of the school such as student demographics or pressure to meet governmental mandates. The response from school executives was unanimously in favor of generating school-based plans of action which would provide real-world solutions to bridge the gulf created by educational barriers.
School to Work Transitions: The Value of External Partnerships to Promote Student Preparation

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Need: Often times, many students complete post secondary academic programs, but have not developed the proficiency to thrive in the workforce. According to Kim (2006), those who complete post secondary programs (often times four-year college graduates), may encounter difficulties in the transition due to a lack of work experience. As the contemporary job market becomes more competitive, it is pertinent that students not only acquire academic proficiencies, but professional work experiences to aid in their preparation. One key strategy to remedy this societal ill is for local external companies to strength partnerships with academic institutions, and to afford students opportunities to apply academic knowledge in a workforce environment.

Overview: In efforts to strengthen external partnerships with workforce entities and post secondary academic institutions, strategies must be designed to reveal the systematic approach of the transition from the academic environment to the workforce. In addition, there must be the implementation of the planning, designing, and execution of school-to-work transition initiatives for technical programs that adheres to the contemporary job market, the fluctuation of the economy, and the increase of competition. After students complete a program, especially those in the STEM disciplines, they should have acquired commendable experiences that would link their academic and professional experiences; thus, improving the transition from school to work.

Major Points:
• Promote an effective and smooth transition from school to work for post-secondary graduates of technical programs by:
  • Developing a working knowledge of the purpose of academic mastery, career preparation and progression, integrated academic and technical programs, articulation with outside entities, and effectual partnership models;
  • Evaluating current academic and occupational trends; and
  • Identifying how to integrate academic and workforce/technical programs.

Summary: This research shall render information reflecting national school-to-work initiatives, and how articulations and partnerships are currently strengthening. This research will also help to further explain key components of community initiatives; school-based learning, work-based learning, connecting activities, etc. The combination of these forms of learning will produce strong candidates who will be well prepared for the ever-changing technological workforce.
Accreditation and the Need to Identify Key Processes, Products, and Services

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Need: A robust assessment process is key to ongoing improvement of overall program performance and thus the successful pursuit of accreditation. Robust in that the assessment process is a fact based, bottom up review of all key processes, products, and services associated with the program under scrutiny. To effectively assess these elements, a program must be familiar with their key customers, processes and supplier relationships, and requirements.

Overview: The purpose of this presentation is to offer a perspective on a tool that possess a proven track record and that can contribute immensely to program planning and assessment. Specifically, the presentation deals with COPIS, a tool that helps develop a cohesive and comprehensive concept of program mission. COPIS is also the acronym for key Customers, Outputs, Processes, Inputs, and Suppliers, and a means by which a program can pull together and organize what is known about these key processes, products, and services, and what the program practices intuitively. COPIS formalizes and gathers together all the disparate pieces of knowledge concerning the program. Of utmost importance though, COPIS facilitates face-to-face dialogue that results in consensus on what a program considers to be the “key” aspects of who and what they’re all about.

Major Points:

• ATMAE Accreditation.
• Program planning and the role of assessment.
• COPIS and its elements—key Customers, Outputs, Processes, Inputs, and Suppliers.
• Assessment—customer satisfaction indicators, customer quality requirements/indicators, data systems, process performance/quality indicators, and methods and indicators of supplier quality.
• The COPIS worksheet.
• Application of COPIS and creative dimensions.
• Summary.

Summary: COPIS helps define the program. It helps the program focus on improving products and services by improving how things get done (the processes) rather than simply what is done (the products and services). It is predicated on data based decision making. And it facilitates fleshing out the adage that “what gets measured gets done”.
Accountability, ATMAE Accreditation, and Strategic Planning

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Need: Strategic planning is the cornerstone of any viable technology, management, and applied engineering program. It is one of the integral steps in fulfilling a program’s mission. Its role is to ensure that, through effective preparation, programs and associate activities are best positioned to achieve the long-term goals and objectives of the program. It will assist program administrators set long-term directions and policies for the program and make decisions on near-term priorities and resource allocations. It will also assist those who develop and implement programs by providing guidance for multiyear program plans and budgets. Consequently, ATMAE accreditation must be an integral part of any technology, management, and applied engineering program’s strategic plan. The outcome of the accreditation process should be the springboard from which near and long term plans are developed. The purpose of this presentation is to develop the relationship between ATMAE accreditation and its role in developing a program’s strategic plan. The objective of this presentation is the integration of the ATMAE accreditation process with a program’s strategic planning process.

Overview: Strategic planning can be defined as the process by which the guiding members of an organization envision its future and develop strategies and plans for achieving that future. During the formulation stage of the strategic planning process, those guiding members will: (1) conduct a values assessment, (2) analyze the organization’s mission, (3) envision the organization’s future, (4) assess its current capabilities, (5) conduct a gap analysis, and (6) develop strategic goals and objectives. The outcome of the ATMAE accreditation process is to articulate a program’s current capabilities. These results, when melded with a program’s vision, yield performance gaps which serve as the basis for near-term and long-term goal setting. The gaps in performance also yield an atmosphere of creative tension which is essential to meaningful program improvement.

Major Points:

- Strategic planning process and its stages—formulation, deployment, implementation, and review.
- Steps in the formulation stage.
- ATMAE accreditation—what is it?
- Formulation—Melding ATMAE accreditation with a program’s strategic plan.
- Deployment, implementation, and review.
- Summary.

Summary: ATMAE accreditation is a process technology, management, and applied engineering programs use to diagnose and evaluate themselves. Furthermore, it is a process that allows programs to identify strengths and weaknesses and recommend specific actions that can be taken to maintain a program’s assets and remedy those areas of weakness. This process must be an integral part of any technology, management, and applied engineering program’s strategic plan.
One Plus One Equals One? - A Case Study of Departmental Merger and Change

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Need: In these very difficult economic times, every day brings news of cuts to education at all levels. Universities are coping using an array of strategies. This presentation will address issues surrounding these change implementations. The intent is to help provide a sense-making framework for these types of occurrences with the intent to optimize change.

Overview: In our college, two departments - Industrial Technology (IT) and Organizational Leadership and Supervision (OLS) - are in the process of merging into one new department. This forum will consist of members of each merging department discussing the process of this merger within the general framework and principles of organizational change. The IT Department is accredited by ATMAE, while OLS is undergoing its first site visit by ATMAE in the Spring, 2010.

Major Points:
- The change process
- Characteristics of each department
- Merger events and timelines
- Application of theory to practice
- Comparisons between academia and industry

Summary: CEO’s often consolidate functional departments during challenging economic times. Universities are beginning to react similarly to state budget cuts. Attendees will learn about the similarities and differences in theoretical, academic and industrial change processes through a case study of a departmental merger in the College of Technology at Purdue University.
Need for More Deans of Colleges/Schools of Technology

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Need: One important way to grow technology programs is to have more deans of technology. We see more deans of engineering programs where technology programs are housed. We also see deans of business programs where technology programs are housed. To grow technology programs we need more deans of technology.

Overview: Going through the 2009 ATMAE Technology Program Directory, I found only 19 programs where the deans were technology deans. Most of the deans were from engineering or business programs. I sent a survey to the 19 deans as to what was important to be a dean.

Major Points:
• Requirements for deans regarding administration
• Requirements for deans regarding curriculum
• Requirements for deans regarding technology/change
• Requirements for deans regarding funding
• Requirements for deans regarding recruitment
• Other requirements

Summary: We will summarize the results of the study as to the important requirements to be deans of technology. There is a need to grow deans of technology in order to grow technology programs.
Concurrent MS Degrees Across the Atlantic: Technology, Innovation & Sustainability

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Need: As the practice of technology, engineering and business is increasingly international, supply chains are globalized and professionals interact across borders and continents with escalating frequency, Industrial and Engineering Technology graduates are increasing expected to have the competencies required to function effectively in such environments. Essentially this means that they have to possess multicultural understandings and skills, awareness of the business and technological practices of other nations, geographic familiarity and preferably multi lingual capabilities.

Overview: This presentation will highlight the essential components of a three country partnership of universities to offer two concurrent masters degrees, one from each side of the Atlantic, in a two year period. The session will describe the openly available funding mechanism, partner selection principles, common degree components, and administrative requirements that make such program innovation possible. We will also share the current evolution of a program of studies that focuses on Technology, Sustainability and Innovation.

Major Points:
- EU-FIPSE Atlantis funding opportunities
- The partnership between the Dublin Institute of Technology (Ireland), the Polytechnic University of Cataluña (Barcelona, Spain) and Purdue
- The memorandum of Understanding
- The program of studies
- Lessons learned about successful international partnering

Summary: Highlights of a successful three country (USA, Ireland, Spain) international partnership offering concurrent Master’s degrees focused on Technology, Innovation & Sustainability will be shared so that attendees could replicate the initiative. Q&A time and resources will be provided.
Breaking Barriers to Faculty Collaborations Across STEM Fields

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Need: The need to have students design and build a technical solution to a problem has necessitated faculty collaborations across the STEM fields. Breaking the barriers to marrying these disciplines effectively is necessary so as to be able to bring all the tools you can to building the solution.

Overview: Given an understanding that STEM is a meta-discipline is relevant. As such, a mindset that allows for the free exchange of ideas, joint policy making, and shelving all complexes (undue proclamation of superiority of a discipline) will help to forge on. As we look at models for 21st Century skills and the issue of competitiveness, it is clear that the integration of STEM fields will play an important role. Similarly, our focus should be on the higher level thinking skills, collaboration, and innovation needed in all areas as we look at the global workforce.

Major Points:
- Identification of barriers - awareness of differences between the principles of STEM fields
- Breaking barriers, when and how?
- Preferences for possible capstone courses
- Current research cluster practice across STEM fields and outcomes

Summary: We need to innovate our educational curriculum so it does reflect 21st century, real world skills our children will need to survive and thrive. The successful integration of STEM fields for effective learning on the part of the learners and valuable participation of faculty across the STEM fields is the focus of this presentation.
Systems Engineering Approach to Technical Education

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Need: There are many factors coming together that are forcing colleges to reevaluate how and what higher education provides particularly in the technical and professional fields. Considering the number of changes (new technologies, assessment, expected outcomes, reduced funding, etc) introducing even more changes to the system might appear too much for the system to absorb. (Agazarian, 1997; 88) On the other hand this might be the best time to strategize a new plan at both the course and program level founded in the principles of System Engineering and Lean Thinking.

Overview: The interdisciplinary approach of engineering systems offers a unique way to view the current complex higher education system. Systems engineering seeks to understand and evaluate the processes used produce a product or service and the human resources as well as the interfaces required to be successful. Lean Thinking is a philosophy based on eliminating or at least reducing waste. The time seems right to evaluate and apply the principles of systems, lean thinking, and continuous improvement of systems to applied engineering education programs.

Major Points:
- The current system is driven by many factors, some contradictory:
  - Internal and external demand for outcomes and assessment
  - Funding and budgetary demands
  - The University’s development and adoption of a philosophy statement for undergraduate education
  - General education requirements trend for more hours
  - Demand for more technical courses
  - Limiting BS degree to 121 semester credit hours
  - Tools available to contemplate these issues:
    - Lean Thinking
    - Principles of System Engineering
    - Theory of Living Systems
    - Previous research and experiences

Summary: In this paper we attempt to address the issue of balancing general education with professional or major education. The results of the initial research indicate that neither general education as defined by LEAP Learning Outcomes nor technical education, as defined by ATMAE and ABET are mutually exclusive. In fact they overlap. The question becomes, is it possible to effectively achieve both sets of outcomes within the same course? In an attempt to collect current information, we have set up two variations on team-teaching. The first was a lean manufacturing course taught by an engineer and a historian. The second was Life Cycle Assessment with an engineer and an industry professional. A third approach in which the senior year is completely overhauled is under consideration and will be discussed.
Becoming a Dean: “To Be or Not to Be...”

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Need: From 1998 to 2009, the presenter served as Dean of a College of Technology. He is asked on a regular basis about the nature of the dean’s job, how one prepares to take on an administrative role, and the like. Given that the dean’s role, in general, continues to evolve, it is often difficult for someone who does not have direct experience to understand all of the issues involved. The presenter has over 25 years of higher education experience, has attained the rank of professor, served as a department chair, and served as a dean. This session can be viewed as a personal “career counseling” session.

Overview: The presentation will include the following topics: What is the dean’s role and how is it changing? What skills, attributes, experiences, and so forth are typically looked for during a dean’s search? What is a dean’s search like? General Career Development Issues in Higher Education; and general discussion.

Major Points:
- The nature of the dean’s job is changing in general.
- Becoming a dean requires a diverse set of skills.
- How and when should one move through the ranks?
- The dean as a leader and manager.
- The typical search process.

Summary: Following this session, the participants will have a better understanding of the dean’s role, in general and how to prepare. The presenter is a trained counselor and facilitator and will offer general and specific (i.e., individual) information. Participants will have the opportunity to think critically if administration is for them.
Genesis of a Cross-Disciplinary Management Sciences Program: Project Workplan, Deliverables, and Lessons Learned

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Need: Over the past 50 years, American management sciences (MS) education has narrowed in on mathematical modeling and quantitative analysis tools. However, international MS educators have integrated behavioral sciences with mathematical modeling for skills to address what are described as ‘messy problems’: solutions that address social issues, technology challenges, and human resource needs alongside quantitative analysis tools. This presentation will explain how SDSU developed a fully scalable management sciences program model that has quantitative and behavioral science analytical rigor in a new cross-disciplinary program curriculum.

Overview: In summer 2008, SDSU President Chicoine established the Economics and Management Task Force with the charge to develop three distinct program areas, which included undergraduate and graduate Management Sciences. The Management Sciences subgroup, consisting of high-ranking managers in financial services, manufacturing, construction, and entrepreneurial startup industry sectors working with faculty from SDSU in Industrial Management and Economics, collaborated to develop a comprehensive set of program outcomes / competencies. The subgroup project deliverables included a scalable curriculum framework for undergraduate through graduate level management-related programs, a governance structure for the cross disciplinary management sciences faculty body, and a delivery plan for the new curriculum that leveraged existing resources, reducing the need for new funding sources.

Major Points:
• Project workplan including milestones, deliverables, and resource management
• Program analogs that were used to formulate the new management sciences program model for SDSU
• The seven (7) program outcomes / competencies developed by management practitioners
• Description of how the new curriculum maps to accreditation requirements
• Lessons learned including project schedule and resource management challenges, collaboration across departmental and college boundaries, and developing a shared governance model

Summary: Attendees will learn how SDSU utilized a broad-based business and industry task force to drive the curriculum and program development process. This method has assured externally validated competencies underpin the new management sciences curriculum. The fully scalable management sciences program model will be disseminated to session participants in addition to discussion of lessons learned from this ongoing project.
Classroom Inquiry and Technology to Improve Teaching and Student Learning

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Need: Physical science education, specifically physics and chemistry, provides a strategic link to technology education. The prerequisite knowledge in the physical sciences is necessary for many of the STEM fields at the post secondary level. Classroom inquiry, understood as a way to teach science, and think about the nature of science has played a central role in the educational reform agenda in science education. Although teachers have been recognized as primary change agents, they lack clarity about what inquiry means and how it can be translated into classroom practice. One method of impacting the quality of students entering the post secondary ranks is to assist in the professional development of K-12 teachers.

Overview: Goals of this teacher professional development project are to strengthen grade 5-12 science teachers’ ability to engage students in science inquiry and serve as mentors to new and pre-service teachers. The project is designed to improve teachers’ ability to convey knowledge and application of inquiry-based methods, utilize technologies (e.g. computerized laboratory interface tools), and positively impact student achievement and attitudes toward and engagement with STEM fields.

Major Points:
- Accomplishing goals of state content expectations, STEM, and national standards
- Classroom use of computer response systems for interactive lesson development
- Implementing lab projects and demonstrations in science using computerized sensors such as Pasco and Vernier instrumentation and computer simulations

Summary: Attendees will understand how to expand practicing teachers’ conceptual understanding of the physical sciences (physics and chemistry), as well as the pedagogy for student learning of critical concepts in the physical sciences utilizing new technologies. The project described is focused on the application of classroom inquiry and technology to improve teaching and student learning.
Developing a Continuity Management Plan for Technology Programs

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Need: Administrative leadership in modern technology programs is presented with multiple and wide-ranging challenges. Among these challenges is developing a plan for managing the continuity of a program in the face of faculty turnover, accreditation, assessment, and other issues. This continuity management plan can integrate and build upon current best practices from academia and other fields to insure a program’s continued future success.

Overview: Faculty availability and turnover continue to be significant issues for administrators of technology programs, and there has been little practical information or research made available as to how best to manage program continuity in the face of these problems. The result is that much institutional knowledge remains at the individual faculty member level rather than at the program level. This knowledge is often not shared and is lost as faculty members leave the program, and little of the knowledge brought in from new faculty members is fully utilized. Drawing from university, industry, and military experience and practice, this presentation helps administrators lead the continuity management process and integrate other existing processes, such as accreditation and assessment efforts, into their overall plan and insure their program’s continued success.

Major Points:
- Trends in faculty availability and turnover
- Challenges unique to program continuity at universities
- Defining continuity management
- Best practices from other organizations
- Developing the continuity management plan
- Full utilization of institutional knowledge
- Getting ideas from new team members
- Integrating current efforts of accreditation and assessment
- Conclusions and recommendations

Summary: Attendees of this presentation will understand the need for and challenges of preparing a continuity management plan. Current trends, best practices, and the integration and refinement of current practices to insure a program’s continued success are covered as they relate to the administrator of a technology program.
Integrating Faculty into a Technology Program Team: Perspectives from Current Faculty and New Team Members

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Need: Administrators in technology programs recognize that when the recruiting and hiring process for new faculty is finished, the more difficult process of integrating the new member into the team just begins. This process of welcoming, preparing, and unifying the new member into a cohesive technology program team can set both the new member and the program on a path to success if done thoughtfully and properly.

Overview: Although the difficulty of integrating new members into an existing team is recognized throughout every organization, little research and information is available to assist program administrators in leading the integration process. The result is often a half-hearted or half-developed process that does little to start the new team member on the right road and does not bring them on board as quickly or efficiently as could be achieved with better practices. Drawing from the viewpoints of existing program faculty as well as new team members, including both tenure-line and contract, this presentation helps administrators lead the process of integrating new faculty into their instructional teams.

Major Points:
- Challenges unique to leading and integrating faculty teams
- Best practices from industry and academe
- Welcoming new team members
- Preparing new team members
- Tenure-line faculty perspectives
- Contract faculty perspectives
- Role of current faculty
- Leadership, potential pitfalls, and administrative concerns
- Conclusions and recommendations

Summary: Attendees of this presentation will understand the challenges and opportunities of integrating new faculty members into a technology program instructional team, including both best practices and potential pitfalls. The welcoming, preparing, and integrating processes are covered as they relate to the administrator of a technology program.
Designing a Senior Capstone Course to Meet Student Learning and Program Assessment Goals

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Need: Designing and assessing a Senior Capstone course to help students integrate coursework, reflect on learning experiences, and transition from the academic world to the professional world is a challenge that many departments face. This presentation will focus on how to design an effective senior capstone course that provides course integration and closure to the undergraduate experience, and develop powerful documents that faculty can examine and assess student achievement and program goals.

Overview: The Senior Capstone course in the University of North Dakota’s Department of Technology was designed and developed to bring integration to the undergraduate experience, provide students with an opportunity to reflect on the meaning of their college experience, and to facilitate graduating students’ transition to post-college life. It also affords powerful documents through which faculty can examine and assess student achievement and program goals. During this presentation the purposes for and design of the Senior Capstone course will be shared, along with issues that may arise in planning and implementation, the assessment of student achievement and program goals, and what has been learned through course development and assessment.

Major Points:
- Purposes for the Senior Capstone course
- Design of the Senior Capstone course
- Issues in planning and implementing
- Assessment of student achievement and program goals
- What has been learned through course development and assessment

Summary: Designing and implementing a Senior Capstone course to help students integrate coursework, reflect on learning experiences, and transition from the academic world to the professional world is a challenge that many departments face. An additional challenge is for faculty to conduct meaningful assessment of student achievement and program goals. During this presentation the purposes for and design of the Senior Capstone course are shared, along with issues that may arise in planning and implementation, the assessment of student achievement and program goals, and what has been learned through course development and assessment.
A Graduate Student Advising Database System

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Need: Graduate program faculty members are often tasked with advising students on course selection, thesis topics, and other issues related to completion of graduate work. They are forced to use Microsoft Word or Excel to manage graduate school students’ progress, since there are limited information technology choices available to them. Furthermore, determining the number of students that will need a particular course in upcoming semesters is a daunting task since no system is available that can produce the number of students that will need a particular course in a specific semester. Graduate program faculty members need a database system that can track a student’s progress from time of enrollment until graduation. This system can be used to enter advising information, produce plans of study, and reports of the number of students that need each course in upcoming semesters.

Overview: A multi-user database system initially developed in 2002 to manage community college students was later modified in 2006 through 2007 to manage graduate students’ records. Preliminary feedback from faculty that have used the system and the students that have benefited from it indicate that it has made their jobs much easier by maintaining continuity if advisers are changed or if the student is advised by more than one person. Furthermore, they find it easier to advise students when they have a graphical user interface with boxes in front of them prompting them for information. Some students have also noted that they are more focused on what they need to accomplish every semester, because the system provides them a detailed report of their program of study. Program managers have also benefitted during scheduling of courses from this system, since they can now produce reports that pinpoint the number of students that need each course in a given semester. Since the system was developed using Microsoft Access, is easy to setup and modify. No additional software is required other than Microsoft Access.

Major Points:
- Graduate faculty members need a system to manage their graduate students’ progress
- The system should be easy to use and modify and requires limited resources
- Degree program managers need a system that can track all students’ progress and produce needed reports

Summary: Attendees of this presentation will be able to see how a multi-user database system can be used to advise graduate students, provide them with a printout of programs of study, and produce reports that aid in course scheduling. Furthermore, they can see how this system can be modified to meet the advising needs of any degree program.
Using a Database System to Initiate, Track, and Assess Early Intervention Strategies to Improve Retention in STEM Programs

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Need: Academic institutions are working hard to improve science, technology, engineering, and mathematics (STEM) program enrollments and retention rates. To assist them in their efforts, a standard method to identify at risk students early in their academic programs is needed. A database system can be used to identify at risk students and to initiate more personalized intervention strategies that improve student academic performance and prevent student losses.

Overview: A database system has been developed and is being tested in a pilot study at a community college in North Carolina that allows instructors in STEM programs to initiate an early alert for a student they believe is at risk of dropping out or failing a course. The system allows alerts to be submitted at any time during the semester through a standard graphical user interface. Once an instructor initiates an alert notice, an academic advisor or other designated member is notified through email that an alert has been submitted. Based on the nature of the alert and comments, the academic advisor will then be able to implement a prepared intervention strategy to help the student improve performance. As data is accumulated within the database system, patterns of student problems and effective intervention strategies used to address them will begin to emerge.

Major Points:
- Improving student retention in STEM programs requires early identification of at risk students.
- Effective intervention strategies that actually work to retain students need to be identified.
- A database system should be used to track at risk students, their problems, and the strategies that have been used in order to maximize STEM retention rates.

Summary: Attendees of this presentation will be able to see how an automated system can be used to identify and manage at risk students in STEM or other types of programs. Furthermore, they can see how a database system can be used to track intervention strategies used to assist at risk students. Most of all, they will be able to see how a database system can help determine which strategies are the most effective at retaining students in these programs.
A Joint Fortune 500 Manufacturing Company/Doctoral Research-Intensive University Collaborate to Develop a 40-Hour School of Technology Lean Manufacturing Academy

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Need: To remain globally competitive, higher education institutions that teach manufacturing, and manufacturing industries, must collaborate and innovate to develop programs and curriculums that match emerging industrial manufacturing needs. Manufacturing companies and educational institutions that do this will develop and hone cutting edge technologies that enable graduates to enter industry with knowledge and proven skills to provide solutions to ever more complex industrial manufacturing problems.

Overview: In “Bridging the Gulf”, the purpose of this presentation is to show the innovative route that one U.S. HBCU Doctoral Research-Intensive university, sponsored by a Fortune 500 manufacturing company, took to develop a lean manufacturing academy literally complete with all of the bells and whistles. This second-year institution used a combination of the manufacturing company’s middle and upper level managers and the university’s manufacturing professors to provide classroom instruction and assessments. To demonstrate that the academy was multi-functional, the collaborative team used two hands-on projects, one manufacturing activity, and one service case study, to facilitate student learning while promoting collaborative group work. Two factory visits entwined with classroom activities, cemented students’ new knowledge of lean manufacturing concepts. The collaborative instructors used academy graduates’ end-of-course evaluations and take away comments for continuous improvement of the academy. Upon graduation, students received joint manufacturing company/university certificates, complete with each organization’s official logo.

Major Points:
- Describe higher education/industry’s needs for improved collaborative joint ventures
- Describe how one manufacturing company and one university “Bridged the Gulf” to innovative and develop a mutually-beneficial certified program
- Show that by making student outcomes a priority, higher education and industry can come together and provide solutions that propel both to the global forefront of manufacturing

Summary: Today’s global manufacturing competitive environment demands ever increasing manufacturing efficiencies. Higher education/industry collaborative student learning innovations is one way to provide solutions to adequately staff manufacturing organizations with globally competitive employees.
Continuous Improvement and Student Retention: A Survey of ATMAE Undergraduate Conference Activities

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Need: There has been a decline in student attendance and participation in the ATMAE conference. A survey of students attending the 2008-2009 conferences was conducted with the purpose of understanding the attitudes and opinions of various activities supporting undergraduate students. This research study serves as a baseline for future study and also a trend analysis for the purpose of continuous improvement in producing high quality student centered activities at ATMAE national conventions.

Overview: The Association of Technology, Management, and Applied Engineering (ATMAE) is a premier association of individuals dedicated to the promotion of industrial technology in business, industry, education, and government. To promote and perpetuate the association, the involvement of students is crucial to the future of the organization. Due to the fact that student attendance has been decreasing over a number of years, multiple surveys have been done of approximately 200 students, faculty, and advisors participating in the national conventions in 2008 and 2009. This research fills a gap in knowledge of student attitudes and opinions of 1) the overall conference and 2) specific activities dedicated to ATMAE students. The primary purpose of this study is to establish a statistically sound, baseline of judgment from a students’ perspective of the ATMAE annual convention. A secondary purpose is to propose changes to the convention to increase student participation and retention based upon survey results.

Major Points:
- Explain the need for the survey
- Explain survey methodology, statistical methods, and delimitations
- Analyze survey results, student demographics
- Implications for administrators and educators
- Recommendations for future ATMAE association activities

Summary: This study establishes a quantitative basis for student recruitment and retention to the ATMAE association. This research details student and professor attitudes and opinions of the ATMAE national convention. Recommendations for improvement of ATMAE convention student division activities are based on student survey results.
Building Enrollment: A Grant to Provide Scholarships to Students

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Need: Two primary concerns for most administrators are finding ways to increase enrollment and acquiring external funding to support programs. This presentation will provide details of an ongoing scholarship program that was developed and funded through a National Science Foundation (NSF) grant to increase enrollment.

Overview: There is increasing pressure in most technology based programs to find ways to bring in external funding to support the operation of the programs. One primary venue for external funding has been through various federal grant programs. Often, efforts towards federal funding tend to focus on laboratory or curriculum development. One potential funding area that is sometimes overlooked by administrators is student scholarships. This presentation will describe efforts that resulted in a federally funded program designed to provide scholarships for students in our programs. The presentation will highlight areas that made the program attractive to the funding agency along with lessons learned during implementation of the program.

Major Points:

- Identifying an appropriate funding agency
- Using a cross disciplinary approach
- Utilizing common University resources
- Creating focus on the system, not the scholarships
- Success breeds success
- JSU’s Program Details

Summary: Attendees will understand how Jacksonville State University developed a program to provide scholarships to students that has twice been funded through the National Science Foundation. The model presented can be used as a starting point for any program looking to increase enrollment by providing scholarships to students.
Beta Results of Using Qualtrics and Facebook On-line Survey Techniques for the 2010 ATMAE Self Study at Indiana State University

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Need: The purpose of this presentation is to share the first time experience of using on-line surveying instruments and techniques. The surveys that are normally conducted as part of the ATMAE self study can seem monumental. Learning what to expect, level of difficulty, advantages and disadvantages when using either Qualtrics or Facebook will be discussed.

Overview: Qualtrics is an on-line survey tool for questionnaire design and data collection. Shared during this presentation will be the experiences learned at Indiana State University of the first time use of Qualtrics and Facebook for conducting their ATMAE self study surveys. The beta experiment at Indiana State also included samplings using conventional email and Facebook as the two main communication mediums. A comparison of the two mediums will also be presented.

Major Points:
- Demonstration of the Qualtrics software
- Advantages/Disadvantages of on-line surveys
- Beta results of the Qualtrics and Facebook experiment
- Recommendations for ATMAE self-study applications

Summary: During this presentation the beta results of using Qualtrics and Facebook on-line survey techniques for the 2010 ATMAE self study at Indiana State University will be discussed.
Increasing Graduate Enrollment: Generalizing Industrial Curricula to Attract All Majors

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Need: Most graduate programs dedicated to industry and manufacturing focus on curriculum that is specific to technical knowledge. In essence, courses are advanced studies of technological content covered at the undergraduate level. As manufacturing continues to be outsourced overseas, interest in graduate programs of this nature is diminishing, thereby, causing program coordinators to scramble in order to attract enough students to meet minimum course enrollment requirements.

Overview: The graduate Industrial Management program at The University of Texas at Tyler was on the verge of being dropped due to low enrollment figures. Less than three years ago, the program was entirely revamped to offer course work relevant to a more educationally diverse group of graduate students.

Major Points:
- Querying business and industry
- Redefining your mission
- Determining your market
- Generalizing your curriculum
- Marketing your program to graduate faculty
- Marketing your program to graduate students

Summary: The graduate Industrial Management program at The University of Texas at Tyler staved off elimination by generalizing the curriculum to suit the needs of graduate students from all disciplines. This presentation will demonstrate how to transform a technical program into an area of study relevant to most disciplines.
Undergraduate Energy Program Development: A Group Discussion

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Need: Careers in energy are becoming one of the highest demand areas for qualified employees in the nation. Therefore, undergraduate energy programs are becoming more common as the need for these graduates increase. However, because of the relative infancy of undergraduate energy programs, there is very little information on what curriculum should be included, benchmarking and graduate job descriptions and placement. A review of existing energy programs will reveal a wide range of curriculum offered. This makes it very difficult for colleges and universities to develop effective and needed programs in this area. Through a group discussion of faculty and professionals in the field of energy, many of these questions can begin to be answered.

Overview: The job growth in the Alternative Energy industry is projected to increase upwards of 25% between 2006 and 2016 (Woodrow, 2009). This will put tremendous pressure on colleges and universities to supply these technical professionals. However, there is currently little information pertaining to how energy programs should be structured and what curriculum should be offered. Currently the University of Central Missouri is developing an Alternative Energy and Power Systems Management B.S. degree. One of the challenges has been finding benchmark intuitions and graduate job descriptions. The purpose of this discussion is to begin to discover the most important aspects of an effective undergraduate energy program. First, current information pertaining to energy curriculum and job demand in the U.S. will be shared with the audience. Next, a number of discussion questions will be offered to the audience as well as a short survey. Through this informal discussion, audience and presenters will gain vital information on current energy programs as well as ideas on how to develop, improve, or start a new energy program at their institution.

Major Points:

• Current state of energy program in the U.S.: Number of two year and four year programs; Type of curriculum offered (theoretical or technical); Placement and job descriptions of graduates
• Audience discussion and survey topics: Program objectives and curriculum needed; Articulation; Industry Needs

Summary: Without some kind of benchmarking it is very difficult to develop new, or to enhance existing higher education energy programs. Hopefully through this discussion, audience members and presenters will gain a much clearer view of curriculum and program objectives in undergraduate energy programs.
Synthesizing Managerial and Technical Knowledge and Skills: Guiding a Student Team Through the Process of Developing a Robot for the ATMAE Student Competition

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Need: This presentation will focus on how development of a robot for the ATMAE student competition was used as an opportunity to model product development and concurrent engineering, and help students synthesize knowledge and skills gained while pursuing their majors. The presentation should be helpful to faculty and administrators who are looking for ideas about using interdisciplinary projects to teach and motivate students.

Overview: During the past academic year, a team of students developed their robot to enter in the ATMAE competition in Panama City Beach. Activities were structured so as to require application of the knowledge that students learned during their courses of study. Because their school has never competed before, it was necessary to develop the robot from the ground up. This provided an opportunity to help the students take part in a product development project using concurrent engineering. They incorporated principles from their Product Development, Project Management, and Quality Control classes, while applying technical skills from their various disciplines. Students on the team were from the department’s Industrial Technology, Mechanical Engineering Technology, Electronics Engineering Technology, and Master of Science in Engineering Technology programs. The co-presenters are the faculty sponsor for the ATMAE student chapter and a graduate student who participated on the team. This presentation will provide a view of the project and its successes from both the faculty and student perspectives.

Major Points:

• This project provided a safe environment for students to gain some practical experience and boost their confidence levels. This was true because:
  • Students were exposed to all aspects of the project, and they could see the fruits of their efforts.
  • This was an enjoyable project that students participated in voluntarily.
  • Students worked with peers whose own levels of experience were similar.
  • The consequences of any negative outcomes were not as severe as they would be on the job.
• Additional benefits included the following:
  • The project increased the visibility of ATMAE among faculty members and students, at a school that historically was not involved with NAIT.
  • In the future, this project will serve as a subject matter for teaching secondary school students and encouraging them to pursue careers in engineering and technology.

Summary: Working on a cross-disciplinary team to develop a complex product provided students with an opportunity to synthesize the technical skills and managerial knowledge they learned while pursuing their majors. Using development of a robot for the ATMAE competition as context for the project was an effective way to create a safe environment and provide an enjoyable project to work on, both of which enhanced learning.
How to Establish a Solar Electric Boat Development Program as a STEM Application for Academic Institutions

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Need: Solar electric powered boats may promote zero-emission aquatic transportation and recreation not only for Iowa lakes and rivers, but for all US and world waters. For nine years the University of Northern Iowa solar electric boat project has been recruiting students from electrical engineering technology (EET), manufacturing technology, technology education, and graphics communications majors. This paper presents feasibility and necessity of such an applied engineering project as a wonderful example of Science Technology Engineering and Mathematics (STEM) for both engineering and engineering technology institutions. After many years of work, University of Northern Iowa solar electric R&D program has begun to recruit minorities and women to the project as previous teams continuously enhanced the project and recently ranked third in the 2009 annual international solar electric boat competition sponsored by ASME and IEEE. The annual international competition includes categories for outstanding workmanship, sprint, slalom, solar slalom, outstanding technical report, commercially viable hull design, and outstanding solar system design. In June 2009, the UNI solar electric boat team won outstanding electrical system design award, third overall, third on engineering design display, and third on solar slalom. Students involved in this project have shown excellent progress by developing their technical and teamwork/social skills as part of both Senior Design I and II courses and successfully completing course requirements. Few sophomore and junior students also worked in the project as volunteering in the extracurricular activities while they had to work up to approximately 200 hours through the academic year and the annual competition event in June.

Overview: Design and construction of a solar-electric powered boats and racing in an international competition to promote clean boating technologies have been an excellent learning experience for students at UNI. In addition to bringing classroom theoretical knowledge to life in an applied project, students have learned how to work collaboratively in teams to solve problems similar to those that they may encounter in their careers after graduation. The success that the senior design course has enjoyed through the complexity of the project undertaken by the students is an excellent indicator of the validity of the courses in the curriculum. Similarly, engineering and engineering technology programs are strongly encouraged to incorporate renewable energy based senior projects into their curriculum to promote eco-friendly energy technologies for a brighter future for our future generations. Many interested local and regional, private or public elementary, junior high, high school students and teachers have visited this project regularly in the last nine years. There has been strong media coverage showing the project to the public. This has also increased awareness of STEM among young Iowans whose families are mostly dealing with agriculture. There is no doubt that student recruitment has already been impacted positively as well. The EET program has an increase of enrollment of 70% from 2001 to 2009.

Major Points:
- Increase awareness of STEM among young scientist and engineers
- Increase student enrollment with such projects
- Promote STEM education among students with green energy projects
- Involve students in senior design and capstone classes/projects with solar boat project
- Increase awareness of alternative energy education

Summary: Solar-electric boating does present a viable, environmentally friendly alternative to the status quo of the current state of recreational boating. There was no CO2 emitted by any of the craft competing during the event, an exciting demonstration of solar-electric technology was presented by all teams, the students had a valuable real-life experience and they had fun doing it.
Accreditation Synergy: A Case-Study for Conducting Accreditation Activities for Multiple Agencies

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Need: In a period of diminishing funding for higher education programs and the desire to document outside measures of program quality, accreditation of our degree programs is even more important that it was in the past. All institutions of higher learning must be regionally accredited to assure access to Federal Funds and to assure the recognition and transferability of their degrees awarded. Many institutions of higher learning also seek specialty accreditation as measures of degree program qualify or in place of or in supplement to State and Institutional Program Reviews. Higher learning institution faculty and staff must devote significant time and energy in delivering successful accreditation experiences especially when the faculty and staff must respond to multiple accreditation agencies. Effective and efficient procedures to assure successful accreditation from multiple agencies can make the process more rewarding, more meaningful and less painful or objectionable by those who must carry out the process.

Overview: This paper will provide a case-study of how the authors’ institution approached the accreditation activities simultaneously for its 10-year Regional Re-accreditation by the Higher Learning Commission (HLC) of the North Central Association of College and Schools while addressing either initial or reaccreditation of both ATMAE and ABET. The paper presents information on the authors institution’s approach in designing, populating, and subsequent decision making activities within a comprehensive Outcomes Assessment Model adopted by the institution. Their Assessment Model is presented. Faculty and staff activities required to populate the model is discussed. Recommendations for meeting assessment needs of multiple agencies are made to generalize this contribution to the needs of other institutions.

Main points:

- Reasons
- Internal Program Review (Institution and State)
- Regional Accreditation (such as HLC)
- Specialized accreditation agencies: ABET, ATMAE
- Outcomes based-assessment: CHEA, HLC
- Case-study based on authors’ Institution
- Developing the strategy: Serve all agency and local needs; Minimize overlap; Limit what is measured & analyzed; Focus on key items each year; KIS-Keep it simple
- Determining the data management system: Commercial; Home grown
- Typical components in performing outcomes assessment: Undergraduate, Graduate programs
- Summary, Conclusion, and Recommendations

Summary: Today, college degree programs need to demonstrate the quality and success of their programs more than any time in the past. The information presented in this paper will demonstrate how to prepare of accreditation by multiple agencies without losing sight of the primary mission for delivering the quality and needed degree programs.
Developing and Sustaining a Collaborative Distance Learning Master of Science Degree

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Need: Working professionals interested in advancing their career profiles often seek graduate degrees while fulfilling current employment and personal obligations. Distance learning affords the flexibility of asynchronous course delivery while maintaining quality and assessment characteristics that educational institutions and employers require. The future of higher education includes the use of technology to allow students and employers to select expert faculty from different institutions to customize a graduate degree program. Consortium efforts among institutions to offer degrees currently exist in selected disciplines, and industry as well as students would be willing to adequately fund a Master of Science in Technology degree. Technology departments have the faculty with the technical expertise to develop and deliver the necessary courses to complete a distance learning Master of Science degree.

Overview: This presentation will discuss the methodology and incentives used at Arizona State University to develop and sustain for six years a distance learning Master of Science in Technology Degree with concentrations in the following disciplines: Environmental Technology Management, Fire Service Administration, and Graphic Information Technology.

Major Points:
- Define the degree requirements of an existing on-line MS in Technology degree
- Discuss the advantages of creating a consortium effort to deliver an enhanced curriculum with industry validated outcomes that focus on the expertise of selected institutions.
- Discuss the continuum of quality found in existing on-line instruction, to include the technology required to provide on-line advisement and oral defenses of thesis or applied projects.
- Discuss the faculty incentives and business model used to develop and sustain distance learning degrees or certificates.

Summary: ATMAE institutions have an opportunity to form a consortium that provides an industry validated on-line MS in Technology degree which will increase enrollment while reducing or dispersing costs related to offering graduate instruction. If done correctly each of the home institutions will admit and graduate students that pay tuition and fees respective to their universities and course offerings. These are students that may be place bound or cannot otherwise attend synchronous class offerings, and generate tuition revenue not currently realized by those schools. Graduate school requirements and governing board permissions will be addressed by each of the peer institutions participating in the consortium. Ultimately this presentation will offer a forum for discussion related to the creation of a consortium on-line degree by interested peer ATMAE institutions.
Market Pay: A National Academic Struggle to Compensate Faculty in High Demand Disciplines

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Need: Recruitment. Retention. These are two words well understood by chairs and deans who must recruit and retain qualified and properly compensated Industrial Technology and Engineering Technology program faculty. To help chairs, deans, and faculty understand the need for competitive pay, a survey has been conducted on seventy-eight national ATMAE-affiliated United States colleges and universities to determine competitive (market) pay salary levels and to obtain concepts for funding faculty salary increases.

Overview: Competitive pay is important for education institutions attempting to hire and retain the most qualified faculty for Industrial Technology and Engineering Technology programs. A literature review was conducted to determine salary levels for the Association of Technology, Management, and Applied Engineering (ATMAE); the American Association of University Professors (AAUP); and the College and University Professional Association for Human Resources (CUPA-HR). A twenty-two question online survey was developed and given to (78) national ATMAE-affiliated colleges and universities who possess Industrial Technology and Engineering Technology programs. Information was obtained from deans and chairs through an introductory email and enclosed web link to the survey. The survey was posted from mid-September through the end of October, 2009. Descriptive survey data was used to categorize accrediting agencies used by programs, degree levels offered, student body size, competitive pay status, organizations used for competitive pay adjustments, faculty leaving due to lack of competitive pay, and faculty leaving within or outside of their respective state. And a listing of competitive pay funding methods is provided. A one-way analysis of variance (ANOVA) test was performed for each academic ranking in terms of institutions offering, or not offering, competitive pay.

Major Points:

• Educational institutions must recruit and retain qualified faculty in Industrial Technology and Engineering Technology programs  
• Competitive pay helps to reduce faculty member movement between institutions  
• Competitive pay funding methods need to be developed for financially constrained institutions

Summary: Industrial Technology and Engineering Technology programs stand upon the academic strength of their faculty. Faculty members who are adequately compensated tend to remain at an education institution for a greater length of time. Through the analysis of competitive pay salary levels, and possession of unique funding methods, colleges and universities are more inclined to have successful applied technology and engineering programs.
Preparing the Self-Study for Accreditation of a Masters Degree Program

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Need: The goal of accreditation is to ensure that education provided by institutions of higher education meets acceptable levels of quality (US Department of Education, 2010). Having accreditation is very beneficial to any organization. It is not only a measure the quality of the institution and services, but also the curriculum. The recommendations from the peer-review of the accreditation team helps to reveal the organization’s strengths and weaknesses for better strategic planning, implementation, and further evaluation of all components. Moreover, accreditation allows institutions to strengthen their standards of performance excellence, while providing high quality and consistent education to their students. This presentation is designed to assist other institutions and faculty in the creation of the self study document.

Overview: The Association of Technology, Management, and Applied Engineering (ATMAE) is recognized by the Council on Higher Education Accreditation as the professional accrediting agency for technology, technology management, and applied engineering degree programs in the United States. To assure the efficiency and effectiveness of our Masters Degree programs in the School of Technology, University of Central Missouri, all stakeholders must put forward effort to prepare the self-study for internal review and ATMAE accreditation team. The MS in Industrial Management and MS in Technology received full accreditation in November 2009. These were the first graduate degree programs accredited by ATMAE.

Major Points:

- ATMAE evaluation criteria for Masters Degree program accreditation, and the details of the preparation process.
- Significant documents used in preparing the self-study
- Roles of administrators and faculty
- University internal review documentation and the self study.
- Preparing for the ATMAE accreditation team visit.
- Major documentation on student satisfaction, and graduate follow-up survey.
- Assessment data points.
- Recommendation from the ATMAE accreditation team.

Summary: In summary, this presentation is designed to be a primer for any institution planning for graduate program accreditation by ATMAE. The end product will be a clear understanding of the tasks, workload, timelines, and data gathering necessary for a successful site visit.
A Critical Overview of ATMAE’s Role in the 21st Century: Establishing and Maintaining Program Visibility in a Market Driven Economy

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Need: Diversity of background among faculty and administrators is a unique and characteristic of ATMAE programs. However, at this critical time in which rightsizing, restructuring, and downsizing of programs have become a new norm in institutions of higher education, ATMAE professionals need to network together in order to provide and maintain a consistency of purpose and enhance the professions’ visibility in accordance with the ATMAE’s new mission.

Overview: Considering the significant mission and demographics developments in our discipline that resulted in changes the organization’s name to ATMAE, this presentation attempts to provide ATMAE professionals with research-based historical data regarding the socio-economic purpose for which ATMAE (Industrial Technology) programs were developed. The main thrust is to learn from our past experiences, strengthen our present position, and continually improve our practices in order to not only stay competitive but also take a leadership role in the development of the national economy.

Major Points:
• The dynamics of core concepts and ATMAE specialties will be discussed.
• A review of literature on historical and philosophical background of the discipline of ATMAE will be presented.
• The strategic directions for industrial technology and the role of new ATMAE leadership will be discussed.
• The socio-economic roles, positions and responsibilities of ATMAE alumni will be explained.
• Internal and external efforts with market value of faculty salaries will be discussed.
• The focus of IT programs in the future will be discussed.

Summary: The presentation will provide ATMAE professionals with a database regarding the challenges faced by and opportunities existing for the ATMAE profession in the 21st Century.
Characteristics of Association of Technology, Management, and Applied Engineering (ATMAE) Faculty: A Demographics Study

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Need: The primary purpose of this presentation is to present the 2010 demographics data collected to determine the characteristics of the ATMAE faculty, and to update the data on the Demographics section of the ATMAE home page: http://atmae.org/index.php?option=com_content&view=article&id=11&Itemid=28. The data will exhibit the salary, positions, field of preparation, background, employment status and projected retirement of ATMAE faculty, and administrators. The data will enable the ATMAE professionals to look forward and address the critical issues such as market value, program recognition, professional visibility, that impact the development of the ATMAE profession and recruitment and retention of qualified professionals in the discipline. The Demographic data is used to benchmark the salaries among ATMAE accredited institutions.

Overview: A three-page survey information form has been posted on the ATMAE web site, and communicated with the department chairpersons, department heads and administrators of the ATMAE accredited programs. The questionnaire focuses on key characteristics of ATMAE faculty including salaries, primary field of preparation, teaching and research responsibilities, academic status, earned degree, age and gender, and retirement status in the academic year 2009-2010.

Major Points:
- The salary range of IT faculty/staff will be presented and compared
- Faculty salaries will be compared with similar disciplines.
- The primary field of preparation of ATMAE faculty will be discussed.
- Recruitment strategies will be introduced
- Teaching/research responsibilities of ATMAE faculty will be described.
- Academic rank of ATMAE faculty will be presented.
- Qualifications of ATMAE faculty will be discussed.
- Benchmarking of ATMAE faculty salaries with closely related disciplines such as Engineering, Engineering Technology, Management, and Business Administration will be discussed.

Summary: This presentation will provide ATMAE professionals with an accessible, relevant, and recent database regarding the key characteristics and qualifications of faculty members who currently teach in ATMAE accredited programs. The data will assist the ATMAE organization and ATMAE leaders to make informed decisions regarding the future of the profession.
ATMAE Alumni: A Trends Analysis and Demographics of 2005 ATMAE Accredited Programs Alumni

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Need: The ATMAE accredited programs alumni survey results were among the indicators that created the need for changing the name of NAIT to ATMAE. A trends analysis of ATMAE graduates will help to determine the market value of our graduates, and to help promote ATMAE programs. This presentation presents the data obtained from selected ATMAE accredited institutions alumni of 2005 regarding their positions and responsibilities, salaries, job satisfaction, professional achievements, qualifications, and promotions. The data presented will contribute to the revision and development of the discipline.

Overview: A review of literature regarding the need for obtaining feedback from alumni will be presented. The results of the surveys will be analyzed, and the process of developing, validating, and administering the questionnaire will be discussed.

Major Points:

• The salary trends during the past five years will be explained.
• Positions held by ATMAE graduates as well as their responsibilities and salaries will be presented.
• Highest academic degree and qualifications of graduates will be presented.
• Perceptions of graduates regarding potential improvement in programs and courses will be discussed.
• The professional impact of ATMAE accreditation on program’s graduates will be discussed.
• Graduates perception of ATMAE certifications such as CTM, CSTM will be discussed.

Summary: Although ATMAE has recognized the importance of programs graduates feedback by asking ATMAE accredited programs to conduct an alumni survey and disseminate the results, a review of literature indicates that very limited research data is available on alumni perceptions of their programs. This presentation will provide a trend analysis of ATMAE alumni of 2005 at the national level.
Community Colleges
Workforce Collaboration through Partnerships: An Innovative Approach

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Need: As higher education strives to provide the needed workforce development programs for students and employers in their area, the costs become a barrier to creating new programs. In this presentation, we will show how the Clarion University-Venango Campus has built 30 different technical concentrations into an AAS degree program thru the use of technical partnerships and the advice of employers at almost no cost to the University.

Overview: The challenge to provide quality programs in a diverse workplace in today’s tight economic market can be overwhelming. Clarion University-Venango Campus has created a unique model that allows for multiple partners in multiple areas, thus allowing students choices in areas where employers have positions to fill. This presentation will focus specifically how this program was developed, why it was developed, and how it might be a model for higher education in the future.

Major Points:
• Employers have a need for a more diverse workforce
• Higher education institutions have a limited budget to develop additional programs
• Identification of technical partnerships that create a win-win scenario for both institutions
• Specific examples of success
• How schools can create similar programs utilizing the concepts developed in this model

Summary: Attendees will understand the technical partnership model used at Clarion University-Venango Campus to restructure how they create technical partnerships. This model can improve the offerings at their particular campus, and thus help serve their local workforce and student population better.
Creating an Innovative Bridge from High School to 4 Year Institutions

Mr. Jake Hildebrant  
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Need: Many graduating high school students do not consider a college education as a feasible choice for their future because of their financial situation or their apprehension of failing. These “neglected majority” students are often overlooked by educational institutes because of their inability to promote the scholastic image of the universities. In this presentation Jake Hildebrant will demonstrate how the Advanced Industrial Integrated Technology program at Madisonville Community College has reached out to these high school students and how the community college system can bridge a gap for these students from high school to universities.

Overview: The Advanced Industrial Integrated Technology (AIIT) program at Madisonville Community College has been able to open the door for local high school juniors and seniors, who would have normally been overlooked by university recruits, to be able to get a jump start on their college education. The AIIT program lecture is offered 100% online, and students can schedule their lab time on their own schedule to complete their coursework. The program has also partnered with other local universities to build a 2+2 program so graduates can use their credits to complete their Bachelor degree. This combination offers students an affordable, practicable pathway to their college career.

Major Points:
- Explain the importance of community college programs partnering with local high schools and 4 year institutions
- Need to interest the “neglected majority” of high school students so they will pursue a college degree
- Explain the difficulties of teaching a technical program online, and demonstrate the process of overcoming these obstacles.

Summary: Programs in the community college systems play a vital role in today’s society in bridging the gap for high school students and 4 year universities. The AIIT program at Madisonville Community College has done this by offering lectures 100% online and targeting “neglected majority” students who would normally be overlooked by recruiters. The steps that the AIIT program has taken can be used to improve any Integrated Technology Program.
Sustainable Development Program in Community Colleges

Dr. John Hannon Martin, CSIT
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Need: Community Colleges and Technology Schools course offerings are directly tied to the communities, which they serve. How to begin meeting the demand for Sustainable Technologies will be explored.

Overview: New offerings often start with Continuing Education and are later incorporated into Certificate and then to Diploma. Dr. Martin will show how several colleges have developed networks, curriculum and support for Sustainable Development.

Major Points
- Defining Sustainability
- Defining Sectors
- Renewable Energy- Demand, Efficiency, Balance of Systems, Wind, Solar, Microhydro, Biomass
- Biofuels- Biodiesel, Ethanol, Biogas, Biomass
- Green Shelter- certification, new materials, and new techniques
- Sustainable Development- Emerging Business Opportunities
- Workshops-SVO Conversion, Electric Vehicle Conversion, Electric Kit Builds, Composting, Greenhouse Building,

Summary: Alamance Community College has developed these classes and offered them over the past 3 years. We will examine where we have been, are and are going.
The Technical Professional Certification Exam: Development, Content, and Implications

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Need: Presently, there is an ATMAE certification exam (Certified Technology Manager) available to students graduating from 4-year technology programs. ATMAE had not developed a certification exam to address students graduating from 2-year technical programs.

Overview: This presentation will discuss the new Certified Technical Professional exam that was specifically developed for 2-year college students who majored in a technical field of study. An overview of its development considerations, content, applicability, intended use, and other issues will be examined and explored.

Major Points:
- Identification of the content for the exam
- Development of the exam
- Implications of the exam
- Validation of the exam
- Value of the exam

Summary: This presentation focuses on the development of the new 2-year technical professional certification exam. In addition, a detailed review of its content will be discussed as well as its implications for program assessment.
Results, Findings, and Recommendations from a Needs Assessment Study Focusing on Niche Manufacturing Companies in a Rural Area with No Major Industrial Base

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Need: Rural areas where no major manufacturing base exists still require skilled, technically trained production employees. These areas typically have niche manufacturers who produce specialized products often using specialized processes. In general, community college curriculum in manufacturing technology is tailored for major industrial employers so these niche manufactures may not be served ideally. A needs assessment study can reveal the specialized training needs of small manufacturing companies and highlight possible curriculum changes for educators serving these rural communities.

Overview: This presenter completed his master’s degree in technology through the innovative Weekend Master’s Program at Purdue University. His directed project, “Skill Needs Assessment for Niche Manufacturers in Humboldt County California” has given educators in this rural area a newly framed view of how small, specialized manufacturing companies in the area use manufacturing training resources. This master’s degree directed project has been the basis for presentations on the needs of niche manufacturers, and serves as a starting point for further research in specialized manufacturing training for rural areas.

Major Points:
- Rural areas without major industry still may have thriving niche manufacturing companies
- Locating and identifying niche manufacturers using government data resources
- Administering a data gathering instrument – Surveys versus interviews
- Analyzing data - Finding the skill gaps
- Recommendations for further research and curriculum alignment

Summary: Attendees will be shown how a skill needs assessment study can be performed in rural areas that have no major manufacturing companies. Ideas for additional research and curriculum development in the area of specialized manufacturing will be discussed.
Construction
Educating for a Green, Sustainable Future: To Green the Impossible Dream

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Dr. Elaine Hoffman
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Need: A greater effort is required to include educators in the planning and implementation of green technologies. “The USGBC promotes strategies aimed at improving performance across all the metrics that matter most”. S. Richard Fedrizzi President, Chief Executive Officer and Founding Chair of the USGBC states about the USGBC, “…a community of volunteers delivering green buildings for everyone within a generation is a single-minded mission…”. This raises many questions. How will we, the people, know and value the potential of the green dream as industry evolves green, sustainable technologies and standards for us? Any change, raises concerns for those involved and people in general. How does the public know about green building? What segment of the population collects the data and transfers this information to the public, to the workforce or the occupants of green buildings. Teachers are the link.

Overview: What do students know about the green movement, when they graduate from grade school, junior high, high school or college? Will they know the importance of the green building? Students represent the future. Education is the direct pathway to the workforce. Teachers are the bridge connecting the workforce and to the green building movement. Teachers engage and foster the recognition of student opportunities in a green tomorrow.

Major Points:

• Long-Term Public Opinion: Participants will recognize the importance of education in changing and guiding long-term public opinion as identified by positive social acceptance of the green building.
• Educators & Workforce Development: The participant will derive a better understanding of the importance of educators in workforce development as they estimate their own potential needs for growth based on new technologies.
• Justification of Future: The learner will observe the need for organizations partnering with educators in planning and implementation of ideas as justification for further organizational growth.

Summary: The presentation will give participants a sense of the importance for establishing and nurturing stronger relationships between green/sustainable organizations and educational institutions from K-12 to higher education.
At What Threshold Are Buildings Considered Energy Efficient?

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Need: There is continuing concern over meeting the energy needs of the United States and the global economy, and how these energy needs will be supplied. There are two ways of meeting the current and growing need for energy while being sensitive to the potentially limited supply. Either the supply of energy must be increased or consumption must decrease, or more likely a combination of both. To control and decrease energy demand in buildings calls for an understanding of energy consumption in the built environment and defining what constitutes energy efficiency in buildings. LEED, Energy Star, and other green building rating systems typically gauge energy efficiency by percent savings or percentile rank compared to other similar buildings by construction type. While these current rating systems may be useful for ranking building performance, they do not provide benchmark energy consumption data that can identify energy efficient thresholds to more easily quantify usage and predict energy costs. The findings from this study would be useful to faculty and students studying sustainable building design and green construction methods.

Overview: This session will present the results of an analysis of over 50 buildings identified by the Department of Energy as “energy efficient” to determine a design metric that can quantify consumption thresholds, predict energy costs, and therefore be used by design professionals to justify energy related planning decisions. Specifically discussed will be the (a) factors for selecting the units and metric used to measure energy consumption in buildings, (b) the source of the data analyzed to determine efficiency, and (c) the methodology utilized to establish the consumption threshold for a building to be considered energy efficient.

Major Points
- Advantages and disadvantages of current energy efficiency rating systems for buildings.
- Overview of the factors used to select an energy efficiency design metric.
- Discussion of the source data and analysis procedures.
- Findings from the analysis and a suggested threshold for energy consumption in energy efficient buildings.

Summary: To answer the question “What constitutes energy efficiency?” an analysis of over 50 buildings identified by the Department of Energy as “energy efficient” was undertaken to determine the actual energy consumption threshold at which buildings may be considered energy efficient. A single design metric was identified that can be used to justify design decisions and predict energy costs.
Developing an Internationally Recognized Certification Exam for Construction Managers

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Need: Presently, there is not an international certification or licensure exam available to construction management majors for documenting their competency and expertise in the field of construction. Some states offer contractors licensure exams; however, these exams are expensive and were not developed to provide feedback to programs who would like to analyze the results as a method for program assessment.

Overview: The purpose of this study was to develop an internationally recognized certification exam for construction management majors that can be used by the construction industry as a means of identifying qualified applicants for employment. In addition, construction management programs across the globe could require their students to take the exam in order to assess the quality of their programs.

Major Points:
- Identification of the content for the exam
- Acceptance from industry
- Development of the exam
- Contributors to the exam
- Validation of the exam
- Value of the exam

Summary: This presentation focuses on the development of an internationally recognized construction management exam used to certify future construction managers. Content for the exam will be discussed in detail for possible use as a method for program assessment.
How Do We “Bridge the Gulf” and Keep Construction Teachers in the Secondary School System?

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Need: The dilemma of discovering, recruiting, and retaining teachers is not a new problem facing our educational system. The Career and Technology Education (CTE) field has not been immune to the teacher shortage problem. Teachers going into education and not staying in the field long enough to become an established, viable asset to the program is one of the problems facing CTE programs today and in some programs, such as construction technology education, the shortage is so severe that it threatens the program of study’s very existence. The purpose of this study was to investigate the reasons construction teachers in the CTE field left the teaching profession in their first five years of service, or if they stayed, what were the dominant factors that caused them to consider leaving the profession and what were the factors that were causing them to remain in the CTE field.

Overview: This presentation will reveal the significant difference in the retention rates of two-year alternatively certified teachers and four-year teaching degreed teachers, the significant difference in why two-year alternatively certified teachers have considered leaving the profession verses their four-year degreed colleagues, and the main reasons CTE teachers stay in the teaching field. Ways that postsecondary educators and industry personnel can help with retention will also be discussed.

Major Points:
- CTE teachers are leaving the profession at an alarming rate
- There are major differences between the two-year alternatively certified teacher and four-year degreed teacher
- There is a discrepancy in the reason teachers are leaving the profession and the reason other teachers think CTE teachers are leaving the profession
- There is overwhelming evidence as to why teachers are staying in the profession
- There are areas where postsecondary and industry can help with teacher retention

Summary: Attendees will understand the difference between a two-year alternatively certified CTE teacher and a four-year degreed teacher and how it affects their retention rates. They will also have ideas of how they can personally help in the support and retention of quality CTE construction teachers in the high school setting.
Key Factors for Determining the Applicability of Using Closed Crawl Space Construction Technologies

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Need: This informational session will present the elements of an evolution of one of the traditional building technologies concerning residential crawlspace construction. The results of several current applied research projects will also be presented for discussion.

Overview: The key factors for determining the applicability of using closed crawl space construction in residential building will be discussed. The results of several current applied research projects will also be presented for discussion. This will include cost and performance analysis of the difference between using conventional venting methods versus a closed (unvented) and conditioned system. A primer on the current construction methods, products and technologies systems for creating a conditioned closed crawl space will be explained.

Major Points:
• Advantages of using a conditioned closed crawl space.
• Construction methods for creating a conditioned space.
• Cost and performance comparative analysis of traditional versus conditioned crawl spaces

Summary: The conference participants will gain an understanding of the benefits using contemporary conditioned crawl spaces including construction techniques, performance, and cost.
Assessment of Inventory Control Methods to Optimize Lean Construction Projects

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Need: Lean is a management process that has been incorporated into manufacturing organizations to achieve and maintain competitive advantages worldwide. While the search for the perfect construction process is still ongoing, the introduction of lean construction has had a dynamic impact on the efficiency of the building process. As the lean process is gathering momentum in this industry, metrics controlling the effectiveness of the inventory controls are paramount to cost-savings and material delivery. In this presentation, comparison models based on field data will show the different dynamics that are essential to implementing a successful control system.

Overview: As the construction industry moves towards more sustainable, environmental building structures, the implementation of lean inventory control concepts can greatly reduce the cost and environmental factors that are becoming the standard in the industry. The challenge for lean construction is to develop a metric of inventory control that meets the demands of project delivery but maintains the highest levels of efficiency in operation. My focus with this study is to assess those systems available through field data and show the impact that well-organized systems offer to organizations before, during and after project completion.

Major Points:

- Development of an inventory control matrix to optimize operations.
- Assessment of inventory control methods to foster cost-savings within the building process.
- Identification of control measures to facilitate industry best practices.
- Integration of inventory and delivery scheduling to construction projects.

Summary: Attendees will comprehend the different metrics associated with lean construction and future inventory control measures. The models presented will show a correlation between cost-savings and efficiency that can be used in lean construction projects.
Aligning Sustainable and Environmentally-Friendly Processes to LEED Construction Projects

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Need: LEED, (Leadership in Energy and Environmental Design), is defined as a system to categorize the level of environmentally sustainable construction in sustainable building. The construction industry has witnessed a dynamic shift to sustainable construction, and in the process, neglected some of the building process. As the standards of the industry continue to spiral, the need for aligning eco-friendly guidelines with these accreditation projects becomes increasingly important. LEED project certification is concerned with the endgame of attaining credits and sometimes ignores the importance of the process and techniques that can be used to reduce costs and carbon footprint in the construction process.

Overview: As sustainable building continues to evolve, the necessity for checks and balances become increasingly more evident in the industry. This presents a problem as many times, the overall project is assessed with a small dynamic of certification categories, many times leaving out the process that was involved along the way. The focus of this presentation is to show that a refinement of the construction process, especially in terms of sustainability and eco-friendly techniques, can have far-reaching benefits for both, the owner and contractor.

Major Points:
- Identification of eco-friendly processes that will reduce waste on a construction project.
- Need for guidelines to enhance “environmentally” friendly practices on construction projects.
- Development of a decision matrix to improve the building process.
- Assessment of cost-savings techniques in the building process.

Summary: Attendees will understand dynamic modeling associated with LEED building and categories targeted for improvement. The model presented can be used to improve processes in construction as a metric to enhance cost-savings associated with sustainable projects.
Developing a Laboratory for a Structural Design Course in a CM Program

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Need: The structural design course is designed in a CM (Construction Management) Program to help students to understand about load, strength, and stability of bridges and buildings. A laboratory of structural design is an essential component to visualize and understand the following: a) reaction due to load, b) stability of structure due to force components c) analysis of bridge truss d) Load vs. Strength. A laboratory of the course prepares students to get familiar with the real construction industry by connecting theoretical studies and the application of these studies.

Overview: Laboratories of structural design course help to familiarize how theoretical concepts are applied in the real world. The following laboratory topics have been chosen to bridge the gap between theoretical knowledge and real construction. a) Force component analysis using Force Table b) Reaction determination of beam using force distribution system c) Bridge truss member force calculation using Advanced Structures System d) Analysis of roof truss using Advanced Structures System e) Stress-Strength comparison of Steel/Concrete using Stress/Strain Apparatus.

Major Points:
• To develop laboratory topics so they connect theoretical knowledge with the construction industry
• To provide laboratory knowledge of structural design concepts to make students enthusiastic about understanding these concepts.

Summary: A structural design course helps sophomore students to get familiar with the fundamental concepts of analyzing and designing bridges and buildings. The laboratory for this course helps students to understand capacity of bridges or buildings by visualizing these concepts. Students can compare theoretical calculation with laboratory measurements.
The Cost of Latency: Assessing the True Impact of Latent Defects in Construction

Mr. John R. Patton
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Need: Research about defect analysis in the production industries is fairly extensive, however very little research into latent defects (LDs) is available. What research has been conducted varies widely on the most basic elements. It is important to understand the nature of LDs within the broader discussion of construction defects & defect analysis. Various researchers have defined LDs in vastly different ways and this paper will attempt to reconcile these conceptual differences and offer a standard method of assessing the impact of LDs. The research will examine the impact of LDs on facility life-cycle costs, performance, and customer value. Additionally, since many LDs are not discovered until a failure is manifested, the magnitude gap analysis will be conducted to determine if additional investment during the transformation phase could have prevented catastrophic failures caused by LDs. Additionally, this research will discuss the impact of LDs which are not manifested through a specific failure. Even these ‘hidden’ LDs can work to degrade the performance and value of the facility.

Overview: Research has very broadly defined latent defects. For example, Chong and Low’s (2006) extensive inspections of completed projects produced an enormous list of what they defined as latent defects. However their definition of latent defect was any defect that could be observed in the completed project, whether or not a specified condition had been communicated, much less agreed on by both contracting parties. Over 2800 LDs were recorded by these researchers, but without a clear understanding of the trade-offs that led to each design decisions, it could be assuming too much to name this type of ‘defect’ as a latent defect.

Major Points:
- Discuss why the magnitude of latent defects is so difficult to assess.
- Examine the impact of latent defects on facility performance, life-cycle cost and value.
- Comparative analysis at the various ways of defining & recording latent defects from the review of literature.
- Determine ways in which a latent facility failure is not always due to a latent defect.
- Discuss the impact of LDs that are not manifested through facility failure.

Summary: This research examines how latent defects act to impede facility performance, increase life-cycle costs and rob the facility of purchased value. This research will examine how latent defects are studied and defined in the construction industry.
Obstacles to Building Information Modeling

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Need: Many obstacles remain to be conquered before Building Information Modeling is proliferated and broadly utilized across various sectors of construction industry. Issues such as lack of expertise, legal, competitive, propriety, and confidential trade information in addition to lack of interoperability among BIM authoring software challenge’s the concept of Building Information Modeling. This presentation discusses various obstacles to BIM usage by mid size and small construction firms including subcontractors.

Overview: Building Information Modeling (BIM) promises efficient construction delivery with reduced risk, and increased proficiency for owner, architect, and constructor. New contract phenomenon in construction industry such as Integrated Project Delivery (IPD) and Guaranteed Maximum Price (GMP) are placing pressures on contractors large and small to adopt the BIM technology. This ever increasing pressure to invest in new technology is compounded with beginning of recessionary decade and stiff competition.

Major Points:
- Legal issues - propriety information such as productivity/ profit margin.
- The interoperability - Industry Foundation Classes (ISO/PAS 16739).
- Implementation/investment in BIM technology.
- The need for hiring/training of individual as a company’s BIM liaison.

Summary: Broad acceptance of BIM by construction firms requires overcoming unique sets of challenging obstacles. Impact of Building Information Modeling on construction industry can be as decisive as (CAD/CAM) which transformed the manufacturing industry over a decade ago.
Development of Polymer Concrete Solar Tile Panels

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**Need:** Solar energy is increasingly becoming an important source of renewable energy, particularly with unpredictable fluctuations in fossil fuel prices and availability, besides its negative effects on the environment.

**Overview:** This paper summarizes the design procedure and the production process of developing polymer concrete solar tile panels. It also presents an assessment of their superior performance as part of a passive solar system in the (MIT) Solar Building #5, where measurements over 15 years demonstrate direct gain solar space heating through the use of solar tile architectural finish tiles.

**Major Points:**
- Background
- Criteria of the matrix
- Criteria of the building panel
- Polymers in passive solar heating systems.
- Field Observations.

**Summary:** Solar tile panels are simple building elements with no moving parts, maintenance free, and meet acceptable aesthetic standards of building appearance. They are light weight, impermeable, waterproof, building material, with a good strength-to-weight ratios and proper heat transmission rates.
Producing Thermoplastic Polymer Concrete Blocks from Non-Recyclable Non-Biogradable Thermoplastic Scrap

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Need: The automotive industry have massive amounts of contaminated, non-recyclable, and non-biodegradable scrap thermoplastics for which disposal costs can be high, and not without harmful environmental effects. These wastes were utilized to produce thermoplastic polymer concrete industrial floor blocks to substitute for the industrial floor blocks made of wood and thermosetting concrete resins.

Overview: This paper presents a case study on the development of field applications of thermoplastic polymer concrete not only for floor blocks, but also in a wide variety of industrial, construction and environmental applications. It also summarizes the methodology of producing thermoplastic polymer concrete, with an assessment of their short and long term performance.

Major Points:

- A brief history of the polymer concrete family of building materials.
- The effect of international oil shortages on the amounts of polymer thermosetting resins needed to produce industrial floor blocks.
- Utilization of massive amounts of the contaminated, non-recyclable, and non-biodegradable scrap thermoplastic wastes of the automotive industry, for which disposal costs can be high, and not without harmful environmental effects.
- Technical aspects of producing thermoplastic polymer concrete floor blocks.

Summary: The superior performance of thermoplastic polymer concrete floor blocks minimized and in many instances prevented costly plant shutdown time and maintenance costs. Meanwhile, it also utilized massive amounts of the contaminated, non-recyclable, and non-biodegradable scrap thermoplastic wastes of the automotive industry, for which disposal costs can be high and not without harmful environmental effects.
Distance &
Online Learning
Exploiting Features of the Internet for the Benefit of Students with Special Medical Demands and their Caregivers

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Need: Students are attending online classes in record numbers. Those with special medical demands, or significantly, those who take care of such family members, find extra challenges in the online environment despite its convenience and flexibility. Special handling is recommended to ensure that all members of society, not just those privileged with good health, are able to receive an education.

Overview: According to the official website of the National Institute on the Education of At-Risk Students (At-Risk Institute), one of five Institutes created by the Educational Research, Development, Dissemination and Improvement Act of 1994. The At-Risk Institute supports a range of research and development activities designed to improve the education of students at risk of educational failure because of limited English proficiency, poverty, race, geographic location, or economic disadvantage. However, the above definition does not include those who are under special medical demands, or their care-giver family members; to that end, the educational system has not evolved to address the needs of students with special medical demands, or their family member care-givers trying to go to school. Such students are forced to deal with sudden, unplanned demands on their time, and are obligated to spend great amounts of time in doctors’ offices or hospitals. In these settings, they normally do not have access to a computer, or are not allowed to use wireless devices, and consequently cannot use the time to work on class. These are high-risk students who do not fit the institutionalized definition of high-risk.

Major Points:
- Take conscious advantage of the anonymity offered by Internet - many students who would feel out of place in a social setting due to their condition find they may shine in an online class.
- Weaknesses provide unexpected strengths through compensation. Use a mix of media to make the class more even-handed for all.
- Use Interactive applications wherever possible—this gives the student a sense of power over his environment, BUT.
- Do not use interactive media that demands real-time or face-to-face interaction. Many medically challenged students simply can’t respond as quickly as those without medical problems, and their slow response puts them in an embarrassing situation.
- Build a course plan on a “modular” basis, where possible.

Summary: Students who have special medical needs and their caregivers are at-risk students who often “fall through the cracks” in the educational system because of the high demands of their medical conditions. Special features of online learning should be consciously exploited in order to “bridge the gulf” of getting an education to those students.
Starting a Successful Distance Learning Degree Program

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Need: The growth in distance learning programs has been great and some programs have been more successful than others have. Originally, degree programs and curricula were designed based on the traditional on-campus learner. Therefore, distance-learning programs need to be composed of different components.

Overview: As distance learning has grown, providing pathways for a variety of educational backgrounds has become an important goal. A variety of constituents are interested in increasing access to a greater audience. The constituents include students, faculty members, administration, state agencies, and legislators. This presentation describes how to start successful distance learning bachelor degree programs. The components of this success are transferability, variation in class delivery, grant funding, university support, quality standards, and staffing.

Major Points:
- Need for programs
- Two distance education programs at Bemidji State University
- Transferability of student credits as block transfers
- Blended delivery composed of face to face, interactive television, self guided, and web
- Financial support growing the funding through initial individual faculty from the Department of Technological Studies faculty and later funding by an E learning grant
- Variability in Staffing
- Ramping up and “field testing” classes
- Measure of success - student enrollment
- Evolution into “Quality Matters” Classes

Summary: The attendees will be aware of the components needed to start a successful distance learning degree program. The development is based on the Bachelor of Science in Technology Management and Bachelor of Science in Applied Engineering degree programs offered through the Department of Technological Studies at Bemidji State University.
New Online Program to Serve Students with Associate Degrees

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Need: Once we started our mechanical engineering program we saw a drop in technology program enrollments. We understand that eventually the enrollments will pick back, as students find that technology is what they wanted and not engineering. However, in the meantime we needed to do something to keep enrollments in the technology program at a sustainable level. Our solution was to develop an online technology completion degree for students with associate degrees from community colleges.

Overview: The online program is designed to serve students with associate degrees from community colleges. It will consist of a core of the four technology management courses and other applicable technology courses that can be taught as online courses. Students will take a minor in management or energy studies which will also be taught online.

Major Points:
• New Online Program Development
• New Online Course Development
• Minor in Management or Energy Studies
• Comparison of number of students in online versus traditional courses

Summary: We will detail the process of developing the online program in the Bachelor of Applied Arts and Science in Industrial Technology Program in the School of Business at the University of Texas of the Permian Basin. We are developing online courses for the program starting in fall 2009. It has been a busy and exciting time as we continue with the development of online courses and recruitment of students for the program.
Technology Management Graduate Student Preferences for Online Learning

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Need: As online graduate programs continue to grow, so does the availability of learning mediums and delivery tools. Faculty and students are increasingly using web-based means of communication such as blogs, wikis, discussion boards, and collaborative tools in addition to assigning traditional readings, lecture notes, homework, writing exercises, and examinations. There have always been multiple choices available to instructors for the delivery of content and the assessment of learning, but now there are more varieties of instructional technologies from which to choose. Given the choice, are there certain online approaches that graduate technology management students prefer?

Overview: Qualitative and quantitative data was gathered from current students and alumni of an online Technology Management Master of Science program. The questions assessed student preferences regarding instructional technology mediums for delivery of course content and the means of communication to ascertain commonalities. In addition, students were asked about the effectiveness of these delivery technologies in comparison to traditional modes. Distance learning instructional technologies were limited to asynchronous types as they are the most flexible.

Major Points:
- Instructional methods for online programs
- Student preferences for online delivery methods and mediums
- Perceived effectiveness of instructional technologies compared to traditional means
- Students qualitative responses
- Recommendations

Summary: Attendees will gain knowledge of asynchronous teaching methods and insight on student preferences for content delivery. Graduate coordinators and department heads can employ these ideas to help grow their online programs.
How Does the Hybrid Delivery Format Impact a Student’s Engagement with a Course?

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Need: Distance learning is becoming increasingly common in all areas of academia as students look for increased flexibility in scheduling and reduction in transportation. Colleges also receive benefit in the use of distance learning through the increased enrollment without additional capacity requirements. In lab based studies, like those found in engineering and technology related disciplines, a hybrid format may be utilized to reduce the number of hours in the traditional face-to-face format, while maintaining the opportunity for hands-on lab based curriculum. However, hybrid and online only courses are less frequently offered in lab based curriculums as the hands-on component is an essential part of the course material.

Overview: In this presentation, we will present a case study comparing two sections of a lab based course offered simultaneously, one in the traditional face-to-face method and one using a hybrid delivery format. This presentation will detail the results of this study, illustrating the impact of delivery format on the student’s success. Comparisons between the two delivery formats, summary of the student surveys and suggestions for improvement in delivery will be addressed.

Major Points:
- Need for increasing the number of hybrid courses delivered in lab based courses
- Differences between the traditional delivery method and the hybrid delivery method
- Results of case study performed
- Suggestions and areas for further research, development and discussion

Summary: Attendees will observe the differences between traditional and hybrid delivery in a lab based technology course and observe the impact on student engagement and success in such a course.
Developing Asynchronous Digital Media for the I-Pod

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Need: As educators we constantly seek delivery methods for instructional materials that are timely, efficient, and effective. Developing instructional materials can be a time intensive activity. Applying a standardized process for producing digital instructional media can alleviate some of the time constraints associated with producing media.

Overview: As students become more astute regarding digital technologies, their expectation for instruction is evolving to include digital media that is accessible in an asynchronous format. In addition, in laboratory related classrooms where demonstrations are common the need to have consistent efficient content delivery is important. Developing IDM for any classroom can be time prohibitive. A store and forward concept of media development reduces instructor time in the development process thus making IDM more feasible for classroom use.

Major Points:
- A Store and Forward Concept for IDM Development
- Benefits and Process
- Classroom Application
- Student Examples

Summary: Attendees will learn the store and forward process for digital media development and will view student produced material.
Online Instructor Burnout: Exploration and Suggestions for Elimination

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Need: Beginning in the 1990s, online instructional delivery has become an important component in higher education. To date, more than 2.33 million college students are taking at least one online course. Online teaching and learning presents new challenges for instructors in colleges and universities and among those challenges is online instructor burnout. Burnout is a catchall term that is used to describe a syndrome of emotional exhaustion and cynicism that occurs in response to the stressors and strains of professional life. Burnout among educators has been studied, but no specific work has been done on burnout among higher education online instructors. This presentation examines burnout among higher education faculty members instructing online courses. Therefore, the purpose of this presentation is to present levels of burnout among university faculty instructing courses in an online learning environment.

Overview: Online instructional delivery has become an important component in higher education while simultaneously presenting new challenges for instructors. This presentation examines the extent to which burnout occurs among higher education faculty members instructing online courses. Further, measures of burnout among higher education online instructors will be compared with existing normative data of educators. Participants will learn the six major influences, the symptoms, and the negative effects of burnout. Finally, recommendations will be made to eliminate the syndrome before it develops.

Major Points:
- Describe burnout and signs of this syndrome
- Explain the importance of understanding burnout among online instructors
- A comparison will be made among higher education online instructors and existing normative data of educators
- Learn the six major influences, symptoms, and effects of burnout
- Recommendations will be made to eliminate online instructor burnout

Summary: Attendees will learn how to identify burnout as it relates to online instruction. This information will enable online instructors to employ methods to avoid the burnout syndrome.
A Study to Determine the Perceived Impact of Recording Face to Face Class Presentations and Incorporating Them in the Delivery of Online Courses in Technology Programs

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Need: The purpose of this study is to investigate if recording face to face classes will help online students enhance their learning. A comparison is also needed to determine if the use of recordings affect student learning in online courses. The intent is to develop a set of best practices while identifying the pros and cons of using this innovative instructional methodology. The study group will consist of students enrolled in courses hosted by the University of Central Missouri.

Overview: Little pedagogical research exists identifying if differences exist between online courses using recordings and those that do not use this communication technique. According to Bender (2003) it is beneficial and important to vary the learning activities in online courses. Instructional technologies vary between course, instructor, major and university. With the growth of online degree programs it is necessary for researchers to pay closer attention to this technology and investigate the use of video in online course delivery.

Major Points:
• Does recordings enhance student learning of online courses?
• Would attendance to online courses be affected?
• Will the recordings be viewed by all students?
• Will the grades be higher?
• What are the pros and cons of using recordings of f2f classes in online courses?

Conclusions: Information presented in this study will serve as a reference to help establish a baseline of best practices for online instruction using recordings. The goal will be to establish guidelines for faculty to incorporate this innovative instructional method to enhance student learning.
A Study to Determine the Perceived Impact Internet Video Technology (IVT) Has on Instructional Methods for Technology Programs in Select United States Institutions of Higher Education

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Need: The purpose of this study is to investigate if student perceptions differ between online courses using Internet Video Technology and those that do not. A comparison is also needed to determine if the use of IVT will affect student participation in online courses. The intent is to develop a set of best practices while identifying the pros and cons of using this innovative instructional methodology. The study group will consist of students enrolled in Industrial Management courses at the University of Central Missouri.

Overview: Little pedagogical research exists identifying if differences exist between online courses using Internet Video Technology and those that do not use this communication technique. According to Bender (2003) it is beneficial and important to vary the learning activities in online courses. Instructional technologies vary between course, instructor, major and university. With the growth of online degree programs it is necessary for researchers to pay closer attention to this technology and investigate the use of video in online course delivery.

Major Points:
• Does Internet Video Technology (IVT) enhance student perceptions of online courses?
• Would attendance to online courses be affected?
• Will technical difficulties increase?
• Are students more engaged in the class while using Internet Video Technology?
• What are the pros and cons of using Internet Video Technology?

Conclusions: Information presented in this study will serve as a reference to help establish a baseline of best practices for online instruction using Internet Video Technology. The goal will be to establish guidelines for faculty to incorporate this innovative instructional method to enhance student learning.
Developing Meaningful Online Courses

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Need: This presentation is needed because not only are students demanding that more on-line course options be offered, but academia has realized the advantage of online delivery for multiple reasons including fiscal considerations, efficiency, and meeting student needs. However, many instructors find that delivering courses with calculations, formulas, or other challenging material is particularly problematic. Students and instructor alike struggle with these more difficult topics because traditional demonstration techniques once conducted on chalkboards or overhead projectors prove to be more difficult in on-line courses, especially those that do not use real-time delivery. Balancing students’ needs to learn and understand computations with an instructor’s desire to deliver a course that is practical, efficient, and relevant is where the challenges lays. Without an understanding of what strategies are available, easy to create, and practical to utilize, many instructors such as those teaching statistics, math, quality, or production planning will be unable to successfully assist students in acquiring necessary skill sets. Additionally, instructors will either miss opportunities to teach on-line or will be overly burden by the process.

Overview: This presentation will focus on proven suggestions, techniques, tips, and shortcuts for meeting the challenges of creating and delivering courses for complicated subjects containing calculations and formulas. The strategies are designed to be easily used by instructors, even those with minimal technical support or knowledge. Using YouTube, Facebook, worksheets, or PowerPoint are a few of the more common, lower tech strategies available. How to incorporate these with newer applications such as Adobe Connect, Signals, or real time on-line chats are also discussed. Having a variety of applications and strategies available will accommodate students at all levels of technical knowledge and connectivity.

Major Points:
- Establish the need for course improvement in distance education
- Define the core philosophy of improving delivery methods
- Discuss specific individual lower tech strategies and technologies
- Discuss innovative applications to tie traditional strategies with newer online technologies
- Identify the benefits of this new approach to both student and instructor

Summary: Attendees will be introduced to strategies on how to create a new on-line course or how to augment an existing course with the introduction of various technologies appropriate for teaching subjects which contain calculations and formulas.
The Absent Graduate Assistant: Trials and Tribulations of an Emerging Development

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Need: There is an increasing need to understand the changing roles of the professor and graduate assistant (GA) due to the increased utilization of distance learning via the Internet. The age old belief that the professor and the GA must be physically located on campus is obsolete. While presently small in numbers, there is a growing population of GA's who never set foot on campus. Therefore it is prudent to evaluate the role of the remotely located GA and the challenges he or she may face along with those the supervising professor may encounter.

Overview: A survey of the Engineering Technology List Serve and the ATMAE Professional Members List Serve will be conducted to estimate the number of remotely located graduate assistants in technology programs. Questions will be asked to investigate the issues faced by both the graduate assistant and the supervising professor. The results of the study are intended to provide a clearer picture of the changing roles of the professor and graduate assistant due to increased on-line distant education courses via the Internet.

Major Points:
- Role of the remotely located graduate assistant
- Role of the supervising professor
- Characteristics of successful and unsuccessful cases of remotely located GA's
- Trends in the utilization of remotely located GA's

Summary: Attendees will gain insight into the growing use of remotely located graduate assistants along with the benefits and challenges associated with their utilization. Supervising professors can use this information to avoid pitfalls with remotely located GA's and help develop effective strategies and successful professional relationships with their GA's.
Investigating Virtual Manufacturing (VM) Education for Technology Majors at UNI

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Need: Virtual Reality (VR) is not limited to video gaming and high tech industries. It recently has been associated with the education and linked to many research purposes. The impact of VR on education is the engaging knowledge that students can acquire during their experience. Learning theories suggested that a meaningful knowledge must be connected to the learner through interaction. Therefore, many schools now are exposing their students with VR experience to enhance their learning.

Overview: According to the theories, students who acquire knowledge through interaction with their peers or through an engagement experience such as VR are more likely to have improved critical thinking skills. The faculty members of the Industrial Technology Department at University of Northern Iowa (UNI) will attend a seminar on VR and Virtual Manufacturing (VM) in a Midwestern company to investigate the impacts of VR education on the career selection. The authors will report the experience of the faculty members and reflect their thoughts on how could VR technology influence the course education.

Major Points:
- The authors will offer the seminar in two sessions. The first will provide an overview on the fundamentals of VR related equipments. This will help to explain that VR technology can be utilized in different field of studies. The second session will focus on VM applications that are related to the audience background in Industrial Technology. During the seminar, discussion questions and surveys will be addressed to collect the information needed to reflect the following ideas:
  - The possible impacts of VR on students, teachers, and education in technology majors at UNI.
  - How faculty are willing to integrate VR technology in their course work if it is accessible.
  - The basic trends of the VR especially on motivation.

Summary: Integrating the VR technology to education systems has a tremendous effect on students and teachers roles; teachers must have more guidance role, whereas students are more responsible for the knowledge earned. With the wide spread of the VR today and the outcomes that will be discussed after the seminar, it is expected that the VR technology will have more attention from the UNI faculty members. Eventually, students’ education will be influenced with innovative and creative teaching methods similar to the effects seen with the integration of the online education.
Engaging Your Students Online

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Need: While educators and learners in classroom-based courses have already discovered the benefits of an engaged learning approach, the power of engagement in online courses is yet to be fully realized. We assume that the technical generation understands how to interact and learn online. They may know how to use technology and feel as comfortable with it as a knife and fork; however, research indicates that knowing how to play online does not constitute knowing how to engage and learn in an online community. This presentation is designed to share with you best practices in how to engage any age in an online learning community with simple, inexpensive, diverse and yet highly effective online technologies.

Overview: Engaging audiences online without suffering through long digital dialogues is a teaching art form. Teachers and learners both agree that courses designed to have the student read, write, and take a quiz are not the most beneficial learning environments. Students want more interaction and activities and teachers want less writing intensive grading and high maintenance technology. Although education has advanced in the numbers of classes offered online, the simple majority of those online classes still employ a correspondence type pedagogy where students read, write, and take a quiz. There is so much more to offer in an online environment. Attend this presentation to learn how to design courses that create interaction and learning and are low time intensive to administer/teach. The presentation will cover Soft Chalk learning modules, Panopto live power points, Youtube homework tips, Google Doc’s research portals, and self administered discussions.

Major Points:
- Learn the fundamentals of creating an engaging learning environment that is low time intensive to teach/administer
- Create portable learning units in Softchalk
- Generate live power point presentations from your desk with Panopto presentation software
- Create video homework tips on Youtube
- Utilize team research projects in Google docs

Summary: During the presenter’s 10 years in technology software management, she led a distance learning team for Great Plains Software that was designed to teach employees technical and soft skills content. She is a member of the MSU-Moorhead Instructional Technology Advisory Team. She is very active as a business consultant for Microsoft, Mekorma Software, Ottertail Utilities, and numerous businesses. She is a writer for The Microsoft Partner Channel magazine. The presenter is employed at MSU-Moorhead as an Assistant Professor, Technology and teaches Leadership and Project Management. In addition, the presenter is a partner at 6Dimensions: People and Technology consulting firm.
Delivery of an Online Quality Management Course for Adult Learners

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Need: The introduction of quality management systems in the workplace offers strategies for process improvement, strategic organizational change, and continuous quality improvement. Opportunities to learn these concepts in an online format allows for an efficient and cost effective delivery method. However, adult learners often do not have the comfort level with online learning that college-aged students take for granted. This presentation will describe the process which was used to develop and deliver an online non-credit course in quality management systems for adult students. Strategies used to encourage online discussion and student interaction will also be discussed.

Overview: The presentation will describe how an online course in quality management systems was developed with three major goals: introduce the new topic of quality management systems, engage adult learners in online discussion sessions, and maximize learning using strategies emphasizing the special needs of adult learners. Implications relating to adult education, quality management, and online engagement of students will be helpful to those who work with adult learners in an online learning environment.

Major Points:
- Development of course content best suited for adult learning styles
- Challenges of delivery online coursework to adults
- Methods of encouraging online discussion and interaction
- Implications and recommendations for educators who work with adult learners

Summary: The audience will understand the process of developing and delivering an online course in quality management for adult learners. The challenges of introducing new content areas to adults and best practices for engaging students in an online learning environment will be discussed. Information from this presentation may prove helpful to those who work with adult learners in both classroom and non-classroom settings.
Design and Development of an Online Course in Engineering Technology Using Web 2.0 Tools

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Need: The adoption of social interaction technologies in the classroom using the Internet and other appropriate technologies such as Web 2.0 tools in the teaching and learning process is becoming a highly valuable tool in the delivery of classes to students. The majority of students attending college today are characterized as the net generation with familiarity and ease of use of social technologies. These students are an ideal target population for distance learning opportunities. To take advantage of the opportunities that distance learning offers our students and to bring educational opportunity to those who may otherwise be unable to enroll for classes at the University, the school of engineering and technology is in the process of developing a set of courses leading to an entirely online Masters Degree program in Technology Management.

Overview: In an online learning environment, special focus is placed on engaging students and encouraging a reflective learning environment to occur in which students are made aware of their abilities as learners as well as content and concept acquirers. The challenge to faculty is tapping into the tools that many students use on a daily basis at home and with the portable devices they carry with them each day. Most of the Web 2.0 tools are freely available on the World Wide Web, and they are excellent collaboration tools. However, students do not have direction in how to use them in a meaningful way. This presentation taps into many of these tools and shows how they could be deployed in the classroom to empower students to take ownership of their own learning. Many of the available social networking tools are examined, and are used to facilitate collaboration, self directed learning, and to provide students an opportunity to share with a wider audience.

Major Points:
• Design considerations in an online teaching and learning environment.
• New learning technologies, communication tools, content tools, assessment tools.
• Demonstration of excellent Web 2.0 teaching tools which allow for active learning to take place.
• Deploying and using TeacherTube as an alternative to YouTube.
• Features that allow interactivity between faculty and students, between students and the learning tools, and among students themselves to communicate and give feedback on various topics that are being studied and discussed.

Summary: Attendees will be exposed to the many Web 2.0 tools available today for teaching and learning process. The presentation touches on the processes involved in using the social networking tools to design and develop a course in engineering technology for online teaching.
Mapping the “Online” Passage: A Guide for Moving Technology Courses to Distance Learning Formats

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Need: As part of institution-wide measures for cutting costs, increasing class sizes, reducing equipment budgets, and for competing with peer institutions, faculty members are being asked to consider moving courses online. While certain disciplines lend themselves more readily to such online transitions, this process can be quite challenging for technology programs, where laboratory activities are integral to the teaching and learning process. Beyond posting material online it may not always be clear about what additional steps are needed for making this transition effectively. Faculty members need to use the instructional strategies and appropriate media suitable for the achieving the educational objectives of the course. Only then will students acquire the necessary knowledge, skills and attitudes needed in a given technology related profession. For learning to be effective, students must be provided with every opportunity for working with the equipment, for personalized instruction from the instructor, and for group work. A blended approach to learning, incorporating a mixture of online and in-class meetings, is needed for addressing the different dimensions of a technology course and students’ learning styles.

Overview: Converting a traditional course to an online one requires additional steps beyond making texts, references, or presentations available online in a Learning Management System (LMS). Carefully thought out strategies for achieving this transition are clearly needed for maximizing student learning. The presentation will address how this can be achieved effectively, and will provide suitable examples of technology course content that has been migrated to an online format.

Major Points:

• Making student learning outcomes occupy center stage while developing online instruction
• Redefining the roles and responsibilities of the instructor and learner in online learning
• Activities for engaging the online technology student, including the use of games, simulations, group activities, case studies, and advanced features of learning management systems
• Using rapid web authoring software for converting existing content to distance learning formats
• Embedding hyperlinked resources, audio and video content, along with texts in courses
• Issues related to fair use of copyright material in online courses
• Blended technology course serving as the bridge between traditional and all online courses

Conclusions: Technology courses need to be primed for making the transition to online formats, in part because of the program cost/revenue considerations, and also for actively engaging students who have grown up with the Internet. Including online course content should be regarded as a standard feature rather than as an optional extra. Achieving the transition to a blended online format using a structured methodology will provide students with opportunities for conducting laboratory work. It will also include advances in educational technologies, games, simulations, and group activities that encourage student participation.
Student Verification System for Online Assessments: Bolstering Quality and Integrity of Distance Learning

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Need: The rapid growth of online examinations using Internet-based assessment tools has continued. The inability to control a student’s environment while taking exams has been a major challenge for academia everywhere. A clear correlation exists between an increase in the number of acts of dishonesty and the failure of institutions and instructors offering courses to monitor and enforce policies on cheating. The purpose of this study is to develop, implement, and research feasible strategies to support the integrity and quality of online assessment. The project will develop and test systems for remotely proctoring assessments that integrates facial recognition software, video surveillance systems, and computer restriction software into a system for monitoring student identification and activities while taking online examinations.

Overview: According to the Chronicle of Higher Education, the U.S. Congress is concerned about quality and integrity of distance learning and has added language to legislation renewing the Higher Education Act that encourages schools to fight cheating more effectively (Lardinois, 2008). In addition, education industry analysts expect the demand for online examination proctoring which incorporate student identification products will skyrocket in 2010 coupled with pressure from the U.S. Department of Education requiring schools ensuring the identity persons taking examinations is truly the student enrolled in the course (Webwire, 2009). The inability to check actual student identification or to control the materials they access/copy during assessments, via internet only examinations, opens programs up to cheating scandals.

Major Points:
- Literature reviews of biometric identification systems (e.g. fingerprint, username and password, analog and digital facial recognition, retina, voices, and others.)
- The cost effectiveness of using facial recognition, video surveillance system, and software restricting the computer’s functions.
- Comparing efficiency and accuracy of the biometric tools, between analog and digital facial recognition, in identify students, at least 60 samples.
- Report on existing remote proctoring examination in the academic and business environment.

Summary: In summary, online assessment and proctored testing deal with the issue of student identification and the environment in which materials are accessed effectively but it also negates much of the advantage of providing Internet based-course work. Utilization of biometric system with updated technology in video surveillance in the online examination will lead to certainty and quality assurance of student achievement and school’s reputation.
Effective Web-Based Tools and Interaction in E-Learning Systems

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Need: Interactivity and interactions have been identified by research as the key success factors in design and developing instructional materials of online education. An efficient feedback system is a critical interest that sustains a high level of engagement, whether between students and instructor, fellow students, or interfacing with the learning environment. This study gathered data from graduate students’ quality survey and interviews in 2007-2008 to preliminary present the levels of students’ satisfaction in web-based tools and learning activities. Also, the study presented features and formats of virtual collaboration that have been successfully employed in the online Industrial Management and Technology programs.

Overview: The rapid growth of E-learning for education and training in the past decade has been remarkable. Kopf (2007) reported that the U.S. E-learning market was worth $17.5 billion in 2007 and the U.S. enterprise E-learning adoption accounts for 60 percent of the market, while Europe’s accounts for 15 percent, overall usage of e-learning in Asia is expected to reach a compound annual growth rate of 25-30% through 2010. With advanced technology and advantage in convenience of all parties, there will be a higher demand and progression of online delivery. As faculty and educators, we must strive for excellence in teaching and increasing learning effectiveness for our students and the future of education.

Major Points:
- Statement of problems: feedback system and interaction in E-learning systems
- Useful web-based tools and learning activities; tables and graphs
- Analyzing and designing e-learning interactions
- Interactions in teaching by virtual collaboration
- Cause-effect diagram of successful virtual chat meetings
- A rubric for assessing level of interaction in virtual collaboration

Summary: The information derived from this study will support online course developers and educators in maximizing Web-based tools to promote the interaction and collaboration among students, and between students and instructors. Further research may focus on evaluating more Web-based tools that highly contribute to students’ understanding of course contents and students’ achievement, specifically the Web conferencing that incorporates multimedia and allows texts, images, and voices from all participated parties.
Virtual Advanced Manufacturing Online Study: To Implement Evaluation Methods for Teaching and Quality Control of a Course in a 2-Year Advanced Manufacturing Program

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Need: The problem in this study was to investigate students’ perceptions when completing course work via online and over the distance. One of the difficulties with online course content delivery is knowing the quality of instruction using this means. This study addresses the use of “five principles of instruction”: Authentic problems, demonstration, activation, application and integration of concepts learned via online and measuring student’s own academic learning time; this includes their learning progress, their satisfaction and the quality of instructional lessons delivered online.

Overview: Either delivering traditional instruction or via modern online technologies, there are benefits and challenges that come from implementing a learner-centered approach, Problem based learning, and complex learning scenarios. It is difficult for instructors and administrators to put these goals into practice, this is particularly true with online teaching and learning tools, as well as to measure the effectiveness of “homemade” courses for online delivery or those that are commercially available. This study presents the results of evaluating a Virtual Advanced Manufacturing Online course of Study (VAMOS). Some of the questions answered are: 1) what are the relationships among students’ satisfaction with the online component of the course, their learning progress, course quality and instructor rating of their performance? 2) When students agree that the “five principles of instruction” occurred, what are the odds that academic learning time also occurred? And 3) how does students’ own success in the course compares with instructor rating of students’ success?

Major Points:
- Virtual Advanced Manufacturing Machine Shop
- First Principles of Instruction
- Academic Learning Time
- Online Course Evaluation
- Quality of instruction
- Complex Learning
- Online and Distance Learning

Summary: Attendees to this presentation will learn how students perform when they complete laboratory activities using an “Online Virtual Shop”. In addition, participants will gain an appreciation for students’ feedback in terms of their perception of how their Academic Learning Time affect their progress while learning online and their evaluation on the use of “first principles” of instruction while completing online coursework.
Learning Retention Comparison for Distance Course to On-Campus Students

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Need: Distance learning plays a big role in today’s higher education. It eliminates several limitations and provides a chance to full-time worker to get a higher degree. However, unlike traditional students who have direct contact with instructors, distance students generally contact with instructors via distance communications such as email and the Internet. This limits the interaction between instructors and students, and deteriorates the learning rate. Therefore, distance students may not perform as good as traditional students. The purpose of this study is to compare the performance and learning retention between two groups of undergraduate students, a traditional class and a part-time student, full-time workers taking the same class via distance.

Overview: In this presentation, we will present findings from the study of learning retention comparison between traditional and part-time students. Data will be collected as pre-test and post-test scores. Research setting will be class IT 230 - Industrial Supply Chain Management, offered by Department of Industrial Technology, Purdue University. Traditional students include undergraduate students taking a face-to-face class on West Lafayette main campus. These students are mostly sophomores or juniors. Most distance students are full-time workers that registering this class through Purdue Statewide across State of Indiana. They learn materials through Adobe Connect in Blackboard via the Internet. They communicate with an instructor by email. Results may include learning rate for both student groups. Data will be analyzed as descriptive and inferential statistics. Summary and recommendations will be provided as well. A survey will be conducted to gather students’ inputs for improving.

Major Points:
- Learning retention comparison between traditional and distance students
- Pre-test and Post-test
- Recommendations by students for future class
- Recommendations by authors for future study

Summary: Attendees will learn the similarities and difference between traditional and distance class in a comparison of learning retention. Results will be supported by statistical analysis of data. Recommendations will be made for the faculty and instructors who conduct distance classes to improve the effectiveness of students’ learning experience.
Developing Active Forum Discussions Using Case Studies in an Online Course: A Case Study

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Need: Online courses are becoming one of the most popular modes of delivery in higher education. Some online courses lack interactivity among the students and faculty. This lack of interactivity makes some students feel disconnected. Research has found that the higher the interactivity, the higher the completion rate of online courses. In online courses, forum discussions replace face to face discussion in the traditional classroom. In this presentation, I will answer the question: Can forum asynchronous discussions using a case study enhance the learning process? I will describe how I use case studies to connect students in forum discussions in an online Manufacturing Research course at Southeast Missouri State University. The focus of this capstone course is to apply the concepts learned in a technology degree program.

Overview: Challenges to an effective online class include increasing interactivity while fostering student learning. Appropriate course design, quality and effectiveness of the instructor improve the learner’s satisfaction and learning. Because students are social, forum discussions allow participation in meaningful dialogue relating to real world scenarios. In addition, students gain practical knowledge and learn to apply concepts learned in their degree programs. Students can use case studies to analyze a problem, discuss strategies to deal with the problem and apply solutions. In addition, a well developed online course can apply Chickering’s 7 principles of undergraduate education.

Major Points:
- Need for active forum discussion in an online course
- Examples using case studies to connect students in forum discussions
- Perceptions of students on the effectiveness of case studies in forum discussions
- Lessons learned and future endeavors

Summary: Attendees will understand how to develop active forum discussions in online courses. Case studies used in forum discussions allow students to participate in meaningful discussions relating to real world scenarios. In addition, students gain practical knowledge and learn to apply concepts learned in their degree programs. Examples and applications of the case study in forum discussions will be presented. Student perceptions of forum discussions using case studies will also be covered. Active forum discussions using case studies can enhance learning in most online courses.
An Evaluation of a Virtual Warehouse Management Laboratory for a Distance Learning Course

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Need: The growth of the global economy is fueling a demand for logistics professionals and creating new opportunities for many states in the US with large international ports. Along with this growing demand for logistics professionals requirements of technology skills such as databases, knowledge of warehouse management systems (WMS), and a firm understanding of how data captured from WMS should be optimized for a smooth flow of goods through the supply chain. This development requires the training of a large number of workers to acquire these necessary skills to meet the demand.

Overview: The Department of Engineering and Technology at Virginia State University is recognizing this growing demand for logistics professionals and is offering a logistics concentration within its Industrial Technology degree program. But, with the anticipating demand from students, especially in rural areas around the State and the country, where many retailers have established large warehousing and distribution facilities, the Department is offering logistics courses and laboratories via distance education for a greater flexibility as to the time and place of instruction. In this presentation, we will present the design process and the evaluation of a warehouse management online laboratory. We will also show how the platform was used to fulfill student’s online learning requirements.

Major Points:
- Identification of critical virtual environment concepts to ensure the same experience as face-to-face environment
- Recognition of important terminology commonly used in the management of value chains as related to inventory handling and storage
- Need to perform efficient vital warehouse management tasks in a virtual environment and to optimize operational efficiencies while promoting a safe working environment

Summary: Attendee will understand the design and testing requirements for a virtual laboratory for an online course to fulfill the learning objectives in an online course as in a face-to-face setting. The virtual warehouse model can be used to improve any industrial technology online laboratory course.
Electricity, Electronics & Computer Technology
A Solar and Biodiesel Energy Conversion, and Monitoring System for University-Based Implementation

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Need: Interest in renewable energy systems have been attracting the attention of scientists, engineers, technologists, and policy makers in view of problems of cost, reliability, and scarcity of fossil fuel sources. We have a real opportunity and challenge to transform our economy from one running on fossil fuels to an economy largely based on clean energy. We should not rush into this and damage the economy. We must use our current energy sources more wisely and develop technologies to utilize smarter sources of energy such as nuclear, solar, wind, geothermal, tidal, etc.

Overview: We must all become smarter and more conservative consumers. We must know how much we use, and reduce or eliminate waste. We can do a better job of this if we knew how much energy we actually consume. For renewable energy sources to be competitive with conventional sources, it is also necessary to focus on monitoring, targeting, reporting, and recommendations for load-side energy saving products. This task is made easier and effective by the decreasing costs and increasing power of monitoring hardware and software tools. In this paper, details of a campus-based ongoing renewable energy project are presented.

Major Points:
- Solar Power
- Biodiesel
- Monitoring, Control, and Conservation

Summary: A pilot-scale biodiesel energy conversion plant, using waste vegetable oil from the campus restaurant(s), and a solar power system are being deployed. The energy production will be continuously monitored in real-time using smart power meters and a dedicated computer system.
Technologies Behind the Phenomenal 3D Movie Avatar

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Need: James Cameron’s new 3D blockbuster movie ‘Avatar’ has been a phenomenal box office success. It is the most significant 3D movie ever produced. A number of revolutionary filmmaking techniques have been created during the production of Avatar. To name a few, for its development of 3D viewing and stereoscopic filmmaking, cameras were specially designed for the film’s production; the facial expressions of the actors were captured and digitally translated to the face of CGI (computer-generated imagery) generated characters using a facial-performance-capture system. It’s our vision that the movie and the technologies bring great opportunities for higher education. Students are fascinated by these state of the art computer and multimedia technologies. The big-budget hi-tech movie industry opens enormous career opportunities for students who are interested and well-prepared in this area.

Overview: On January 27, 2010 ‘Avatar’ became the highest-grossing film of all time worldwide, surpassing the previous record holder ‘Titanic’ (Both films were written and directed by James Cameron). The film is composed of 60% computer-generated elements and 40% live action. Avatar represents a dramatic advance in movie-making technologies. The experience of Avatar in 3D explores the potential of film to bring viewers into a materialized onscreen world. This proposal introduces the production process of Avatar and explains some of the revolutionary technologies during the movie production. Prior to the film being shot with the live-action cinematography, the 3D Pandora environments were rendered in CGI. The virtual world of Pandora used over a petabyte (1015) of data storage. The Fusion 3D camera system was developed to shoot stereoscopic HD video. CGI-generated environments could be viewed through virtual camera from any point and angle. Finally, Simulcam merged 3D camera and virtual camera in real time.

Major Points:

• The production process of the Avatar movie.
• Fusion 3D camera system for stereoscopic HD video shooting.
• Facial-performance-capture system for actor facial expression capturing.
• Virtual camera system that places actor’s CGI role into digital surroundings in real time.
• Simulcam – a merger of the 3D fusion camera and the virtual camera system.
• Avatar’s supercomputer server farm at Weta Digital’s data center.

Summary: A number of revolutionary filmmaking techniques have been created during the production of Avatar. These technologies bring great opportunities for higher education. We will introduce the technologies used in the production process of the movie. In particular, we will focus on the technologies behind the 3D cinematography.
Potential Industrial Applications of Unmanned Aerial Vehicle Automation and Control Systems

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Need: The purpose of this presentation is to demystify the electronic systems both on and off board a contemporary civilian unmanned aerial vehicle (UAV). Often one industrial sector may develop control systems which can advance the technology and be deployed successfully in other industrial applications. Disseminating and sharing knowledge of like technologies is the first step in achieving this outcome.

Overview: The research team will give a brief historical perspective of unmanned aerial vehicle automation and control systems. This will be followed by the new state of the art technologies which are being used in the unmanned field and its integration between man and machine. It will include degree of autonomy and use of the technologies in aviation and its relationship and applicability to industry. UAV automation and control systems may be used to minimize operator workload, prevent operator-induced errors, and protect against exceeding limitations. These principles and technologies can be leveraged to include industrial applications as well.

Major Points:
- Indiana State University demonstrating actual UAV control systems.
- Explanation of the software, hardware and integrated circuits
- Explanation of data transfer logic and guidance systems.
- Virtual cognitive automation systems.

Summary: The conference participants will gain an understanding of the potential industrial applications of the UAV automation and control systems.

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Need: Graduates of EECT programs are increasingly being required to demonstrate their proficiency in installing, configuring, using, troubleshooting, and managing essential software systems and applications. This, along with dwindling departmental budgets, is prompting technology faculty members to consider inexpensive alternatives for teaching computer electronics and networking. Without sufficient experience with these software applications graduates will not be able to compete or collaborate professionally with their peers. Proprietary operating systems such as Microsoft’s Windows Server 2008 R2, or software applications such as National Instruments’ Multisim, or Rockwell Automation RSLogix 500, and security software services such as GFI’s network server monitor, typically involve licensing and ongoing maintenance fees. Open-source software alternatives, such as the StartCom Enterprise Linux operating system, Digital Works circuit and PSIM PLC simulator, or the Backtrack security testing software respectively, offer this functionality at a significantly lower cost. Companies hiring computer networking graduates are also looking for software that can reduce software application overhead costs. Alternatives for office productivity software along with most web applications are eagerly sought by businesses and educational institutions, along with database driven online systems. Open source alternatives for these and other applications are available, and may be used for providing technology students with the edge needed for competing globally.

Overview: The presentation will discuss how open-source software may be used in the computer technology curriculum for providing functionality at par with commercial software applications and operation systems. The deployment of free and stable operating systems along with applications is poised to overcome its corporate counterparts, thereby bridging the digital divide. Ideas for facilitating learning about open-source applications, content management systems on the GNU/Linux operating system will be discussed. The challenges faced in the adoption of open-source software, including the sharp learning curve it often involves will be discussed.

Major Points:
- The widening gulf in information access due to rising costs of proprietary software.
- Open-source and proprietary software applications in technology classes and small businesses.
- Using Linux distributions for providing a broad range of stable and secure software applications.
- Developing Blogs, Wikis, and E-commerce database driven websites with open-source software.
- Network security using open-source applications.

Conclusions: The use of open-source software applications holds the promise of providing students in computer electronics and networking area with many of the skills and tools needed for succeeding professionally. These applications are built using sound programming design principles, and offer a phenomenal level of stability and security. Using open-source software as a teaching tool encourages students to explore, use, and support free software. Besides the obvious saving in costs, it develops in students’ online research and troubleshooting skills, owing to the high degree of customization possible with the software. It offers exciting opportunities for students to demonstrate their skill in deploying secure websites and software applications.
The 3 C’s of Future Computer Networking Technologists: Critical Thinking, Creativity, and Communication

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Need: Graduates of computer electronics and networking technology program are expected to demonstrate the ability to solve multifaceted problems using critical and creative thinking, and communicate the results to both technical and non-technical audiences. Technology faculty members thus need to provide opportunities for students to develop these skills along with the essential knowledge, skills and attitudes expected of professionals entering these specialized fields. Students need practice in communicating technical issues succinctly both in writing and speaking, elaborating on the issues as needed, providing suitable examples, and illustrating their ideas while problem solving, especially in a team based environment. Researching and evaluating online information sources, and using these for solving technical issues effectively should be included especially in upper-division courses. For achieving these vital objectives, specific activities need to be embedded within lectures, laboratories, and in course and capstone projects.

Overview: The presentation will discuss strategies which technology faculty members can use for encouraging critical and creative thinking in various computer electronics and networking courses. The factors which could improve or inhibit creativity in technology courses will be discussed. Course and capstone projects play a vital role in developing student confidence in taking on larger technical problems and solving these in unique ways. The projects should provide students the opportunities for defining the problem, making proper assumptions, conducting research, generating ideas, comparing alternative solutions, implementing, troubleshooting, and communicating the results effectively. Doing so will progressively expand students’ understanding of the complexities of the computer electronics and networking field they are preparing to enter.

Major Points:

- Skills needed for future graduates of computer electronics and networking programs extend beyond traditional course content, and cookbook approaches to problem solving.
- Methods for strengthening thinking skills so that students can prioritize content, as well as analyze, synthesize and evaluate technical issues.
- Facilitating the development of creative traits in classroom interactions. Encouraging responses that reflect originality, “outside the box” solutions or designs, and withholding judgment while brainstorming.
- Determining, comparing, and evaluating suitability of components, devices, and software used in computer electronic networking systems based on design specifications.
- Selection of proper computer electronics tools while testing and troubleshooting technical problems in laboratory activities course and capstone projects.
- Using in-class presentations, paragraphs, papers, online class entries, videos, and reports for expressing ideas and online research related to computer electronic networking systems.
- Rubrics for evaluating student work related to critical and creative thinking, and communication. Validation of skills by internal program and external advisory committees.

Conclusions: Critical and creative thinking is an integral part of the designing and constructing practical computer electronic networking systems. The laboratory activities, assignments, and class projects should require students to demonstrate their skills in these areas. In addition, students should have the opportunity for communicating their online research findings and their progress on ongoing projects to peers and faculty through structured in-class or laboratory activities. Innovative instructional techniques are needed for providing opportunities for students with different learning styles to practice these important skills, helping students learn about regulating their learning. Students’ equipped with these important skills are likely to find themselves better prepared for facing professional challenges of the future.
Implementation of VMware ESXi in Telecommunication Lab

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Need: We will present a virtualization technology that abstracts processor, memory, storage and networking resources into multiple virtual machines and can run unmodified operating systems and applications and we will show how it is used to update the Network Security course at the Southeast Missouri State University, Cape Girardeau based upon input received from students and employers working in the department.

Overview: The “Network Security” course in Industrial and Engineering Technology (IET) department at Southeast Missouri State University includes concepts related to network attacks, security management, and other security tools. It also requires lots of equipment (computers, firewalls, routers, etc.) and other resources to accomplish all the objectives covered in the course. Therefore, it will be beneficial to use a technology that can lower the number of physical servers which will lead to reduced hardware maintenance costs and increased space utilization efficiency in the lab. Implementation of concepts such as virtualization can help to develop a standard virtual server that can easily be imaged on other systems.

This research will present an efficient implementation of VMware ESXi Server which will create virtual machines and will further help in running multiple operating systems (Linux, server 2003) on a single server. It is expected that implementation of this technology will help in the development and testing of Network Security labs. The comparative methodology will be used to show the reduction in hardware, energy and administrative costs. This study will help in examining the two scenarios of telecommunication lab with or without VMware ESXi implementation.

Major Points:
- Need for the Network security course
- Comparison between existing and future telecommunication lab scenarios.
- Comparison between attributes such as hardware resources, energy consumption, and other costs associated with maintenance and administration.
- Effect on the performance of students and ease of use.

Summary: This research paper will focus on the successful and effective VMware ESXi implementation for the development and testing of network security labs. It will compare the two scenarios and will evaluate the students’ performance based on that.
Methodology Proposal for Testing If Biometric Face Recognition Software Is Biased Upon the Color of the Skin

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Need: Biometric technologies have been with us for several decades; yet the massive implementation of biometric security applications has recently surged as one of the responses to the September 11 attacks on the United States (US). It is believed by government agencies, the media and public in general, that a massive implementation of biometric applications will increase the security of the US population. Recently there have been some complains about face recognition software, stating that it does not work properly when minorities try to use it. There is a need for an experimental methodology that can be used consistently to find out if there is a statistical significant difference in the outputs of a face biometric system when minorities use this technology.

Overview: Biometrics can be defined as all the authentication techniques relying on measurable physiological and individual human characteristics that can be verified using computers. This presentation outlines a methodology based on experimental design in order to find out statistically significant differences in a face recognition system when is used by dark skin persons against white skin persons. A full factorial experiment with three factors (Illumination, distance and angle) at 2 and at 3 levels is designed and implemented. The results of our findings will be discussed using multiple regression and ANOVA techniques. Although our experiment covers only dark skin vs. white skin test, it can be used to test other features.

Major Points:
- Biometric fundamentals
- Experimental design methodology on face recognition
- Face recognition software biases toward minorities
- ANOVA and regression techniques used to discuss the results

Summary: Attendees will be exposed to the fundamentals of biometric technologies. A statistical methodology based on design of experiments will be presented in order to find out if particular face recognition software is biased when dark skin is tested against white skin. The methodology can be used to test any other feature besides skin color. ANOVA and multiple regression techniques will be used to discuss the results.
Development of a Single Axial Rotating Flux (SARF) Generator

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Need: As energy costs and the concern for environment increase, there is a need to turn to Green Energy Solutions to meet the demand for electricity. One such solution is to harness wind power. One of the crucial components of a wind mill is the power generator. As the use of wind mills increases to generate electricity, there is a need to create generators that are light weight, low cost and of high efficiency. This study aims to contribute to this need.

Overview: Electric Vehicle Institute (EVI) within the College of Technology is a platform for developing systems related to alternative energy. As part of this mission, a project was conducted by Mr. Charles Codding together with an undergraduate student Mr. Jarred Voldness and others members of EVI to develop a more efficient power generator to be used in windmills. The group succeeded in developing a prototype, which is lighter, more efficient and of lower cost than those available in the market. This has further led to an application for a Patent of this design. The authors will present the design and the results obtained from the prototype developed.

Major Points:
- Design of the Single Axial Rotating Flux Generator
- Methodology of creating a prototype
- Results obtained from the prototype
- Economic and Engineering Advantages of the new design

Summary: This study serves as model for applied research in power generation using wind power. The study shows the development of a Single Axial Rotating Flux Generator which is more efficient and of lower cost than those available in the market. The presentation will show the design process, the new design, results of the prototype and comparative analysis of the efficiencies obtained.
Advantages of a Robotics Concepts Course for a Large Multi-Discipline Technical Center-Based BEST Robotics Team

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Need: Creating an effective learning environment for a BEST Robotics team is difficult in its own right. On a large, multi-discipline team such as one based at a technical center, it can be exponentially more so. The Western Arkansas Technical Center (WATC) BEST Robotics team based at the University of Arkansas-Fort Smith has been successful but the learning experience has been admittedly lacking. In the past, students have had to work on designing, building, and testing the robot as their class and work schedules permit. Students have not been able to fully utilize the engineering design process and have been required to build and use their first idea. In addition, participation on the team by pre-engineering students has been virtually non-existent. In an attempt to alleviate these issues, a basic Robotics Concepts course was developed and added to the required pre-engineering curriculum to expose students to fundamentals of robotics and their construction, such as linkages, electromechanical systems, leverage, and other topics. The course was also offered as an elective to students in other WATC programs and also regular college engineering students. While the purpose of the course is not only BEST Robotics, the BEST competition serves as the course’s midterm project (and final project, if the team qualifies for the Regional competition) and is used as a vehicle to introduce the concepts to the students.

Overview: The primary objective of this course is to improve the learning experience for students participating on the WATC BEST Robotics team and the engineering students in general. By participating in this course, the students will learn more about different concepts involved with robots and have more time to design prototypes, test ideas, and document the design process in the form of an engineering notebook.

Major Points:
- Students will learn more about robotics concepts and be able to test ideas to determine what works best for specific situations.
- The engineering design process will be utilized and students will document their findings in the form of an engineering notebook.
- Pre-engineering students will be more fully involved in the BEST process.

Summary: Attendees will learn how a basic robotics concepts course can help improve the learning experience for the students and create more student involvement in the overall engineering design process.
Development of Usable Circuit Models for Spintronic Devices

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Need: In 1988, the first experimental evidence of the phenomenon of “giant magnetoresistance” (GMR) was discovered in thin multilayers of ferromagnetic and antiferromagnetic materials. Since then, the solid-state device engineering community has been able to turn this effect, in which a reversal of the polarization of the electron’s spin degree of freedom from layer to layer results in as much as a 100% change in resistance, into commercially important advances in magnetic memory devices for computers. Further research into these magnetic materials has led to proposed devices that would use the control and transport of the electron spin across material interfaces to either replace or modify the conventional semiconductor device, which uses currents due to electric charges to function. It is time to develop simpler equivalent circuit models, based upon the physics of spin transfer, spin torque, magnetization reversal across interfaces, and quantum mechanical tunneling of spins, so that proposed spintronic devices and their behavior when integrated with other, more conventional circuit elements can be evaluated for their performance. This presentation will attempt to do just that.

Overview: The first presenter is a Co-PI on an NSF-EPSCoR grant to the University of Kentucky for the establishment of a Center for Advanced Materials (CAM-UK). Both presenters are involved in the development of simple models for the transfer of electron spins across thin barriers between magnetic materials, and have developed a scattering matrix technique to simulate the “spin current” through these devices. This spin current can take place either alone, or in conjunction with electric current flow. The expectation for such devices is that they will make for more compact, and particularly less power hungry, devices in computer systems of the future. In particular, this presentation will examine the use of very small amounts of electric current that can be used to control the states of magnetization and the transport of electron spin across device junctions. Finally, an Ebers-Moll type model, such as is used for modeling conventional bipolar junction transistors (BJT’s) has been developed for a “magnetic bipolar transistor” from the scattering matrix model developed by the presenters.

Major Points:
• Nature of Spintronic devices and their present role and future prospects.
• Development of models based on a scattering matrix technique to simulate the physics of spin transport and spin torque in multilayer devices.
• Application of Ebers-Moll type model for magnetic bipolar transistors.

Summary: The presenters hope to bridge the gap between the physics of spin transfer and the circuit behavior of such devices within systems through models that allow for simpler evaluation and calculation of such behavior for a variety of spintronic devices.
Open Source Tools in a Virtual Environment for Electronics Programs

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Need: In the current economic climate, public support for education at the college level is decreased due to lowering of education budgets for state supported institution. This has impacted faculty and staff positions, the educational environment for students, and overall direction and future aspirations of different units on college campuses. Software is a vital part of the learning experience for technical courses within Electronics and Computer Technology, and like programs. A means of streamlining cost would include reducing the need for proprietary software and the updating of computing campus facilities.

Overview: The approach to streamlining cost would include adopting a virtual computing environment with predominately open source software. Potential impact would be all science, electronics, programming, math and some business courses. Courses in which software is strongly influenced by industry such as the emerging phone apps industry would also be added.

Major Points:
- Relevance of Software to Curriculums for Learning
- Infrastructure necessities
- Verified Open Source Software for Curriculum
- Virtual Computing Environment including needed equipment
- Impact of Virtual Environment
- Demonstration of a Sample Environment for an Electronics Program

Summary: Open source solutions with minimal proprietary software in a virtual environment enhances the education environment while minimizing budging constraints of technology oriented programs such as Electronic Technology or Computer Technology and the financial impact on students.
Industry and School Partnerships to Promote Robotic Competition Programs that Encourage Students to Pursue Technical Careers

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Need: Many of our schools systems are currently in extreme financial distress (some are near collapse) and are reducing course offerings to required basics. Meanwhile, the number of students graduating with technical degrees in this country continues to decline compared to other industrialized countries. Robotic competition programs provide a hands-on and exciting approach to science and technology subjects. Technology-oriented industry and education professionals need to come together to supplement school programs and to encourage the next generation of students to pursue technical careers.

Overview: Several national, regional, and local competitive robotic programs will be explored that engage industry professionals and educators to encourage students to pursue technical careers. The programs considered in this presentation have a variety of approaches for implementing their programs, each has strengths and restrictions that should be carefully considered prior selecting a particular program. The resources (time, money, personnel, and equipment) needed to operate the programs will be compared. Restrictions on hardware and software used for robot construction will be reviewed. The relationships between adult leaders and students are carefully considered for each program.

Major Points:  
• Need for industry and educational professionals to work together to encourage students to pursue technical careers  
• Comparison of robot competition programs  
• Resources needed to operate the different programs  
• Understanding the role of adult leaders

Summary: Attendees will be able to effectively compare the characteristics of competitive robotic programs with their local needs, resources, and educational philosophy. Reference materials (printed and/or online) will be provided to attendees for the programs presented.
Zigbee Wireless Application in Manufacturing

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Need: In industrial environments, wiring data cables could be a major issue. Studies have shown that average cost for cable wiring is about $40 per foot in chemical plants and $2000 per foot for a nuclear plant. The cable wiring cost depends on the location of machines, the type of plants, and the labor work needed for installation and maintenance. By using Zigbee wireless sensor Systems, cables are replaced with a reliable wireless network that can provide a robust data communication, avoid extreme costs and enhance the workforce productivity. Each Zigbee wireless network can hold up to thousands of wireless nodes deployed in an industrial plant. Zigbee systems are used effectively in machine controlling and condition monitoring. The key advantages of Zigbee wireless networks are the flexible network topology and the low power consumption.

Overview: Zigbee wireless system has been an attractive technology to manufacturing industry in the last decade. This paper addresses the issue of using a Zigbee point-to-point network based on the Zigbit 900 development kit to replace a cable in a Midwestern Manufacturing Company. The project development is being conducted at the electronics lab of the University of Northern Iowa before it is implemented in the real manufacturing setting.

Major Points:
- Selecting the proper development kit for the application.
- Study the performance of the kit at the real manufacturing location of the application
- Develop application specified programs in C-programming language that will maintain the connection between the sender and receiver nodes.
- Design the hardware circuit(s) required for the interface between the wireless nodes and the machines.
- Analyze and test the project upon completion.
- Investigate for further improvements.

Summary: The project is an applied research that requires solid background in C-programming and intensive experience in electronic circuits. Future studies will extend this work towards more advanced applications of Zigbee networks that include mesh topology. The outcomes of the project have a direct implication on manufacturing industry and a possible change in data communication infrastructure.
Analyzing Zigbee Wireless Network Performance in Manufacturing Environments

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Need: In manufacturing industries, there exist many applications where Zigbee networks are integrated to provide wireless solution for the automated manufacturing processes. It is well known that industrial environments characterized by extreme conditions such as high temperature, pressure, and electromagnetical interferences can affect the performance of the Zigbee networks. The key solution to overcome this performance issue is by monitoring the received Signal Strength Index (RSSI) at the received sensor of the ZigBee device.

Overview: ZigBee is a wireless sensor network (WSN) standard designed for specific needs of the remote monitoring sensor system. The simplest topology for a WSN is known as point-to-point sending and receiving nodes. In this paper, the authors are interested in analyzing the characteristics of the Zigbee performance by focusing on the RSSI signal to monitor the received wireless packets from the sending node. The study will be taking place in two settings: The first will be conducted in a real industrial environment at a Midwestern Manufacturing Company, and the second will be in an artificial industrial setting located at the industrial technology Department of the University of Northern Iowa. The study aims to compare both locations to note the various factors affecting the Zigbee performance.

Major Points:
- Investigate the characteristics of a specific type of a Zigbee Development kit.
- Measure the RSSI and count wireless packets lost if the received signal.
- Specify the causes for the variation in the WSN performance.
- Investigate the requirements on WSN to prevent any sudden downtime.
- Provide a method that can be a model prior to integration of Zigbee technology in manufacturing processes.
- Provide an overview about the reliable Zigbee wireless networks for industrial systems.

Summary: Investigating the Zigbee Wireless systems performance in industrial environment provides a tool to identify the effects of the harsh conditions. It is necessary to run similar investigation to prevent the malfunction of the manufacturing applications. It is also recommended to have an embedded approach to Zigbee applications that can self monitor its performance.
Feasibility of Solar Energy Power Station in Southwest Louisiana, Student Project

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Need: Environmentally and energy-conscious students would benefit in understanding alternative energy and cost related to it. Students learn about solar power and estimating of the cost of installing solar power. In addition, students will conduct estimating project on the feasibility of implementing solar power plants in southwest Louisiana.

Overview: Today we find ourselves totally dependent on an abundant and uninterrupted supply of energy for living and working. It is fundamental to the quality of our lives. It is undoubtedly the key ingredient in all sectors of modern economies. Solar thermal plants are basically power plants that generate electricity from high-temperature heat. The difference between them and conventional power plants is that not gas, coal or oil, but the sun provides the energy that drives the turbines.

Major Points:
- Students learn about alternative environmentally friendly solar energy usage.
- Students estimate cost of solar panel and system for residential homes. Energy conscious students grasp a better understanding and greater appreciation of the value of the “electric-energy” dollar.
- Students estimate the cost of solar power station in southwest Louisiana.
- The cost of solar power energy plant is high but it will be reduced in future by technology improvements and mass production.

Summary: In this paper we will give a brief demonstration of solar thermal power and different system designs of solar thermal power plants. As there is always an increase in need of energy, it is the best time for the state of Louisiana to look forward for the solar thermal energy as it is suitable and has considerable resources for constructing solar plants.
Kill A Watt and Learn To Save Energy and Money: Student Project

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Need: Environmental and energy conscious students would benefit in understanding power ratings and energy usage of electrical systems such as electrical equipment and electrical appliances found in most homes. In this presentation, we will introduce the use of an inexpensive meter called Kill A Watt meter to monitor, current, power, VA, kWh, and power factor of electrical equipment by students in electronics and construction technology courses.

Overview: Students from the Department of Industrial Technology at University of Louisiana at Lafayette learn about power and energy and how to calculate and measure these quantities. In addition, many students conduct energy saving service projects for their communities as part of course requirements. Kill A Watt meter is an inexpensive, light, and easy to use equipment students carry during their energy surveys.

Major Points:
- Students learn about power, energy, and power factor using inexpensive meter.
- Being able to calculate power and energy consumed by the devices will allow students to check the energy being used by electrical devices in everyday tasks.
- Students are tasked with estimating the energy usage of selected low income family homes as a part of community service.
- Energy conscious students grasp a better understanding and greater appreciation of the value of the “electric-energy” dollar.

Summary: Conducting energy surveys and laboratory experiments using Kill A Watt meter provides environmentally energy conscious students with a better understanding of the relative value of electrical appliances, a greater appreciation of the value of the “electric-energy” dollar, as well as, increasing the overall understanding of electric fundamentals.
VMotion Between Datacenters: Virtualization of IP SAN via a vSphere Distributed Network Switch

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Need: Currently, VMotion is not possible between datacenters due to the inaccessibility of the same IP SAN by ESX servers located in different datacenters. There is a need to examine the possibilities of live migrations of virtual machines between datacenters for disaster recovery and business continuity scenarios. If ESX servers located in different datacenters are able to access the same datastore, VMotion between datacenters becomes a possibility. With current trends in virtualization of IP Storage Area Networks (IP SAN), singular entities of storage located on different networks may collectively contribute to a solitary IP SAN.

Overview: If live migrations of virtual machines (VMs) are possible between datacenters, disaster recovery (DR) and business continuity (BC) scenarios may be improved. The biggest obstacle of live migration of virtual machines between datacenters is the accessibility of remote ESX servers to the same datastore. With virtualization of IP SAN via distributed switches, there is a possibility of a live migration between datacenters. The following questions will be answered: How do users configure and analyze current vSphere VMotion requirements? What are the limitations VMotion? What advantages of the possible live VM migrations between datacenters? What is a VMware’s Distributed Network Switch and how does it work? What are the requirements for network connections and IP SAN connections to satisfy live VM migrations between datacenters?

Major Points:
- The importance of live VM migrations in DR and BC scenarios.
- Analysis of IP SAN virtualization for live migrations of VMs between datacenters,
- Overview of current virtualization options available for IP SANs,
- Analysis of current vSphere advantages and limitations pertinent to VMotion technology.

Summary: This presentation examines the possibility of live migrations of virtual machines between datacenters via virtualization of IP SAN located on a vSphere distributed network switch. The importance of live VM migrations is essential in DR and BC scenarios.
Development of Two New Courses on Wind Energy and Its Management

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Need: As states of Texas and Iowa have become pioneers of larger scale wind energy projects in the United States, the needs on new course development on wind energy basics, advanced wind energy, and wind energy management become absolute in some US academic institutions that are located closer to large scale wind farms. This paper describes development of two new course curriculum titled “Wind Energy Applications in University of Northern Iowa”, and “Wind Energy Management” for students in four-year engineering technology institutions.

Overview: Wind power generation is a clean, available, and cost effective alternative source of energy and, better yet, can be readily integrated into both existing and new power grids. While Texas has currently (as of October 2009) an installed wind power capacity of approximately 8,500 MW, Iowa has 3,040 MW followed by California, Minnesota, and Missouri in a new and sustainable competition that we have not seen in many years. The first course is an introduction level wind energy applications and it is co-taught by a number of instructors from cross disciplinary areas plus a local wind turbine manufacturing engineer. Student interest has been excellent and there is a clear need on developing an advanced level course in the next academic year. The second course is developed for technology management majors who have great interest on working on fast growing wind energy farms in nearby cities close to their home towns. Both of these courses are currently offered during fall semester and a current progress will be reported in this paper.

Major Points: Educational institutions particularly universities may play a significant role in promoting wind energy technology to the communities. The curriculum described in this paper includes;

- Challenges on transmission system infrastructure
- Wind variability factors
- Wind turbine and tower manufacturing
- Life span problems on manufacturing material
- Grid tie interconnection issues
- Needs on workforce development in all three levels - technician, engineering technologist, and engineering

Summary: Authors of both four-year institutions are currently working on establishing 2+2 transfer articulation agreements between their institutions and selected community colleges that offer two year AAS degree on wind energy or related sustainable energy programs. Attendees will understand curriculum developments, collaborations between, four-year institutions, community colleges, and industry.
An Innovative Method for Neural Network Modeling of Digital Circuits

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Need: Neural network is an upcoming field, lots of research work is being held in this field. The new software systems in this field will emulate a thinking process that bring research and development opportunity for engineering education. Parallel architecture of neural networks make it potential tool in terms of speed and VLSI implementation. Secondly, they find application in almost every field and open a new platform for students to explore and do their projects. So, there is great need to motivate student from beginning to model neural networks using simple, user friendly software. In this presentation, we will present a very simple way of designing neural network models for realization of digital circuits and its future scope of this work.

Overview: Courses in neural networks should introduce and include topics that cover newer software available in the market that can be used to model neural networks for various applications. We focus that basic of neural networks are taught then students should be motivated to design neural networks for various applications especially digital circuits.

Major Points:
- Benefits of focusing on neural network designing.
- Identification of major software available of neural network modeling.
- Neural network modeling for given digital circuit using software and later implementing them various hardware platforms like FPGAs.
- Future scope of neural modeling of digital circuits.

Summary: Attendees will be introduced to neural system software for neural network modeling of digital circuits with example to lay the basic foundation of neural network modeling. This would not only enhance research and technical skills but would also motivate students to have hand-on experience on neural network modeling without worrying much about mathematical details.
Developing a Wireless Internet Service Provider for Rural Unserved and Underserved Communities

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Need: The United States of America has experienced an explosive growth in mobile broadband wireless communications goods and services but there are many rural unserved and underserved communities that have remained isolated and do not have access to the latest communication technologies. According to the Pew Internet & American Life Project, only 38 percent of rural American households subscribe to broadband at home.

Using technological advances in 4G wireless communications such as WiMAX (Worldwide Interoperability for Microwave Access) and LTE (Long Term Evolution) a micro telco business model can be created to bring wireless broadband services to unserved and underserved communities integrating these communities into the fold of twenty first century vital communications services (business, education, entertainment).

Overview: The 2009 American Recovery and Reinvestment Act provided a total of $7.2 billion to The USDA's Rural Utilities Service (RUS) and the Commerce Department’s National Telecommunications and Information Administration (NTIA) to fund projects that will expand access to and adoption of broadband services. Of that funding, NTIA will utilize $4.7 billion for grants to deploy broadband infrastructure in unserved and underserved areas in the United States. RUS will use $2.5 billion in budget authority to support grants and loans to facilitate broadband deployment in primarily rural communities.

This is an opportunity to create a reproducible micro telco business model to provide broadband Internet access, telephony, and cable television service to rural unserved and underserved communities wirelessly using current advanced wireless technology.

Major Points:

- Need for a Wireless Internet Service Provider model for rural and underserved communities that can be easily replicated and implemented anywhere in the world.
- Use of current 4G wireless technology such as WiMAX and/or LTE
- The WISP model to be implemented will have significant positive impacts on the growth and development of businesses and educational opportunities in rural unserved and underserved American communities and possible worldwide.
- Make use of the opportunity afforded by the 2009 American Recovery and Reinvestment Act to create a business model for local micro telcos that will be sustainable and rentable.

Summary: Broadband access is rapidly transforming the way people communicate, work, learn, and play. There is a dire need to bring such technology to rural unserved and underserved communities in America and other parts of the world. There is an opportunity afforded by the 2009 USA Recovery Act to create a micro telco business model to bring these services to those communities by the use of current wireless technological advances.
Prototype PID-Based Smart Fixture

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Need: For parts with complex geometry and tight geometric tolerances, the appropriate design of the fixtures is the key to meet the quality requirements. Many of aerospace parts have very complex geometry and require very tight geometric tolerances, high surface finish, and crack-free under surface material quality. The challenge is even more significant when machining parts with thin-wall features. The operation of turning or milling the thin-wall feature is easy to fail mostly due to unsuitable clamping and supporting forces and vibrations. The current fixture design practices for those operations are still try and error which induces difficulties in quality control and increases processing cost.

Overview: This project deals with an adaptable smart fixture whose supporting features and clamping features are adjustable to accommodate different part geometries. The clamping forces and supporting forces change automatically during the machining process based on the feedback signals received from the sensors. The PID controller can be reprogrammed and used with various parts, achieving high machining quality through the adaptive control of clamps and supports which improve machining quality of thin-wall features.

Major Points:

- Review of current practices of fixture design
- Need for adjustable fixture
- Sensors and PID Control
- Analysis of experiment data

Summary: A smart fixture is developed so that supporting features and clamping features can be adjusted to accommodate parts with different geometry. Based on feedback signals received from the sensors, the clamping and supporting forces of the fixture are changed automatically during the machining process. The PID controller can be reprogrammed and used with various parts, achieving high machining quality through the adaptive control of clamps and supports.
VMware View 4: Benefits of Using Desktop Virtualization over the Traditional Independent Desktop Environment

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Need: With the increased computer presence in businesses, the difficulty of administering the desktop environments available to end-users can become unmanageable. It is challenging for IT staff to ensure that every desktop is receiving the appropriate software updates, to secure independent desktops at their physical locations, and to create new desktop environments for staff as needed. VMware View 4 is a desktop virtualization solution that addresses these issues. By implementing VMware View 4 it is possible for IT departments to easily and cost effectively manage desktop environments that are presented to end-users from a centralized location on the network instead of having to physically interact with each autonomous desktop. The release of this desktop virtualization solution deserves a more detailed look at the applicability of a system outfitted to centralize administration of client desktops over the traditional independent environment.

Overview: If it is possible to virtualize the desktop environments that are distributed to the users, administration of the desktops can become more efficient along with an increase in the level of security because the virtualized desktops are stored and administered from a secure environment that is only accessible to administrators yet easily accessible when compared to the traditional independent desktop environment. In addition, when used with thin clients instead of the classic thick client it becomes possible to reduce the amount of energy consumed by each device. A few key concerns when dealing with desktop virtualization could be: quality of the desktop environment delivered, network requirements to handle pushing out the virtualized desktops from a centralized location and start up costs.

Major Points:
- Analysis of desktop virtualization using VMware View 4
- Benefits and advantages of using desktop virtualization over independent desktops
- Breakdown of opposing desktop virtualization solutions, including Xen Desktop
- Effects desktop virtualization can have for disaster recovery, business continuity, and energy conservation.

Summary: This presentation outlines the overall experience of using VMware View 4, a desktop virtualization solution, over the tradition independent desktop environment.
Firefighting Robots for the Classroom: An Exciting Application for Your Microcontroller-Based Electronics Curricula

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Need: The study of microcontroller electronics is considered to be a staple topic of study in any electronics, control systems, mechatronics, and automation systems option in Applied Engineering and Technology. While processing speed and capability are without question critical concerns when trying to convey state-of-the-art technological skills to our students, we also need the ability to practically showcase these high-level skills in real world applications.

Overview: The presentation will focus on a new application for the microcontroller electronics classroom: Firefighting Robots. Come learn how to excite, challenge and push students’ applied engineering skills to the limit within the scope of a senior level capstone course in microcontroller electronics.

Major Points:
- Introduction to the Trinity College Home Fire Fighting Robot Contest
- Technology (Components) and Background (Education) Required
- Formal and Informal Methods of Instruction (teaching dynamics)
- Integration strategies for the Classroom
- Demonstration of a Firefighting Robot build by students in 10 weeks

Summary: The study of microcontroller electronics is a common topic of study in any electronics, control systems, mechatronics, and automation systems option in Applied Engineering and Technology. While processing speed, programming ease, and capability are without question critical concerns when trying to convey state-of-the-art technological skills to our students, we also need the ability to practically showcase these high-level skills in real world applications. The presentation will focus on a new application for the microcontroller electronics classroom: Firefighting Robots. Come learn how to excite, challenge and push students’ applied engineering skills to the limit within the scope of a senior-level capstone course in microcontroller electronics.
Assessing Knowledge of Electronics Students via the Incorporation of Manipulative and Design Methods of Examination

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Need: Electronics courses are frequently taken by many applied engineering and technology students in their respective degree programs. It is common for instructors to institute lab activities and theory examinations in combination for traditional assessment. But how do we assess proficiency in design and hands-on (individual) capability? These two areas must also be examined if we are truly interested in assessing the modern applied engineer or technologist.

Overview: The presentation will focus on manipulative and design examination methods used to increase the accuracy of the assessment process on electronics-based courses. Through the use of these additional methods, student performance/capability has also improved in design and hands-on elements that are critical to producing world class applied engineers and technologists.

Major Points:
- Introduction to Traditional Assessment Exams
- Knowledge base for Applied Engineers and Technologists
- Manipulative Examinations (how to design, administer, and evaluate)
- Design Examinations (how to design, administer, and evaluate)
- Qualitative Discussion of Gains

Summary: Electronics courses are frequently taken by many applied engineering and technology students in their respective degree programs. It is common for instructors to institute lab activities and theory examinations in combination for traditional assessment. But how do we assess proficiency in design and hands-on (individual) capability? These two areas must also be examined if we are truly interested in assessing the modern applied engineer or technologist. The presentation will focus on manipulative and design examination methods used to increase the accuracy of the assessment process on electronics-based courses. Through the use of these additional methods, student performance/capability has also improved in design and hands-on elements that are critical to producing world class applied engineers and technologists.
Study of a Wireless Local Area Network (WLANs) Infrastructure Using Indoor Path Loss Model

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Need: Wireless Local Area Network (WLAN) has become popular in the home, office and public business. Wireless Internet access is an undergoing project in many large cities. The coverage of WLAN in the Polytechnic building at Southeast Missouri State University was not adequate, and students and faculty were having problems on Internet access. This research work will focus on the current problems and apply an indoor propagation model to analyze the signal strength and coverage status inside the polytechnic building.

Overview: Indoor pico-cell model is commonly used to study wireless signal propagation inside a building. This research work will focus on the current problems and apply an indoor propagation model to study the current implementation. Signal strength and coverage status will be investigated through both analysis and measurements, and adjustments will be made to the model to guide the future WLAN design and development.

Key Points:
- Introduction to the WLAN implementation at School of Polytechnic Studies.
- Site survey of the WLAN.
- Analysis of the WLAN using the indoor propagation model.
- Result analysis and recommendations.

Summary: This presentation will study and discuss the WLAN implementation in a college building. Site survey and analytical model will be applied to identify design problems and a new solution will be proposed.
How Realistic - Appearance and Operational - Should Electronic Simulation Software Be in Order to Provide the Desired Training Effect?

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Need: Virtual environments, via simulation software, offer a safer and unique way of providing instruction to 21st century students about fundamental concepts in electronic/electromechanical systems. However, while the creative use of specialized software and computerized units offer the possibility of mimicking real-life systems, some questions remain about the efficacy or the ability of virtual programs to provide training that is comparable to using or operating traditional industrial based systems. Some of the reasons that faculty select simulation software might be related to convenience, cost issues—simulation programs do not fail or break, result in damage or require expensive repair actions—and supervision once electronic concepts are introduced. The presenter will share information from a pilot study about the use of electronic/electromechanical simulation software: Multisim, Automation Studio, and LogicPro simulator to teach fundamental electronic concepts, promote skill development, and troubleshooting competencies.

Overview: Technology programs which have electronics, manufacturing, graphic design, engineering or applied engineering content areas often require equipment that is not only costly to obtain but also to maintain. Thus, faculty in these programs increasingly find themselves at a cross road about how to provide students with the necessary hands-on training given the financial constraints under which they are forced to operate. Some have argued that simulation environments provide an alternative avenue for students to obtain experiences that are similar to real-life systems. However, others suggest that some of the available simulation software may not be as intuitive or easily mastered by students, provides little by way of increased benefits, and that the cost associated with obtaining simulation programs including licenses agreement may be just as expensive as setting up a laboratory with real equipment. A pilot study recently conducted of three electronic/electromechanical courses provided mixed results with regard to student preference, the ability of selected software to teach fundamental concepts associated with design and troubleshooting, including student overall achievement scores on an assigned project.

Major Points:

- Emphasize the importance of giving careful consideration to the selection of electronic simulation software for use in courses.
- Identify situations where simulation software is likely to have the most impact on student understanding of fundamental electronic concepts.
- Highlight the importance of applying best practices and how this may have a direct bearing on student enthusiasm and comfort level with simulation software
- Stress the need for faculty to provide adequate time for student training on simulation software if proficiency is to be achieved.
- Explain why the element of realism experienced by students may directly impact the transferability of skills to real-world systems.

Summary: Simulation programs used in electronic/electromechanical courses should provide an element of realism in student work, help students achieve the desired training effect where skills and competencies learned are transferable, and promote a greater understanding about electronic fundamentals. Attendees will understand how the application of best practices, coupled with simulation suitable to the tasks at hand, are essential for success in virtual environments.
The Development and Implementation of Solar, Wind, and Human Power Mini-lab as a Training Unit

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Need: The majority of renewable energy educational training units are built and sold by companies that offer custom-made systems according to the customers' needs, which increase the cost of the training units. Renewable energy teaching tools help students to fully comprehend complex concepts with interactive educational training equipment, and are very important for the hands-on laboratory sections of energy education. Due to the high costs of educational training units, it becomes a budget concern when purchasing training equipment for the laboratory sections of the courses. The costs of such equipment range from ten thousand to fifty thousand dollars per unit. If there is a budget concern for a department, the only option to the instructor is to teach only the associated theory of the course. Taking these issues into consideration, building an energy training unit becomes a smart idea for exposing students to alternative energy field. The training units need to be designed for use in hands-on activities, which provide students opportunities to engage in experiments that will reinforce the material covered. In this project, the outcomes enable the participant to understand and work with the developed systems. The aim is to design and implement interactive educational training units that include solar and wind technologies, human power, and passive solar air/water heating harvesting systems for any level of Renewable Energy Systems courses. This alternative energy educational training unit operates as a portable mini-lab. Students in Industrial Technology program have designed, built, and tested a multi-purpose renewable energy training unit for the alternative energy related classes. This prototype trainer is designed to be used for hands-on activities, which provide opportunities for students to engage in experiments that will reinforce the material covered. The safety of the unit was confirmed after several tests in different conditions on campus.

Overview: Based on current data on global warming, as well as the current U.S. dependence on overseas oil, there is an interest and urgency in utilizing renewable energy sources. In order to prepare students for their future careers, real-world training is imperative for their education. University campuses in the United States have been taking important steps to establish alternative energy research and education. For example, undergraduate engineering and engineering technology programs are now including laboratory-based curriculum in alternative energy. Hands-on laboratory experiments using educational training units provide for enhanced learning experiences. These units provide real time display of key system properties as well as surrounding conditions through a data acquisition system.

Major Points:
- Provide undergraduate students a hands-on research opportunity
- Demonstrate a low-cost mini-lab to academia
- Increase scholarly productivity of faculty
- Provide new opportunities for undergraduate/graduate research projects
- Offer educational workshops to especially High School students/teachers
- Provide enhanced teaching laboratory experiences for renewable energy classes

Summary: The way students became involved in this project began in the Fall’09 semester when several senior students asked the electronics instructor if they could take an independent study (directed study) course with the instructor in the summer and Fall 2009 that would be challenging and relevant to alternative energy technologies. Four students decided to design and build the training units and enrolled in directed study courses in both summer and Fall ’09 semesters. The very important outcomes of this will be shared with academia and industry.
Establishing a Renewable Energy Laboratory and its Data Acquisitions System

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Need: Renewable energy teaching systems can help students to more completely comprehend complex concepts by involving a renewable energy project or series of laboratory experiments. Students in an Industrial Technology program have designed and constructed a small storage shed implementing a passive solar water heating system, a passive solar air heating system, a skylight, photovoltaic modules, wind turbines, human powered bike power generation system, hydrogen fuel cell system as a backup, energy friendly AC/DC lighting, and an energy consumption/generation data acquisition system. Salvaged outdoor lighting towers were converted to support wind turbines and solar modules to serve lab sections of the renewable energy course. The system was designed to offer hands-on activities that provide opportunities for students to engage in experiments that will reinforce the material covered. The complete system serves to cover lab sections of the alternative energy related classes, projects at campus and workshops for high school science teachers and students.

Overview: Energy is one of the major building blocks of modern society and is a fundamental concept in all science and engineering disciplines. Understanding energy leads to an understanding of energy resources and their limitations, as well as the environmental consequences of their use. We live in an age of environmental awareness and alternative energy education fills most of our daily conversations in engineering and science education. In preparing students for their future career, real-world training is an advantage during their education. Research facilities and laboratories are important teaching aids for providing students opportunities to practice theory they learn in class.

Major Points:
- Identify appropriate storage (battery, supercapacitor) technologies
- Learn installing photovoltaic and solar passive air/water heating systems
- Learn to harvest energy from wind power and installation standards
- Learn the applications of hydrogen fuel cells as a backup system
- Generate energy from active/passive human power
- Learn energy efficiency by installation skylight to absorb light into a building

Summary: Attendees will understand building a renewable energy laboratory with limited resources to use in a general alternative energy class developed for technology program students. A detailed demonstration of a laboratory and developed class will be shared with academia.
A Study on the Application of Wireless Sensors in Structure Monitoring

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Need: There has been a growing interest to deploy sensors for monitoring the conditions of infrastructure systems such as buildings, bridges, and highways. Traditionally infrastructure inspection is performed via infrequent periodical visual inspection in the field. Wireless and sensor technology provide an alternative cost-effective approach for real-time monitoring of infrastructures. The collected real-time data can be used for the analysis of the infrastructure life expectancy and safety index, and therefore for the improvement of maintenance efficiency and the prevention of large accidents.

Overview: According to the data from Federal Highway Administration, there are over 25% of all bridges are deficient nationally in 2007. Improved inspection and monitoring method thus are critical to prevent the loss of human lives due to large accidents. Using advanced wireless and sensor technologies to provide continuously monitoring of bridges and other infrastructures is an innovative solution to this challenge. This research evaluates the feasibility and effectiveness of wireless and sensor technology for structure monitoring. The research project has established a basic test bed prototype in the laboratory and gathered structure condition monitoring data. The evaluation of these technologies will be based on the collected data and cost efficiency analysis.

Major Points:
- Need and trends of applying wireless sensor technologies to structure monitoring
- Review of structure health monitoring systems and related wireless sensor technologies
- Introduction to the prototype and platform of a wireless sensor monitoring system
- Performance analysis of the system based on test results and monitoring data
- Investigation on cost efficiency and power efficiency of the battery-power wireless sensor system

Summary: A research project that studies the application of wireless sensors in structure monitoring will be presented. A prototype is implemented and tested to investigation on the feasibility and effectiveness of applying a wireless sensor system to structure monitoring.
Power Efficiency and Lifetime Estimation of a Green Wireless Sensor System

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Need: Recently, the concept “green” has been widely used in solutions used to address problems of global energy shortage and environmental degradation issues. Wireless sensor networks have been considered as one of the feasible and favorable solutions to monitor our physical environment to help to solve these problems. One of the prerequisites for this purpose is that the monitoring system itself has to be green that is the sensor system should be with high power-efficiency. The energy scavenge capability from the ambient environment is also highly preferred. The power-efficiency study and lifetime estimation of a wireless sensor system is then a challenge issue worth further investigation.

Overview: A low power wireless sensor system with strain gages is implemented and its energy consumption rate will be tested under different scenarios. A signal conditional circuit is used to convert the strain gage resistance change to a voltage signal and the output signal will be acquired embedded end sensor nodes. The end nodes convert, process and transmit the signal remotely to the wireless collector node. The remote sensor nodes are battery powered and it is desired to extend their lifetime as long as possible. Therefore we need to implement efficient energy management at the end nodes and investigate the power consumption of the system. The lifetime estimation of such system also needs to consider the patterns on the battery discharge time and the non-ideal battery properties.

Major Points:
- Implementation of a green low power wireless sensor system
- Review on the battery capacity of different types and the non-ideal battery properties
- Investigate on the effect of different factors on the end sensor node power consumption
- Design of experiments was used to determine the contribution of different factors and the critical factor(s) to extend the lifetime

Summary: A study on the power consumption and energy efficiency of a low power wireless sensor system will be presented. Experimental results of power consumption on the implemented system are analyzed to determine the contribution of different factors and used to estimate the lifetime of the battery-power wireless sensor nodes.
Graphics
The Importance of Data Visualization Concepts and Instruction in Industrial Technology and Engineering Technology Programs at the University Level

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Need:  In the past decade, in graphic communication, it has become increasingly important that support personnel be versed in techniques of data visualization in addition to being well trained in the details of technical accuracy in engineering drawing. Due to the amount of training already required to develop the critical accuracy and communication detail needed by designers and draftsmen, the area of data visualization and the concepts of this field have been less emphasized or ignored entirely by many university technology departments. Collaborative research among drafting design students and some faculty indicates that job opportunities for technology department graduates and benefits to employers is being increasingly recognized in industry.

Overview:  This paper will first present a broad definition of this field of graphics and its possible impact for companies in the 21st century industrial market. From this definition the paper will statistically show the current availability of training in visualization techniques and will suggest the need to increase offerings in such training. Possibilities of including more data visualization at the undergraduate level will be suggested. As the importance and quantity of data available to industry today through electronic storage increases daily, effective presentation of this data for the administration of companies and for the promotion of products is proportionately increasing. Attention to methods for effectively communicating data must be given in the graphic training of our technologists.

Major Points:
- Current offerings of most major universities in engineering graphics
- Technical graphic courses involving ANSI standards, orthographic projection, axonometric and perspective drawings remain critical
- Courses in data visualization should include the psychology of graphic presentation, design principles, and software training in the development of presentations.
- Adjustments in curriculum may be necessary for the inclusion of new courses in data visualization.
- Training at the undergraduate level gives graphics technology majors one more very important skill to utilize for their employers and industry benefit when entering the job market.

Summary:  Attendees will be challenged to consider developing courses in data visualization. Industry will be encouraged to support such courses and will subsequently offer their input as to specific needs and opportunities for graduates.
Could You Spare Some Change? Developing Cost Effective Integrative Learning for Digital and Print Media Courses in Financially Constricted Times

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Need: The majority of educators in digital and print recognize that for students to grasp concepts and material relayed in coursework, it is necessary that the students produce finished products for real-life customers. In times where operating budgets become constrained, necessary supplies, equipment, and other materials are reduced to a point where it becomes difficult to allow students to produce projects so the entire process can be grasped. In this presentation, we will describe the financial situations encountered by state universities, evaluation of materials for projects, and development of projects.

Overview: Many careers in digital and print media fields require potential employees to make connections across a variety of different fields of study. In addition to these connections, it is necessary that curricula provide for learning and engagement that allows students work collectively and produce materials that satisfy demands for real customers. The challenge for print and digital media graphics in financially constricted situations is to use available resources to still be able to provide these real products. This presentation will focus on evaluation of the current economic climate faced in universities, integrative learning structure, and methods to implement cost effective solutions to provide for integrative learning.

Major Points:
- Description of the financial situation faced by for digital and print media departments
- Description of Integrative Learning
- Evaluation of institution equipment and materials for projects
- Development of projects and experiences for cost effective integrative learning

Summary: Attendees will understand the economic climate for higher education, concepts of integrative learning, and cost effective means of implementing projects. The methodologies will focus on real world problems and solutions to enhance student learning.
Factor Affecting Electrical Conductivity of Blood Glucose Test Strips

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Need: As the global diabetic population expands, the need for diabetic blood monitoring equipment is naturally growing rapidly. Given the natural market demand growth and public policy support of governments, biomedical industry research and development and progress have become a central focus of national development efforts. The most frequently replaced part of blood glucose monitoring equipment is the blood glucose monitoring strips. These test strips are produced using screen printing. But currently in Taiwan there is no uniform standard for the screen printing manufacturing process. Most of the academic literature in the blood glucose test strip field focuses on aspects of the biochemical reactions involved, but little study has been conducted on the screen printing processes.

Overview: In this study, 23 factorial experiment was conducted (a total of three factors, each factor was set to two factorial levels) to explore the major factors which impact resistance in blood glucose test strips. Three possible key factors which impact the resistance value of the test-strips proposed by the medical industry are: the conductive silver (Ag) ink film thickness (two levels settings at 8μm, 12μm), conductive carbon (Carbon) ink film thickness (two levels settings at 12μm, 14μm) and the mesh count number for the silver ink screen mesh (two levels settings at 250 mesh, 300 mesh). The main purposes of this study include: 1). Investigate the significant factors which affect resistance in the blood glucose test strips the relative effect thereof and how the impacts are imparted; 2). Determine the most optimum factorial combination to achieve maximal reduction in the resistance of the blood glucose test strips; 3). Establish a comprehensive set of factorial combination model to predict the resistance of blood glucose test strips. This 23 factorial experiment yielded 8 different printing combinations, with each combination undergoing 150 prints, numbered consecutively from 1 through 150, then applying systematically random sampling to select 50 samples from the prints.

Major Points:

• The mesh count number for the Conductive Ink Silver (Ag) screen mesh is the most influential factor exercising a positive influence on blood glucose test strip resistivity.
• The smallest resistance appears achievable using the mesh count number with the 250 mesh screen mesh. The next most prominent influence was from the conductive silver ink film thickness, and film the thickness of conductive carbon ink.
• There appears to be a significant interaction effect on resistance from the Conductive Ink Silver (Ag) thickness, conductive carbon ink (Carbon) thickness and mesh number of the silver ink screen mesh, with the most significant influence on blood glucose strip resistivity coming particularly from the interaction between conductive silver ink film thickness and the film thickness of conductive carbon interaction.
• The study results found that when using the silver ink screen with a mesh count of 250, conductive ink silver (Ag) thickness of 14μm, and conductive ink carbon (Carbon) thickness of 12μm, one obtains the most optimum combination for achieving the minimum resistance value for the test strips.

Summary: This study aimed to fill the gap by studying conductivity of screen printed blood glucose test strips to explore and develop a resistance model for predicting electrical conductivity. It is anticipated that the results of this research project can be utilized as an optimum operation model for the screen printing industry to print more reliable and efficient blood glucose test strips.
A Methodology for Developing Wind Turbine Blade Parametric Models

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Need: Parametric modeling using solid model software has become the norm in the design of most mechanical systems, and in the emerging area of wind power the ability to have a model controlled by design parameters is a certain advantage. Formulas based on the amount of available wind in an area can drive the amount of effective surface area of a lift type blade design, and therefore drive the shape and size of the system. Graphics software tools in most common CAD modeling packages allow the user to insert expressions into the model to resize the shape of the model based on these formulas. Graphics students who are aware of this methodology can optimize their usability of a CAD model to be more than a tool for just design documentation.

Overview: Two common residential wind turbine blade designs are manufactured for either a vertical axis or horizontal axis wind turbine. Some vertical axis wind turbines use Darrieus models, which use an airfoil wing design, where the shape and size of the “wing” determine the amount of lift. The same is true when designing a blade for the more traditional airplane propeller type horizontal axis blades. To produce more power in a system it is common to increase the size of the blade diameter, but the parameters of the blades do not necessarily scale uniformly. The method described uses expressions in the model features to parametrically edit the size and shape depending on the overall diameter of blade design.

Major Points:
- Parametric solid modeling techniques using geometric & dimensional constraints
- User named expressions used to drive dimensional constraints
- Formula driven expressions to determine feature size and shape in a solid model
- Darrieus style blade design for vertical and horizontal wind turbines designed in parametric modeling software

Summary: Attendees will understand the methodology involved in creating a formula driven solid model. These graphics techniques are illustrated using the example of designing Darrieus style blades for vertical and horizontal wind turbine designed in parametric modeling software. This methodology can be used to create any mechanical system that may need modifications depending on user needs, which in this case is the amount of power output in certain wind conditions.
Flow Length Measurement of Injection Molded Spirals Using a Flatbed Scanner

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Need: On a volumetric basis, the production of polymers exceeds that of all metals combined. Thermoplastics comprise more than 70% of the polymer tonnage produced annually. Injection molding is the most widely used molding process for thermoplastics. Optimization of the mold injection process can result in significant cost-savings. Many researchers use a spiral mold as a benchmark to assess the flow optimization of thermoplastics. The lengths of these test spirals are critical and sensitive inputs to optimization algorithms which involve variations on temperature, pressure, and speed of injection. However, the accuracy and precision of the published flow length measurement techniques have not been adequately addressed in publications. Furthermore, the published techniques ignore the shape of the spirals’ freeze front that can influence the flow length. A new measurement technique is needed to provide more accurate, precise, and relevant data to guide the modeling and optimization of thermoplastic mold injection.

Overview: A common flatbed scanner is used to image thermoplastic spirals produced to verify the optimization of injection molded parts. Both the length and the shape of the spirals’ freeze front are obtained after the images are imported into AutoCAD. Gage capability tests of this measurement technique are conducted and compared with the measurement capability of other techniques. Other applications are discussed where this technique could be used.

Major Points:
- Optimization of thermoplastic mold injection can result in significant cost-savings.
- Technique provides accurate, precise, and relevant data for thermoplastic modeling.
- Common flatbed scanner and AutoCAD software make the measurement accessible.
- Technique can be applied to a wide variety of part geometries.

Summary: Attendees will understand the potential of using flatbed scanners for a wide variety of dimensional measurements critical in the manufacturing of parts. A detailed example is presented on the measurement of thermoplastic spiral parts.
Bridging the Gulf between Digital Photos and High Dynamic Range Images

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Need: Digital cameras capture a very limited range of tones ranging from the highlights to the shadows. Using High Dynamic Range (HDR) techniques, multiple images can be combined to expand the tones and detail of a photographic image. This presentation will teach how to use HDR to greatly increase the tonal range, resolution and quality of digital photographs.

Overview: The difference between the brightest and darkest areas of a photograph is called dynamic range. Digital photos have a low dynamic range because they can only capture a limited range of tones. The process of HDR is to take multiple exposures of the same scene, each with a different exposure, and combining them together.

Major Points:

• Understanding dynamic range and how HDR can provide very high quality images.
• How to setup a digital camera to take multiple exposures of a scene and the problems this creates.
• Adobe Photoshop does not do HDR well, but there are other application programs that can be used with Photoshop to obtain HDR images.

Summary: HDR techniques provide for very high quality images. This presentation will demonstrate how to use a digital camera to capture images for HDR and then how to use a computer to combine the images together to achieve an image with high dynamic range.
The Correlation between the Performance of Commercial Printing Companies and Conducting B2C Operations on the Web

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Need:  The Web is one of the versatile technologies. Companies can use the Web technology as a business tool for various purposes, such as, to publish the information about their products and services, to market and sell their products and services, to communicate with their customers and vendors, to offer technical support, to do market research, and to receive payment. An empirical research study was conducted to investigate the correlation between the performance of commercial printing companies and conducting business-to-customer (B2C) operations on the Web.

Overview:  A questionnaire survey was conducted to determine the correlation between the performance of commercial printing companies and conducting B2C operations on the Web. The commercial printing companies were asked to select various B2C operations. The performance was broken down into three categories, financial, non-financial, and overall. The financial performance was measured using four financial indicators: sales, profits, costs, and return-on-investment (ROI). The indicators used for measuring the non-financial performance were number of customers, merchandise return rate, and sales and marketing productivity. The overall performance was measured by combining both financial and non-financial indicators. The Spearman correlation and ANOVA statistical analysis methods were used to analyze the collected data.

Major Points:
- Introduction
- Review of Literature
- Research Methodology
- Data Analysis and Findings
- Summary, Conclusions, and Recommendations

Summary:  This paper is based on Auger’s research. Auger found that there was a positive association between multi-objective Web sites and performance of the companies. A survey was conducted to investigate the correlation between the performance of commercial printing companies and conducting B2C operations on the Web. Findings of this empirical research will be presented.
Plot Scale Factor Models for ISO-Detail Drawings

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Need: Engineering design graphics are the principal instruments for documenting design projects. One important task in the documentation process is the selection of a scale factor. In fact, it is required that engineering drawings bear an appropriate scale factor in drafting practice. Scaling skill tends to be acquired on the job as scaling models are hardly available in public literature. Though the availability of CAD software has made the selection process easier and faster, the non-availability of mathematical models for plot scale factors seems to suggest a gap between practice and theory in drafting practice. In this presentation, mathematical models are presented for selecting scale factors for ISO-detail drawings.

Overview: This paper presents mathematical models of the plot scale factor for ISO-detail drawings. An ISO-detail drawing is a single isometric view drawing of a component with proper annotations. The plot scale factor models are based on the dimensions of standard drawing sheets and the principal dimensions of the design graphic model. The application of the models is demonstrated by illustrative examples for cases of reduction scaling and enlargement scaling. The selected scale factors based on estimates from the mathematical models were used to prepare ISO-detail drawings for the examples. In each case, the scale factor selected appeared to be suitable, indicating that the mathematic models are realistic.

Main Points
- Understand ISO-detail drawings.
- Understand scaling in engineering design documentation.
- Transform scaling process from trial-and-error technique to a scientific one.
- Demonstrate scientific model application with examples.

Summary: Mathematical models for plot scale factor transform scaling from a trial-and-error process to a more scientific exercise. The models bring some order and understanding into the selection process. They also, provide tools for training designers, drafters, architects, and engineers as well as help in planning design documentations. Attendee will understand the use of scientific models in scaling engineering design graphics where ISO-detail drawings are needed.
Using Scratch for Improving Problem Solving and Design Strategies Among Students

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Need: It has been widely accepted to refer to Millennial generation as “digital natives” due to their evident fluency with digital technologies. Undeniably, many young people are very comfortable sending text messages, playing online games, and browsing the Web. But does that really make them experienced among new technologies? Can they create their own games, animations, or interactive projects? Can they create and not only consume? Today’s technology creates lavish pool of “download-right-click-template” options. If stripped of that security blanket, students cannot foresee, arrange or prepare necessary steps in problem solving and design strategies. Bypassing the process of problem solving and not finding an intellectual pleasure or stimulants in it creates short-term satisfaction with the final result. Consequently students are less captivated with the learning, and do not create life-long relation with it.

Overview: Scratch is a new programming language, available free of charge, designed for young people (ages 8 and up) that develops 21st century learning skills. As they create and share Scratch projects, young people learn important mathematical and computational ideas, while also learning to think creatively, reason systematically, and work collaboratively. I will present my experience of teaching the Scratch as a part of the freshman course, Multimedia Foundations. In this course I will use Scratch to develop and improve creative and problem-solving skills among students.

Major Points:
- Millennial generation as “digital natives”
- Create - not only consume or Process vs. Final product
- Overview of Scratch
- Common problems among students when using Scratch
- Applicability of Scratch as a problem solving and creative tool

Summary: Attendees will understand basic steps in using Scratch, and its applicability to create projects that will generate and nourish creative and problem-solving skills among students.
Computer-Integrated Design Concentration: Implementing a Product Design and Development Course in the Industrial Technology Curriculum

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Need: Graduates of Industrial Technology programs should have some common understanding of the processes used in designing products for manufacture. This presentation will provide an example of how to address the application of the methods, models organizations, standards and practices used in industry related to product design and development.

Overview: Courses in the computer-integrated design concentration at our university address product design and development, project design and document control, digital manufacturing and tool design. The product design and development course builds upon what is covered in a core class called the design process (the engineering design process). The primary challenge of the product design and development course involves guiding collaborative student product design teams to understand and apply concepts such as product planning, identifying customer needs, developing product specification etc. while developing their products. This is a lecture lab course offered on a quarter system campus.

Major Points:
• Industrial Technology program modification
• Computer-Integrated Design Concentration
• Product Design and Development course structure
• Use of case studies
• Collaborative team-based learning
• Textbook and related educational materials
• CAD systems used
• Course delivery issues related to the quarter system
• Sample student products
• Engineering Senior Design

Summary: Attendees will understand the curriculum development model used at our university to deliver a Product Design and Development course as part of a concentration in Computer-Integrated Design.
Collaborative Teaching Effectively Addresses the Strengths and Challenges of a Graphic Communications Curriculum

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Need: The graphic communications field has been changing at a rapid pace, with the shift from analog to digital processes being one of the main influencing factors. In addition, organizations are being expected to provide a much wider range of products and services than in the past. Therefore, our graduates will need a wide range of both technical expertise and management abilities, knowing everything from color management to production workflow. Likewise, instructors in graphic communications programs need to know and be able to teach a wide range of skills and concepts. They need to be proficient in a variety of technologies and concepts. A viable solution is to practice collaborative teaching methods. This leverages the unique experience and knowledge that each instructor possesses with the project-based nature of the discipline.

Overview: The field of graphic communications offers unique opportunities for collaborative teaching methods. The project-based learning nature of the discipline requires planning and cooperation between students. In addition, instructors often have strengths and areas of expertise which complement each other. For those reasons, activities can be planned and executed to span multiple courses, and instructors can assist and co-teach in multiple courses. This presentation will focus on innovative methods for using collaborative teaching and learning experiences to best serve students. The benefits, issues, and suggestions for implementation will be presented based on the experience of using these techniques at the University of Northern Iowa.

Major Points:
• The graphic communications industry presents an increasingly expansive set of learning outcomes to be mastered
• Instructors each contribute a unique blend of knowledge and abilities based on their experience
• Collaborative teaching methods enhance the strengths while minimizing the issues inherent in teaching graphic communications

Summary: Participants in this presentation will be shown the trials and tribulations of planning and implementing collaborative teaching and learning strategies in a graphic communications program. The curriculum strategies presented can be implemented in any industrial technology program, either on a small scale or as an overall change.
The Evolution of Skills Needed By the Printing Industry. Where Have We Been, Where Are We Going And How To Keep Up?

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Need: The required skills of the workforce in the printing industry have evolved in expected and unexpected ways over the last two decades. How do we, as educators, anticipate curriculum and equipment needs based on the evolution and revolutions associated with technological changes in the print industry?

Overview: Based on the results of dissertation research, this session will address the similarities and differences in the preparation and expectations of workers in the printing industry. In addition to a time-line describing skills and competencies, technological and global influences that have manifested change will be discussed. Session will offer suggestions as to how we, as educators can anticipate the changes to come in order to facilitate curriculum change and equipment needs.

Major Points:
- Overview of presentation
- Description of skills needed in the past, present and future
- Identification and description of trends and changes that can assist in anticipating curriculum and equipment needs.
- Implications for educators with regard to curriculum planning, student competencies and equipment.

Summary: Attendees will outline the skills needed by past, present and future employees in the print industry and how, as educators, we can plan for and integrate this knowledge into our curriculum.
Green Design: Using Solid Modeling Strategies and Analyses to Focus on Green Design

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Need: Product design is going green and there is a need for industrial and engineering technology students to enter their careers prepared to design products that can be recycled, have little environmental impact, and use small amounts of energy and materials as they are produced and used. Current solid modeling packages with their imbedded analysis functions are an ideal place to start the study of green design.

Overview: Solid modeling and imbedded Finite Element Analysis (FEA) are particularly suited to develop green design strategies. The FEA can help make parts and assemblies stronger and reduce material usage at the design initiation.

Major Points:
• Employing contemporary design strategies to create environmentally friendly designs.
• Eliminating material use in the design process by employing FEA analyses to components and assemblies.
• Using part-in-part modeling to reduce rapid prototyping time and material waste.
• The application FEA strategies to reduce and eliminate destructive testing in the design process will be a topic for presentation. A discussion with the audience regarding the academic question, “Can we completely eliminate destructive testing?” will be a part of this presentation.
• The use of traditional bottom up assembly modeling and the more contemporary top down assembly modeling practice will be reviewed, along with part development as they efficient manufacture from the initiation of the design.
• FEA will be used to search for energy saving in designs of products and assemblies as they are used.

Summary: It will be interesting to conduct the debate about the possibility of eliminating destructive testing as it creates a lively intellectual debate and end ups with the group peering and questioning what the future will bring. Attendees will develop an understanding of the integration of green design strategies into the industrial design process. The power of the solid modeling software as it relates to green design strategies will be showcased and there will be a discussion on how we further integrate green design into CAD, Solid Modeling, and FEA-based courses.
Bridging the Gap between Digital and Film Photography: How to Take Better Digital Pictures

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Need: Over the past decade there has been a substantial increase in the number of digital photography courses being offered at both the secondary and post-secondary levels. Unfortunately, many of these courses have become a review of digital image manipulation and do not focus on the ways and means to take better digital photographs using the camera itself. There is a clear need to further educate students in the process of using the abilities of a digital camera to take a better image.

Overview: This presentation will examine the importance of covering traditional photographic techniques such as exposure, aperture, shutter speed, zone systems, and lighting in regards to digital photography. This presentation will also stress the importance of taking a good picture to start with, and how the majority of digital cameras allow users to manipulate everything from shutter speed to aperture.

Major Points:
• Importance of taking better digital photographs
• Basic photographic principles for digital photography
• Basic lighting techniques for digital photography
• Current camera technology

Summary: Attendees will better understand the importance of including traditional photographic techniques as part of any digital photography course. Digital photography should not just be about using a cool filter, or creating a composite digital image, it should also focus on taking high quality images with a camera.
Management
Six Sigma Applications for Quality and Technology Assessment and Management

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Need: The concept of Six Sigma has become an essential analytical and problem-solving tool to understand the fundamentals of statistical applications towards “data-base management” for organizational efficiency, effectiveness and productivity. This course takes a “project management” approach. Six Sigma presentation/paper is designed to assist in the area of analytical, creative and inventive managerial approach for planning, problem solving and decision making ... particularly in a Technological and/or Industrial environment.

Overview: This paper/ conference presentation is designed for Industrial and/or Technology Management professionals to effectively apply the principles and concepts of Six Sigma to improve organizational efficiency, effectiveness, and, productivity by reducing waste, defects and/or failures ... while, improving product quality, reliability and overall performance towards economic sustenance and consumer assurance, profitability and viability.

Major Points:

- Review basic “statistical tools (SPC) and techniques”, and understand the rationale for Six (6σ) Sigma for 21st Century Technology/ Industrial Management.
- Implement the overall SPC/ problem-solving framework for successful initiative for consumer assurance, Quality, Reliability and Productivity.
- Develop skills and understanding of “DMAIC” (i.e: Define, Measure, Analyze, Improve and Control), towards implementing the Six Sigma concepts.
- Learn how to pass Six Sigma “Certification Examination” for Yellow/ Green /Black Belts, and, Master/ Champion for a Six Sigma Manager.

Summary: Six Sigma has become an essential course in the baccalaureate degree, and, at the master’s degree curriculum in Industrial and Applied Engineering-Technology/ Management discipline.
Green Management: How Nature’s Swarming Inspires Optimized Managements

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Need: The ever-growing concern about green industry has several perspectives. One aspect is to not waste the resources and adopt them as needed for the benefit of the specific goals of industry. In that regard, implementing the best and optimized policy plays an important role in the industrial management. However in the management systems which involve human agents, there is not a known deterministic behavior. Therefore classical methods for management will not approach to the best-ever solution. This paper presents a novel alternative idea for the optimized management.

Overview: The swarming behavior of the nature such as flocking birds, schooling fish, swarming wasps have inspired engineers to inspire their behavior to implement computer algorithms which mimics their behavior. Some of these algorithms are Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Cultural Algorithm (CA), and so forth. PSO is a novel algorithm developed recently which is based upon the flying birds’ behavior. Birds will follow their leader in a way that they can reach to their goals in the fastest way. PSO is shown its ability on solving many engineering problems. In this paper, PSO is used to implement an optimized management.

Major Points:
- Inspired by the nature.
- Swarming behavior in birds
- Simple particle swarm optimization algorithm
- Successful optimization
- Management system and similarity to adopt PSO
- PSO-based management

Summary: The idea proposed in this presentation demonstrates a novel algorithm in management which encompasses the swarming behavior of nature. The novel idea presented here shows its ability to an optimized management system to reach the goals in an optimized manner as the fastest way possible.
Lean Accounting: A Critical Component of Economic Recovery

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Need: Traditional financial accounting distorts costs, overemphasizes transaction precision, and encourages financial manipulation over operational effectiveness. Traditional P&L statements do not support managers seeking lean transformation and often show short-term reduced profits. Current financial systems reward overproduction, inventory accumulation, and allocation cost structures. Recent events have shown that financial reporting places too much emphasis on accounting control and not enough emphasis on operational productivity. The accounting systems used by the majority of U.S. managers must change to produce long-term economic benefit.

Overview: Companies are exploring the use of lean accounting as a financial method for improved operations management. A small, but significant, number of companies are using lean accounting to assess overhead allocations, categorize costs by value streams, and measure inventory turns. Using lean methods, companies can increase cash flow through the reduction of excess inventory. Increased cash is useful for future business acquisition and the development of new product lines. Lean accounting has significant potential for accurately reporting the productivity gains from lean while stimulating economic development. Conversely, there are many cultural barriers and business assumptions that make this transition difficult as traditional accounting practices are deeply embedded in corporate practice.

Major Points:
- Current perceptions and distortions related to traditional accounting
- From standard costing to actual costing and plain English financial statements
- Using lean accounting as an active part of lean transformation
- Cultural and systemic barriers: Lean accounting can pave the way to economic recovery

Summary: Attendees will gain knowledge of lean accounting systems. Educators, operations managers, and financial managers will learn about new strategies for accounting practices that can drive lean implementation and better report lean benefits.
Behavior Engineering Model: A Holistic Method to Improving Workplace Performance

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Need: In today’s global marketplace, many organizations are struggling to stay in existence during these troubled economic times. Organizations are searching for ways to become more competitive and profitable. As a result, organizations are using the Behavioral Engineering Model (BEM) to systematically identify barriers to individual and organizational performance. This presentation will describe BEM and explain how its implementation can help organizations continuously improve and compete globally.

Overview: The presentation will describe the Behavior Engineering Model (BEM) as a tool current ATMAE (Association of Technology, Management, and Applied Engineering) practitioners can employ to drive productivity and performance gains with their organizations. Six factors that influence workplace performance will be categorized into the BEM. Environmental and individual factors that affect workplace performance will also be identified as well as methods for closing performance gaps.

Major Points:
- Describe the Behavior Engineering Model
- Discuss six factors that influence performance into the categories of the Behavior Engineering Model
- Distinguish between environmental and individual factors that affect workplace performance
- Demonstrate a step-by-step method for closing performance gaps

Summary: The audience will learn about BEM and how to identify barriers to individual and organizational performance. Further, a step-by-step method will be demonstrated for closing performance gaps. Information from this presentation may assist managers and others interested in continuous improvement in their organizations.
Integrated Risk-Based Inventory Classification System

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Need: Inventory costs constitute a very high percentage of annual expenses of any organization, and thus the effectiveness of the inventory management policies adopted by organizations is critical to their financial success. In today’s challenging economic times, efficient inventory classification and planning is more important than ever and can be a key competitive advantage for any organization. Various inventory classification methodologies are explained in existing literature. But these methods are either too simplistic to formulate effective inventory management policies or too complex to implement. Thus, there is a need for a new inventory classification system that will be easy to implement, yet powerful and effective.

Overview: In this paper, we develop an integrated risk-based inventory classification (IRIC) system which will help manufacturing and service organizations in deciding optimal inventory management policies. The proposed methodology exclusively focuses on three major goals of inventory management: performance efficiency maximization, risk minimization, and cost effectiveness. Unlike existing methodologies, the new method classifies the attributes of inventory items in three classes: risk-related attributes, performance efficiency related attributes, and cost attributes. It is obvious that there are trade-offs involved among these three types of attributes. For example, if one decides to implement a policy that only focuses on cost minimization, then such a policy may not be robust enough to sustain the changes in market demand and supply, and may result in excessive backorders. Thus, there needs to be a right balance among risk, performance efficiency, and cost effectiveness. The proposed IRIC method tries to achieve that right balance.

Major Points:
- An extensive review of existing inventory classification and management methodologies.
- Mathematical modeling of the proposed IRIC system.
- Testing and validation of the IRIC system using simulated risk scenarios.
- Comparison of the IRIC system with two well-known existing methods.
- The IRIC system prototype software and its applications.

Summary: The focus of this paper and the presentation is on the development of a new integrated risk-based inventory classification methodology that addresses the shortcomings of existing methodologies. The presentation will be of interest to industrial engineers and operations managers, who manage inventory control and planning operations in their respective organizations.
Emotional Intelligence: Its Implications for a Technical Manager

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Need: Some technologists, whether in software, manufacturing, health care, or various other disciples, may be inclined to believe the difficulties of understanding and using emotions in the workplace as “fluffy”; however, Emotional Intelligence (EI) is “the hard science of soft skills,” and was popularized by psychologist Daniel Goleman. In Howard Gardner’s view, author of Multiple Intelligences, traditional types of intelligence, such as IQ fail to fully explain cognitive ability. Other EI research indicates that most often or not, it is not IQ alone, although extremely important, but EQ +IQ that determines a person long term reputation, quality as a leader, networking capability and job success/satisfactions. As technology changes and the role of the technologist consistently evolve, a potential new “bridge” between technical managers and employees and customers may be enhanced by applying the principles of high emotional intelligence.

Overview: The earliest roots of emotional intelligence can be traced to Darwin’s work on the importance of emotional expression for survival; E.L. Thorndike’s(1920) work on Social Intelligence; David Wechsler’s (1940) work on describing the influence of non-intellective factors on intelligent behavior; and Howard Gardner’s work on Multiple Intelligences. The publication of Daniel Goleman’s best seller Emotional Intelligence: Why It Can Matter More Than IQ popularized the term. The major components of Emotional Intelligence include: Self-awareness which is the ability to read one’s emotions and recognize their impact; Self-management which involves controlling one’s emotions and impulses and adapting to changing circumstances; Social awareness which is the ability to sense, understand, and react to others’ emotions; Relationship management which is the ability to inspire, influence, and develop others. The purpose of this presentation is to relate the concepts of Emotional Intelligence to the role of the technical manager and help create an understanding of how this can enhance the technical manager’s results and performance.

Major Points:  
- The evolution of Emotional Intelligence as a recognized management discipline  
- The difference between trait, mixed, and ability based Emotional Intelligence models  
- The components of Emotional Intelligence  
- How Emotional Intelligence can enhance the performance of a technologist or technical manager

Summary: Emotional Intelligence is knowledge that will empower technical minds to think differently—logically and emotionally—as they manage complex work systems. The technical manager’s ability to apply Emotional Intelligence may be the “bridge” that creates a high performance culture, higher job satisfaction, and better overall business results. During Pam McGee’s 15 years in technology software management, she has attended Leadership Development training at Harvard Business School, has taught Emotional Intelligence in over 22 countries, and has coached Emotional Intelligence principles to executives, mid and front line management, and students. She is a member of the EI Consortium, APICS, ATMAE, NADE, and MPMA. She is the author of numerous articles on leadership and emotional intelligence and is a writer for The Microsoft Partner Channel magazine. She is employed at MSU-Moorhead as an Assistant Professor, Technology and teaches Leadership and Project Management. In addition, she is a partner at 6Dimensions: People and Technology consulting firm.
Enhancing Supply Chain Management with Lean Six-Sigma Principles

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Need: In the global marketplace of today, competition is no longer between individual companies, but is fiercely between entire supply chains. If key members of the supply chain do not concern themselves in optimizing the holistic supply chain, new entrants identifying an opening to satisfy a customer need can create an entirely new supply chain to attract customers away. Once the technological or logistical edge is lost by an existing supply chain, it can quickly become extinct. Lean Six-sigma philosophies have been well understood and practiced in most leading edge companies today. However, the vast potential that Lean Six-sigma principles possess for application to the entire supply chain has not been well explored. Only when individual corporations in a supply chain begin to behave as cogs in a well lubricated clock, will they be able to respond quickly and accurately to their customers with the least cost. In this presentation, how Lean Six-sigma principles can be applied to the entire supply chain for waste elimination and variation control will be presented, and how to make the supply chain invulnerable to competitive attacks by competing supply chains will be discussed.

Major Points:
- Supply chains of today—strengths and opportunities for improvement
- Supply chain synthesis best practices
- Lean Six-sigma principles for supply chain management
- Lean Six-sigma Metrics
- Value stream mapping
- Throughput flow
- Kanbans and supermarkets
- Supply chains utilizing Lean Six-sigma principles
- Conclusions

Summary: Attendees will learn the basics of Lean Six-sigma and understand which Lean Six-sigma principles are best for adaptation in the entire supply chain.
What Parts of the Management Jungle Do Technology Students Need to Explore?

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Need: The transition from NAIT to ATMAE identifies a turning point. The former NAIT website prominently displayed a comment that “we are just the right mix”. But with the title now being Technology, Management and Applied Engineering the question is the right mix of what? A review of the course titles indicates that there is certainly a degree of overlap between the curriculum content of industrial engineering programs in ABET accredited engineering schools, industrial technology or industrial management programs in ATMAE schools, and operations management in AACSB accredited business schools. With the decline of manufacturing in the US operations management degrees offerings have declined in business schools while at the same time many engineers feel that the management skills associated with an MBA are required for career advancement. This would appear to offer ATMAE schools an opportunity to differentiate themselves as the solution for those interested in technology careers. Clearly technology students need quality management, project management, and production management courses and technology programs currently offer those. Addressing how the multitude of management theories confused practicing managers, Harold Koontz coined the term “management theory jungle” in his 1961 article in the Academy of Management Journal. The jungle has only increased in density and today there are over 50,000 articles and books published on management each year. The question is, in an increasingly competitive and technology driven global economy what other areas of the vast management jungle do technology students need to explore?

Overview Management research started in earnest just over 100 years ago. From a few management-oriented works in the nineteenth century, including of Henry Fayol and Fredrick Taylor, the discipline grew to a steady stream of work in the first half of the twentieth century as management research and literature became popular. With thousands of pieces to the management puzzle, one quickly becomes befuddled trying to understand what exactly management is and what a manager does; however, the impact of technology on human behavior and corporate strategy is prevalent in management literature. Management is getting work done by and through people. Technology graduates need to better understand the socio-technical aspects of management theory.

Main Points:
- Management is an extremely broad field and the literature is vast
- With management now in the title the appropriate context needs to be better defined
- The key is to differentiate by focusing on the socio-technical aspects of management

Summary: This presentation reflects on the current course offerings in ATMAE programs, the presenter’s research and the literature on the work of technology managers, interviews with practicing technologists and executives, personal industry experience, and course work at the master and doctoral level in both ATMAE and AACSB accredited schools to identify specific management topics that would be most valuable to technology graduates as they enter the workforce.
Professional Certification: A Study of Significance

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Need: Professional certification organizations claim that employee certification helps both manufacturers and employees reach business objectives and continuous improvement goals. If this is true, a study may determine if the certification of employees truly helps a company. The purpose of this survey study was to determine if certification or non-certification impacts quality cost improvement and waste-cost reductions in manufacturing organizations.

Overview: The American Society for Quality (ASQ) defines certification as a formal recognition that an individual has proficiency within, and a comprehension of, a specified body of knowledge. A certification is peer recognition, not registration or licensure. Certification is the qualification of individuals performing jobs using a predefined set of standards. The Association of Technology, Management, and Applied Engineering (ATMAE) lists certification value for examination takers as recognized expertise, external validation, and commitment to the professional (ATMAE, 2009). Certification examinations offered by ATMAE include the certified technology manager (CTM) and the certified manufacturing specialist (CMS). The purpose of this 235-survey-respondent study was to determine if certification impacts quality cost improvement and waste-cost reductions in manufacturing organizations. Quality cost improvement is reduced external failure costs in customer claims. Waste-cost reductions are internal failure financial data in reduced scrap, defects, rework, labor, and improved cycle time. A quality professional-developed Internet survey supplied data for t-test evaluation. Internet-surveyed participants included members of the American Society for Quality (ASQ) and Society of Manufacturing Engineers (SME) who work for small, midsized, and large manufacturing organizations.

Major Points:
- Certification organizations state that professional certifications Facilitate professional growth for the certificate holder.
- Demonstrate employee job competency through proctored body-of-knowledge examinations.
- Help the financial bottom line of companies who employ certificate holders.

Summary: Professional certifications are big business. People spend a lot of time and money to learn organizationally-identified bodies-of-knowledge in order to pass a timed, multi-questioned, proctored examination. Presentation of this study’s findings will help ATMAE conference attendees to understand the real importance of professional certification.
O*NET Detailed Work Activities: The Impact for Engineering Management Practices

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Need: “The Digital Divide: Bridging the Job Opportunities Gap” vividly demonstrates an ever-growing divide between workers who are successful, and those who are not, in leveraging technology and entering technology-intensive occupations. Managing technical workers is becoming increasingly challenging with the impact of globalization on virtual teams and international organizations. While some organizations attempt to overcome these challenges by utilizing job tasks, others focus broadly on job competencies, knowledge, skills and abilities. What is needed is a standardized taxonomy to describe work, and provide a tool for management to help increase workforce effectiveness and efficiency.

Overview: This presentation will delineate the revised, taxonomical framework of Detailed Work Activities from the U.S. Department of Labor’s Occupational Information Network (O*NET) Content Model. Since O*NET’s original release in 1998, the U.S. DoL has made many, significant improvements and additions to the Content Model. One such modification was the addition of Detailed Work Activities (DWAs). DWAs were designed and intended to be detailed descriptions of job behaviors that occur in multiple jobs. By definition, DWAs are intermediate descriptors between tasks and broader competencies that provide a common language for work description, and allow cross-occupational matching while preserving differentiation. DWAs have many potential uses, and have been incorporated into web applications such as America’s Career InfoNet, O*NET OnLine, and O*NET Code Connector. However, from their initial development, there have been many problems with the DWAs. Some of the known issues with the DWAs were that there were significant data quality concerns, as well as an overall lack of DWA-coverage across the full range of occupations. Among others, these issues have greatly hindered the usability of the DWAs by industry, educators, job seekers, and others. This presentation will review the recently completed release-data of the scientific-update to the O*NET DWAs. The update process and results will be explained, providing examples of updated engineering- and technology-related DWAs. Additionally, uses of DWAs for management, workforce, education and training purposes will be discussed.

Major Points:
• Process methodology and outcomes of the industry-driven DWA update process.
• How DWAs can be used for management and workforce education and training purposes

Summary: Attendees will learn how the recently-updated O*NET Detailed Work Activities can be used to improve efficiency and effectiveness of management, workforce, and education and training processes for engineers and the engineering community.
Application of Total Quality Management Tools to Solve Real Problems for Local Industries

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Need: Total Quality Management (TQM) has been more and more recognized as an effective managerial strategy for achieving and sustaining business success. Distinguished from previous stages in the quality evolution, TQM is a systematic approach that emphasizes the use of efforts from every aspect in the company to satisfy customer needs and make continuous improvement so as to ensure long-term success. The increase of manufacturing globalization and competitiveness created a need that employees should have the know-how of TQM tools. Developing a course in which students can effectively learn the TQM principles and further apply the TQM tools for real problem solving is the focus of this presentation.

Overview: Project-based learning provides obvious advantage in science, technology, engineering and mathematics (STEM) education due to students’ high level engagement and comprehension. This method was applied in a TQM course where students need to learn and use the TQM tools to solve real problems for local industry. Echoing the Plan-Do-Study-Act problem solving circle, students were required to use both qualitative and quantitative TQM tools to identify problems, further make recommendation and even take action to solve problem in a real work scenario. The valuable part is that most of the students selected the topic and conducted real projects for real applications. Besides being useful for the comprehension of class concepts, the achievements made in the project also benefit local industries by contributing ideas and wisdoms for making continuous improvement.

Major Points:
- TQM principles and tools used in TQM problem solving circle
- Development of the project and rubric
- Projects performed by students— how problems were identified and solved
- Achievements, students feedback and effectiveness evaluation

Summary: In using the project-based learning, students perceived a better connection between textbook knowledge and the practical applications. The feedback from the students will help modify the teaching module in the future. Since a large portion of the students enrolled in the class are full time industry employees, the projects completed in the class were really beneficial for their job assignments.
Cross-Disciplinary Technical Communication: Gaining Stakeholder Trust Through Clarity

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Need: Conveying important technical information to stakeholders can be a challenging proposition for scientists, engineers and technical managers. Unambiguous explanations of technical information must be delivered to stakeholders who may or may not have knowledge within the relevant discipline. For stakeholders who have different professional and educational skill sets, the importance of clarity can easily be identified but sometimes difficult to effect.

Overview: This presentation introduces the Multiple Stakeholder Technical Communication model (MSTC, Zuppo, 2010) which provides a framework for cross-disciplinary communication. The MSTC model can be applied in public, private and non-profit organizations where stakeholder understanding and support is critical to the success of the outcome(s). Framing technical communication through the lens of change management and stakeholder theory provides strategies to overcome potential communication pitfalls such that a clear line of sight with regard to innovation remains the primary focus.

Major points:
- Efforts toward innovation are worthless if not communicated and diffused effectively.
- Best practices for communication apply; however technical communication within a cross-disciplinary environment is distinct and therefore requires additional considerations.
- Incorporating change management theory, where necessary, can assist the communicator in understanding how to position the message in line with planned change efforts and organizational strategy.
- Communicating technical information in a global environment may require specific efforts to ensure the message is unambiguously sent and received.
- Some modes of technical communication across disciplines may be more appropriate than others (e.g. written vs. oral; telephonic vs. face to face, etc.) when considering the purpose of the communication and the time frame within which the information must be conveyed and acted upon.
- Considering stakeholder theory in cross disciplinary technical communication efforts is critical to successfully delivering the message and thereby answering the “what’s in it for me?” question for the receiver(s); leading to positive outcomes and cohesive team efforts.
- While the technical information and details of the communication are important, the information should be no more and/or no less technical than is appropriate for the situation.
- Credibility of the message, as well as the credibility of those responsible for communicating the message, can instill trust and therefore foster an environment of stakeholder cooperation.

Summary: Technical communication in a cross-disciplinary setting is a dynamic process. Understanding the conditions surrounding the creation and delivery of the message paired with sound analysis of the technical aspects of delivery can make the difference between success and misunderstanding. Delivering a well-crafted message that is highly technical to professionals who practice within other domains can be challenging but not impossible if sound communication tactics are developed and utilized, positioning the communication in line with furthering the organization’s strategy and climate of innovation.
Employee Harassment Issues Via Workplace Technology: Technological Change of a Different Type

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Need: As workplace technology continues to rapidly evolve, the potential employee relations issues that can arise also continue to evolve. Organizations must understand and work to cultivate and environment that understands the importance of the distinction between appropriate and risky behavior when considering enterprise technology use. Problems resulting in legal action can range from breach of contract, harassment, defamation of character and discrimination. Being able to identify potential areas for legal exposure is an important consideration for every organization, however, effectively conveying this information through training is as critical to the organization’s strategic plan.

Overview: This presentation will discuss the various types of employee harassment issues that can arise wherever ubiquitous workplace technology is in use. Email, texts, internet browsing, instant messaging and other types of communication and social networking have led to an upturn in harassment cases being filed in which workplace and ubiquitous technologies were the vehicles for delivery. Also discussed will be the ethical obligations employers have with regard to technology use and abuse policies and practices.

Major points:

• Textual harassment and “sexting” have gone from societal headlines to a frontline concern for organizations.
• With the rise in technology use and social networking, digital records of intentional and unintentional breaches of proper use of such things as texting, emailing and message board posting have now become fertile ground for employee relations and harassment issues.
• Communicating the organization’s position on electronic harassment is critical to the culture of the organization in that a “hostile work environment” can now be established in virtual corporate worlds; as well as in face to face situations.
• Electronic harassment in the workplace can also be considered criminal activity.
• Clearly outlined expectations and policies along with employee reporting mechanisms that protect the complainant must be established or the organization (by virtue of its technology) could be held liable for a few employees’ bad choices.

Summary: No longer are “sensitivity training” and harassment policies enough for an organization to insulate itself from any of its employees’ poor judgments. The face of harassment claims is rapidly changing and having an understanding of the current zeitgeist with regard to what constitutes harassment (in virtual environments especially) is critical to every manager of technology. It is important to stress the differences between how a message is intended and received, but it is also important to stress that the highest impact of the two is how the message was received. While personal views about sensitivity may vary with the type of work environment, the bottom line of what today’s courts consider electronic harassment is the imperative for all organizations.
Developing a Global Technical Workforce: Strategies for Organizational Effectiveness

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Need: Increasing global competition mandates that organizations must maximize their competitive advantage by effectively leveraging new and existing technologies. As technology changes the tools of management must also change through continuous improvement efforts. Having a strong understanding of the factors influencing the environment in which global organizations must effectively develop and leverage their technical human capital is critical to talent management efforts throughout every global organization.

Overview: Among the factors influencing the development and maximization of a global technical workforce are socioeconomic conditions, teaching/learning styles, attitudes toward learning, overall cultural differences and the meaning of work within the constructs of the environment. In order to be effective in fully leveraging the capabilities of a global technical workforce, organizations must identify the challenges inherent in developing that workforce and formulate tactical solutions to meet those challenges.

Major points:
- Nurturing effective leadership and management development initiatives can be challenging in a global organization; tactical efforts must recognize cultural differences and support the organization’s overall strategy while being sensitive to local views and customs.
- Appropriate training and development for expatriates, inapatriates and third country nationals is critical to successful international assignments; therefore the analysis, design and development processes must directly respond to the needs of the organization as well as have a positive impact on individual career development.
- Addressing the differences in work norms and values must be a primary consideration.
- The organization may need to provide for and respond to different expectations regarding leadership and teamwork (e.g. collectivist vs. individualist cultures) in a variety of global settings.
- Global organizations must address differences in educational and training systems when planning for work performance, as well as planning for how performance is defined and measured.
- Recruiting, promoting and rewarding a global technical workforce may mean different things in different global environments; development initiatives should be designed accordingly.
- Global technical organizations may need to deploy a wide array of tactics and support measures to motivate employees across cultures as “motivation” may mean different things in different societal contexts.
- Negotiating differences in legal, social, economic and cultural environments may require additional support based upon the needs of the organization.

Summary: Developing and maintaining a global technical workforce can be enormously challenging and many aspects of conducting business in a domestic organization are inadequate within the global context. Planning and analysis of the people, processes and tools that contribute to the success of a global technical organization can position the organization for sustained competitive advantage within their respective market(s). Conversely, lack of understanding of what it takes to attract, retain and develop a global technical workforce can reduce an otherwise successful organization to a peripheral “has been”, unable to compete on a global scale.
Manufacturing
Life Cycle Assessment (LCA) using SolidWorks SustainabilityXpress

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Need: To promote the use of Life Cycle Assessment (LCA) to make more informed decisions through a better understanding of the human health and environmental impacts of products, processes, and activities. LCA is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service.

Overview: Integrating sustainability in product design courses allows your students to learn how their decisions will impact the environment. SolidWorks SustainabilityXpress is an application that allows students to determine Life Cycle Assessment (LCA) on a part. Data, such as material selection, manufacturing process, where manufactured in the world, and where a product is used, SolidWorks SustainabilityXpress provides information on carbon footprint, energy consumed, air acidification and water eutrophication. Once the student calculates the baseline, similar materials can be compared based on material properties such as density and tensile strength.

Major Points
- Carbon Footprint
- Total Energy Consumed
- Effect on Air
- Effect on Water
- Material selection

Summary: SolidWorks SustainabilityXpress is used to determine the environmental impact (Life Cycle Assessment) of a product. Life Cycle Assessment (LCA) examines everything that happens in the production, use, and final disposal of the product. Decisions on the material used, how it is manufactured, processes, and services can result in vastly different effects on the environment. This presentation will assist your understanding of LCA and improve the environmental impact of student designs, including calculation of carbon footprint, total energy consumed, and effect on air, water and material selection using SolidWorks SustainabilityXpress.
Design of Solar-Powered Floating Fountain for Analysis of Aeration in Stagnant Water

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Need: The rising cost of petroleum products and depletion of non-renewable sources of energy have increased the need for alternative renewable energy applications. Solar energy technology is one area that is showing encouraging potential to reduce U.S. dependence on fossil fuels. This presentation highlights one of the advances that are making an important contribution in the push toward the development of environmentally friendly products and processes for a more sustainable future.

Overview: Photovoltaic (PV) systems provide a cost- and energy-effective means of permitting a wide range of solar-electric applications. One such application involves the design, assembly, and performance analysis of a Solar-Powered Water Floating Fountain (SPOWF) on a test stagnant body of water. This study was performed as part of Innovative Design and Manufacturing Research at the Research Center for Cutting-Edge Technologies (RECCET), at the FAMU-FSU College of Engineering, Tallahassee, Florida. The goal was to increase the level of dissolved oxygen in the pond by harnessing solar energy for submerged aeration. The system is composed of six solar panels, a kit of batteries, a linear current booster, pressurized water tank, two pumps, an air compressor, and a float. The design factors for dissolved oxygen (DO) measurements were; depth of water, time of the day, location of fountain, and status of fountain (on or off). A Split Plot design was used to investigate the performance of the fountain, based on the changes in levels of DO in the pond. Statistical analysis showed a 120% gain in DO concentration (from 4.5 mg/L to 10.0 mg/L) over a 20-day period and significant destratification of the pond.

Major Points:
- Introduction: Solar-Powered Installations
- Design of Major Components of the Solar-Powered Floating Water Fountain
- Assembly and Operation
- Water Aeration and Dissolved Oxygen Measurements
- Statistical Analysis of Dissolved Oxygen Data
- Mathematical Model and Economic Analysis

Summary: The Solar-Powered Floating Water Fountain (SPOWF) unit achieved its main function with the aid of the aerator and fountain, i.e., aeration of the test pond. Consequently, the dissolved oxygen (DO) concentration was increased significantly from an initial low level of 4.5 mg/L to a high of 9.95 mg/L. Statistical analysis of the DO, conducted using a Split Plot Design, yielded a mathematical model that describes a linear relationship between the primary operating factors, (location of the aerator and time of the day) and the output, DO. An economic analysis, conducted by using a geometric gradient for an economic horizon of ten years, corroborated the affordability and benefits of the unit. Potential users include environmental, building and construction, parks and gardens, private homes, estate developers, aquatic, and energy conservation.
A Six Sigma Approach to Solve Gear Geometry Alignment Issues in Gear Manufacturing

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Abstract

The Six Sigma development will address the gear alignment issue in gear manufacturing. The purpose of this study is to evaluate and observe critical factors during production by using Six Sigma methodologies. The study will evaluate the Six Sigma approach of using Six Sigma tools and techniques to assess root causes and further improve the process. The purpose of this study is to reduce non-conformance in gear manufacturing processes.

Keywords: Gear, Six Sigma, Critical Achievement

Conclusion

This project provides a case study of using Six Sigma approach to solve problems. Staffing in manufacturing industries. The case study demonstrates the use of Six Sigma high-quality goals can be accomplished. The project can be applied to any manufacturing industry looking for a major gear production that involves multiple manufacturing processes. The project provides an approach to using the Six Sigma approach to solve business and industry improvements.
Research, Design and Fabrication in an Upper Level Metals Class

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Need: College students specializing in any field should find the work challenging as they move through the program. Commitment to the work at hand is also enhanced when the reward is beyond a letter grade. In this upper level Metals program, students are involved in product design/redesign, tooling up and limited mass production of some type of machine tool. This kind of challenge stimulates problem solving, time management and teamwork with concrete goals and a specific completion point. There is no guarantee of success at the beginning of the class but there is in depth learning and notable personal reward on its completion.

Overview: Students selecting this class have typically done well in the earlier prerequisite classes. As an elective, this class is largely student run and managed. As a loosely knit team a product is selected, analyzed for production and then produced. During the semester experts in industry are consulted, production problems resolved and materials are sourced. Time, costs and quality control are issues that hold everyone’s attention. When production manages to meet the schedule, products are run tested, painted and prepared for delivery. Everyone in the class (including the instructor) gets a finished product.

Past products have included wood lathes, band saws, jointers and belt sanders.

Major Points
- Project selection
- Redesigning for production and consulting with industry
- Tooling up
- Sourcing materials
- Prototyping and simultaneous production
- Quality control
- Fabrication and completion

Summary: Attendees will have a fast overview of what an upper level manufacturing metals class can produce in a semester. During the process the students see the challenges faced by industry and those they address themselves.
A Reverse Engineering Project In Technology Laboratory

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Need: As the use of reverse engineering method in the design process increases, it is essential to provide technology and engineering students with adequate skills in area of reverse engineering techniques in order to meet the future demand of skilled personnel in the work force. Teaching the reverse engineering methods and concepts at the undergraduate level will provide students with the necessary technical skills to be more competitive.

Overview: The objective of this paper is to describe a reverse engineering project which includes utilizing a laser scanner arm and Geomagic Studio software to generate 3-D computer models in manufacturing and design courses. This concept is of high interest to industries and military that use reverse engineering technology in product development and is a way that can help them to be competitive. Using the scanner is a typical way to generate 3-D computer models of actual parts that will be manufactured. First, user utilizes the scanner arm to scan and register the points on the part and the scanner sends the registered points to Geomagic Studio software to generate a 3-D computer model. Once the part is modeled, it can be sent to a rapid prototyping machine to prototype the part. Another application of reverse engineering is in inspection process and quality control. In this case the computer-generated model will be merged and compared to the original CAD model in order to check the specifications of the product prior to starting the manufacturing of the part.

Major points:
- 3-D computer modeling
- Scanner arm
- Geomagic Studio software

Summary: Attendees will understand the concept of reverse engineering and its application in industry and military. This project tests the achievability of creating 3-D parts in the educational laboratory by utilizing the scanner arm and the 3-D Geomagic Studio software. Based on our findings the reverse engineering topic can be integrated into any machine design and manufacturing courses in engineering or technology programs.
3D Parametric Design and Assembly Simulation in Manufacturing Technology Course: Meeting Industry Needs

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Need: The application of advanced technology is not only limited to verifying and simulating the manufacturing system, but is also applied to product and process design, pilot model development, quality assurance, and cost analysis. This paper demonstrates how the manufacturing technology courses were modified to incorporate recent trends in 3D parametric design (solid modeling) and assembly simulation applications in the industry.

Overview: The manufacturing industry implemented 3D parametric design and assembly simulation as one of the vital tools for improving the manufacturing system, in order to produce higher quality products at a reasonable cost and within a reasonable time. This practice was extended after the industry recognized that the capability of the advanced technology is much greater than was previously thought. This paper shows how these aspects of visualization and simulation tools have been successfully implemented into manufacturing technology courses.

Major Points:
- Different aspects of 3D parametric design and assembly simulation
- Recent trend in the aerospace and automotive industry
- Modification of curriculum and lab activities: Hands-on and real life projects
- Work accomplished
- Feedback from the industry

Summary: The demand for technologists who are knowledgeable in and capable of using 3D parametric modeling and assembly simulation as a whole is growing rapidly. Our responsibility is to prepare our students with hands-on experience in advanced technology, coinciding with what the industry wants.
Traditional Manufacturing System vs. Digital Manufacturing System (DMS) in the Production Technology Program

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Need: Digital Manufacturing System (DMS) allows industries to design, construct and run a virtual manufacturing facility. The main idea of DMS is to simulate and validate the entire manufacturing process, from design to production. DMS requires the implementation and collaboration of CAD, CAM, CAE, CIM, CMM, robotics and virtual simulation packages. It will become an essential tool, in that technologists increasingly need to gain knowledge of these tools and applications.

Overview: Producing high-quality products at lower cost is a major goal of the manufacturing industry. DMS allows them to achieve this goal with reasonable time and effort as long as they have appropriate tools and qualified personnel. Technology students need to understand how and where to use these tools. This presentation shows the basic concepts of DMS, along with how it was integrated into a production technology program.

Major Points:
• Digital Manufacturing System (DMS): An overview
• Variation and selection of DMS
• Traditional Manufacturing System
• Modification of curriculum content and activities
• Impact on the budget
• Students’ and industries’ reaction

Summary: Attendees will understand how integration of a Digital Manufacturing System (DMS) into a production technology program greatly enhances students’ ability to acclimatize to the new manufacturing environment, and provides industry with highly qualified manufacturing technologists.
The Effect of Coolant Temperature and Flow Regimes on the Quality of Injection Molded Parts

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Need: In most injection molding operations, most technicians intuitively run the coolant at low to moderate flowrates and at a low temperature as they can possibly achieve to minimize cycle time. Preliminary results of an ongoing injection molding study suggest that part quality may be adversely affected at these operating conditions. The authors propose that acceptable-to-excellent part quality can be achieved by maximizing the heat transfer coefficient of the inner surface of the cooling tubes. Achieving acceptable-to-excellent part quality prevents the need for re-working injection molded parts, which results in cost savings in terms of material and labor usage.

Overview: The mold cooling process in the injection molding of plastics parts contributes about 75 - 80% of the cycle time of the entire process. In an effort to reduce the cycle time and improve production output, many manufacturers have adopted the practice of using low to moderate coolant flowrates as well as maintaining the coolant at low temperatures, which generally corresponds to the temperature of the local water supply system that is approximately at 70 - 75 °F. The authors suggest that by maximizing the individual heat transfer coefficient of the coolant in the cooling tubes by exploring both the flow regimes and the temperature of the coolant, which are independent variables of the heat transfer coefficient. The ultimate goal is to suggest acceptable range of coolant flow regimes and coolant temperatures to achieve acceptable-to-excellent quality of injection molded parts based on proven engineering principles.

Major Points:
- Understanding the science of the cooling process in injection molding
- Suggest coolant flow regimes and temperature ranges for good quality injection molded plastics parts
- Improve an understanding of the entire injection molding process

Summary: The presentation shares the results of the study of the influence of coolant flow regimes and temperatures on the quality of injection molded plastics parts. Attendees at this presentation will gain an understanding of how to reduce scraps or material waste by optimizing the cooling process by manipulating the coolant flow regimes and temperatures.
Understanding the Need for Lean Training for Students in Technology-Based Undergraduate Programs

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Need: To offer graduates in engineering and technology disciplines with educational experiences that will provide them with the skills and knowledge that their future employers expect.

Overview: The graduates of University of Wisconsin Stout in business, engineering and technology disciplines were recently surveyed to identify their primary operational strategy. The results indicated that the majority of them were using lean as their principal strategy to improve their operations and thus reduce operational costs. Employers are in a mode of cost management, hiring reduction and are experiencing increased competition. This has lead employers to be all the more selective in their hiring practices. Understanding which operational tools potential employers are using provides an opportunity for higher educational programs to tailor their curriculum to best meet employers’ needs. This will provide students with a competitive advantage as they enter the job market.

Major Points:
- Results of the 2010 employer survey on operational strategies
- How to provide students with the tools that meet employers’ needs
- The creation and redevelopment of courses to meet these needs

Summary: Attendees will learn how to identify needs of employers and how the University of Wisconsin - Stout revised curriculum to address these needs, adding value to the students and developing improved relationships between future employers and the university.
Measuring the Effect of Lean Implementation at a Low-Volume, High-Variety Manufacturer: A Case Study

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Need: Lean manufacturing has gained prominence in recent years and appears to deliver promising results. However, previous publications documenting these implementations have been focused on large-scale, mass production manufacturers, providing limited documentation to support the value of lean implementation in small-scale operations, especially in low-volume, high-variety manufacturers.

Overview: This research study utilized a case study methodology to analyze the effectiveness of lean manufacturing implementation at a small fabricated metal product manufacturer. Eight performance measures in three different categories were obtained and analyzed for three months prior and three months after the lean implementation. The performance measures were: Financial (gross profit ratio and value-added per square foot of manufacturing floor space); operational (scrap rate, value-added per employee, and running hours as a percentage of staffed hours); and material management (inventory turnover, on-time delivery, and set-up hours as a percentage of staffed hours). Analysis of the outcomes showed mixed results. Possible reasons for this, as well as implications for management and future research, are provided.

Major Points:
- Results of the lean implementation
- How to implement lean tools in small-scale operations
- Success of lean in small operations

Summary: Attendees will learn how the application of lean tools can definitely be successful in a small, job shop environment, but this success can take effect in different forms than in the larger manufacturing firms, and different implementation concerns need to be taken into consideration.
Understanding Manufacturing Costs

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Need: Cost is a key driver in making decisions. Often engineers get buried in accounting terminology and procedures and don’t understand what has the biggest impact on costs. Truly understanding manufacturing costs help the engineer / manager focus improvement on what really has an impact on costs. For example, increasing process yields from 90% to 95% sounds great but reducing set-up time by 20% may have a much bigger impact on costs.

Overview: This presentation will discuss the costs associated with manufacturing a part or product in terms common to manufacturing engineers and managers rather than using accounting jargon. A simple model / formula, developed by the author, will be presented which is applicable to most manufactured products. This will help the engineer / manager to determine where the true costs are and what improvements are needed to reach cost reduction goals.

Major Points:
- Overview of manufacturing costs.
- The impact of labor, materials, overhead, tooling, set-up, etc. on costs.
- Presentation of a formula for determining costs and identifying improvement priorities.
- Examples for class use.

Summary: This presentation focuses on the understanding of manufacturing costs and the prioritization of cost improvement opportunities. This is applicable to all engineers and managers and can be used by professors to enhance the teaching of manufacturing costs. This is an excellent tool to be added to classes in quality control, tool design and build, robotics & automation and lean manufacturing to determine the impact of these areas on overall manufacturing costs.
Using the CMS Exam as a Program Assessment Tool

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Need: Program assessment is an ongoing process to continuously improve our discipline, as well as a requirement for accreditation. The Certified Manufacturing Specialist exam offered through ATMAE is an excellent tool to add to your assessment tool box.

Overview: This presentation will discuss the use of the ATMAE CMS exam as a valid assessment tool for a manufacturing focused IT program. It is given to all graduating seniors as part of their senior capstone course. The logistics for administering the exam are presented as well as the exam results. After reviewing the exam results, the faculty and Industrial Advisory Board considered recommendations to modify the curriculum for continuous improvement.

Major Points:

- Overview of CMS exam.
- Logistics for giving exam.
- Exam results for our program.
- Using the results for continuous improvement.
- Conclusion and future program assessment.

Summary: Attendees at this presentation will have an overview of how the ATMAE CMS exam has been used as a tool in program assessment. Included will be how the program used this exam to understand the actual outcomes of their current program and determine changes to continuously improve the curriculum to better meet the needs of industry.
Implementing Computer Aided Measurement in the Classroom-A Closer Look at the Software and Hardware

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Need: As the degree of precision for many manufacturing environments and applications continues to increase, the tools and technologies used to aid in meeting that precision is continually evolving. Students now need to be prepared to utilize current technologies, especially those related to Computer Aided Measurement (CAM). As the equipment becomes more cost effective and versatile, it is being employed in more industries and in more applications. Local manufacturers such as Boeing, Leica, Sabreliner, & Caterpillar are projecting continued demand and greater need of graduates with the exposure and skills needed for computer aided measurement.

Overview: Computer aided measurement technology and equipment has evolved greatly with current advances in technology. This presentation will provide a brief overview of computer aided measurement technologies, equipment, software, manufacturing utilization examples, and the current equipment utilized at Southeast Missouri State Univ. and its laboratory deployment.

Major Points:
• Need for computer aid measurement instruction
• Introduction of current technologies
• Manufacturing utilization of computer aided measurement
• Current utilization and lab activities at Southeast
• Projected need and uses for CAM technologies

Summary: Attendees of this session will gain a basic understanding of current computer aided measurement technologies, their use and importance in manufacturing environments, and how Southeast is incorporating these technologies including laser tracker, CMM, PolyWorks software, handheld scanners as part of their instruction process.
Case Study in Implementing Activity Based Costing in a Manufacturing Company

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Need: Pricing products and services right is paramount in implementing Lean principles in manufacturing and service businesses. Lean accounting has evolved as a method for costing based on the concept of activity based costing (ABC). Standard costing is the most prevalent method for costing products used in industries today. This method works fairly well if a company only manufactures one type of a product or product family. However, for most companies that produce products today, the range is wide in terms of product complexity and customization. Using standard costing in such instances, products which have a definite process and which have been commoditized over time end up with a disproportionately higher cost than products which are customized or special. Not identifying this trend and continuing to use standard costing for a mixture of regular and customized products tends to attract customized products which have been under-costed and divert regular products to competitors which are over-costed. This is a sure recipe for entering a death spiral for a manufacturing business.

Overview: In this presentation, participants will be shown how the phenomenon of collecting unprofitable products and diverting profitable products to competitors is accentuated by standard costing. Using a simple example, how ABC can be implemented will be demonstrated. A case study where ABC was implemented will be presented.

Major Points:
- Overview standard costing and how it affects pricing
- The concept of activity based costing
- Steps to implement activity based costing
- Case study in activity based costing

Summary: Attendees will understand the right uses for standard costing, and where it can harm a manufacturing company. How ABC can be implemented will be shown along with a case study of a company where ABC was implemented.
Development of Learning Objectives for an Undergraduate Electrical Discharge Machining Technology Course Using the Delphi Technique

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Need: Electrical Discharge Machining (EDM) is a non-traditional machining (NTM) method that utilizes electrical energy to remove material from a work piece. A power supply produces a high frequency of electrical pulses that travel between an electrode and a work piece. As a result, metal is thermally eroded and/or vaporized and flushed away by a dielectric fluid. Likewise, dielectric oil or dielectric water serves as an insulator between the electrode and work piece and as a coolant. In this presentation, we will present a curriculum development model designed and developed with the support of EDM experts with academia and industry.

Overview: This presentation describes a study that documented the creation of an Electrical Discharge Machining learning module that can be implemented as a component of a manufacturing machining course. The purpose of this study was to develop comprehensive learning objectives that support undergraduates’ acquisition of knowledge and skills of the EDM processes and procedures. The availability of the EDM machine in Eastern Illinois University’s Production Lab incorporated with the Delphi Study technique provided an opportunity to investigate the development of comprehensive learning objectives to gain knowledge and skills of the EDM processes and procedures.

Major Points:
- Overview of both the EDM process and Delphi Study techniques
- Development of the curriculum used in the classroom/laboratory
- The managing of the data collected during the collaboration of the EDM experts
- Further execution of this study and further research recommendations

Summary: Attendees will understand the learning objectives associated in the development of a learning module for Electric Discharge Machining (EDM). These learning objectives were derived in collaboration with experts from both academia and industry.
The Loss-Tree Analysis: An Approach to Driving Continuous Improvement in Manufacturing Industries for Excellence

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Need: In today’s global market, manufacturing industries are looking for ways to minimize operating costs and utilize machinery and equipment more effectively and efficiently in order to maximize profits. As a result many industries are using the Loss-Tree Analysis, which is a component of Total Productive Manufacturing to solve their plant’s equipment and production problems. This in turn drives continuous improvement processes, which help to increase the rate of production. This presentation will describe the Loss Tree Analysis and explain how its application has become a driving force in the process of continuous improvement in many world-class manufacturing industries.

Overview: Loss-Tree is a Lean manufacturing tool and a component of Total Productive Manufacturing (TPM), used to monitor and improve the efficiency of manufacturing equipment and processes. It is also a Key Performance Indicator (KPI), which uses data to describe and calculate the performance rates of manufacturing machines, assembly lines, manufacturing cells, etc. The Loss Tree uses graphical representation of data to describe the effectiveness of any manufacturing process and directs the management of the process to the root cause of the prevailing manufacturing problems.

Major Points:
- Define the Loss Tree Analysis and its components
- Describe how to build a Loss Tree
- Explain how to use the Loss Tree Analysis to solve manufacturing problems
- Understand the benefits of the use of Loss Tree Analysis

Summary: At the end of this presentation, attendees should be able to describe the Loss Tree Analysis. In addition, attendees should be able to understand the importance of Loss Tree Analysis as a lean manufacturing tool that is helping world-class industries in continuous improvement process.
Effectiveness of Digital Manufacturing and Simulation Courses in an Industrial Technology Curriculum

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Need: Digital manufacturing has been part of industrial technology curriculum for many years. Applications of this technology include advanced 3D CAD modeling, rapid prototyping/manufacturing, and manufacturing simulations. This presentation and paper documents the personal experiences of our program’s graduates in the use and successes of these applications.

Overview: Since 2000 over 150 graduates of our manufacturing technology program have entered the workforce. Their curriculum included advanced 3D CAD modeling, rapid prototyping/manufacturing, and manufacturing simulation applications. A survey and analysis of responses from these graduates (and some of their direct supervisors) identifies how these and related technologies have been used and benefited them in their personal professional experiences.

Major Points:

• Explanation of the survey and methodology for analysis
• Brief description of the digital manufacturing and manufacturing simulation curriculum utilized in our industrial technology program
• Documentation of the data received, review of the demographics of those responding, and listing of significant comments by respondents
• Conclusions on the effectiveness of these technologies for graduates from our program to their personal and professional development
• Suggestions for adjustments to our curriculum and similar programs

Summary: Attendees will learn from the experiences that graduates of an industrial technology program have realized from our digital manufacturing and manufacturing simulation curriculum. With hindsight they provide an objective perspective into the relevance and contribution of these technologies to successes in their professional careers.
Curriculum Considerations for Advanced Materials Technology: Processing Composite Materials

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Need: As educators in the field of manufacturing, we must seek new ways to introduce students to various technologies. Processing of advanced composites, particularly prepregs is an important concept that is not often emphasized in today’s technology programs. As these materials become more common in production of consumer goods, the need to educate students in the principles of processing composites is becoming more important.

Overview: Discussion will focus on describing the successful implementation of a lab based course in processing advanced composite materials. A step by step plan will be presented which outlines the process of developing this course from inception to current practices. Techniques for acquisition of product materials including resins, fibers, and core materials along with processing materials for vacuum bagging will be presented. Creation and use of tooling (bondforms) for processing laminate and sandwich panels will also be addressed. Topics will also include storage, disposal, and safety when handling these materials. Discussion will include laboratory photos and handouts detailing the successful implementation of this surprisingly cost effective method of designing a curriculum and laboratory modules for processing advanced composite materials.

Major Points:
- Need to stay current with industry practices
- Options for designing a course in processing advanced composite materials
- Cost effective methods for acquiring product and processing materials
- Methods for design and creation of process tooling
- Demonstrating the successful implementation of lab based course content

Summary: Attendees will learn how to incorporate a lab-based course in advanced composites processing technologies into their curriculum. Discussion will focus on cost effective methods for acquisition, laboratory setup, and processing of materials.

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Need: Sustainability is now considered an essential, if not the essential, criteria in any design and manufacturing activity. However, adaptation of sustainable design and manufacturing practices are not easy, specifically since there is no unified metric that can be followed by all to measure their own efforts of sustainable practices as well as methods to incorporate sustainability in their design and manufacturing process. A review of the current state as well as approaches to incorporate ideas of eco-innovation, lean manufacturing and product lifecycle management in the sustainability metric both for the manufacturing industry as well as for the academia (manufacturing technology curriculums) is desirable.

Overview: In an effort to encompass all major factors that can affect sustainability in specific sectors, many different frameworks and metrics have been developed (and are being developed) by researchers and authorities throughout the world. However, since this process is still in progress each set has its own limitations, for example, some of them may be too complicated for use by non-experts. In this presentation, some of the major frameworks/metrics is reviewed from the manufacturers' internal decision making point of view as well as for adaptation in manufacturing technology curriculums.

Major Points:
• Sustainable manufacturing - current state of available frameworks and metrics
• Review suitability of these metrics for various design and manufacturing process
• Need for the standardization for comparison and evaluations
• Incorporating sustainability metrics in manufacturing curriculum

Summary: The presentation will focus on the current state of development of sustainability metrics and how those ideas could be integrated in design and manufacturing activities. Issues of introducing sustainable design and manufacturing criteria in manufacturing technology curriculums are also discussed.
Manufacturing Academic Program Competency Evaluation

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Need: The manufacturing environment is currently evolving due to globalization and development of new technologies. Reforming manufacturing education becomes critical. Engaging and motivating our students in the curricula changing process and inviting our industrial advisory board members to evaluate our curriculum changes have provided us with valuable information in assisting us to further improving the quality of manufacturing education.

Overview: The manufacturing environment is currently evolving due to globalization and development of new technologies. The increasingly complex capital equipment and large volume high performance management systems involved in today’s manufacturing processes have raised the bar for high-level skills, and traditional manufacturing skills cannot meet the new industrial needs. Demand for high-level skills is outstripping supply. Manufacturing education must respond by giving our students the new knowledge and tools to prosper in the global economy. Reforming manufacturing education is necessary. While we are significantly updating our curricula, it is important to know how these changes can meet the industrial needs and how our students feel about these changes. Engaging and motivating our students and our industrial advisory board members to be involved in the curricula evaluation process have provided us with valuable information in assisting us to further improving the quality of manufacturing education. Based upon industrial needs, we designed an “Academic Programs Competency Survey Form”. Through this evaluation process, we have identified our strength and weakness which showed us a clear picture of where we should put more effort to further improve the quality.

Major Points:
- Reforming manufacturing education is critical.
- Evaluating curricula changes is necessary.
- “Academic Programs Competency Survey” which includes 43 competency criteria was conducted.
- Survey results will be presented.

Conclusion: Reforming manufacturing education is critical. While we are significantly updating our curricula, we want to know how these changes can meet the industrial needs and how our students feel about these changes. Engaging and motivating our students and our industrial advisory board members to be involved in the curricula evaluation process have provided us with valuable information in assisting us to further improving the quality of manufacturing education. Based upon industrial needs, we designed an “Academic Programs Competency Survey Form”, and conducted surveys. Through this evaluation process, we have identified our strength and weakness which showed us a clear picture of where we should put more effort to further improve the quality.
Visual Workplace and Standardized Work in an Automotive Environment

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Need: This study will allow engineers and managers at the manufacturing plant to understand the 5S standards, visual workplace, and work standards. The understanding of how these standards and principles operate, the application of them, and the benefits will translate into increased quality, reduced inventory levels, and cleanliness. The seven wastes identified by lean manufacturing experts will be reduced resulting in increased profits for the company. In addition, the activities and results of this study can be transferred to existing and future airbag assembly lines.

Overview: This project will be conducted at a tier one automotive parts supplier employing approximately 1300 employees. The company is responsible for manufacturing parts such as steering wheels, airbags, and anything plastic on the interior or exterior of a vehicle. The process to be examined is an airbag assembly line. This process includes injection, ultrasonic welding of the emblem and cover, pad packing, riveting, and final assembly. This process was installed three years ago and has slowly slipped out of standard. There are several 5S deficiencies, standardized work charts have not been updated or followed, and visual control isn’t present. The purpose of this study is to apply the lean manufacturing technologies of 5S standards, visual workplace, and standard work to create a model line that will be used to the other airbag lines in the facility. By applying the lean technologies listed, there will be an increase in quality, a reduction in inventory, and the areas will be well organized.

Major Points:

• Visual workplace and standardized work of lean manufacturing principles.
• A list of model line standards that the assembly line should adhere to.
• Standard heights development which leads to 50% reduction in inventory.
• A tracking board design and installation that visually defines the status of the pulling cycles.

Summary: In addition to the quality problems reduced, inventory reduced, and the area being cleaned, technicians have stated that they enjoy their job better and have increased their average output of parts by five pieces per hour after the project has been implemented.
Abrasive Waterjets: The Other Alternative Machining Method

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Need: The stream of improvements in the technological world is ever changing and adapting to new trends. It would behoove us as technically competent professionals to ensure that we are educated of new trends and their uses in order to stay one step ahead of an increasingly competitive marketplace.

Overview: For decades, traditional machining methods were the only recourse for those in manufacturing who wished to cut any and all materials. The most basic example of this is the band saw, which served its duty well throughout the years. However, with the increasing proclivity of engineers and designers towards stronger, lighter, and more exotic metals, traditional machining methods of hole making and cutting were proving to be sorely inadequate. Although traditional drill bits and saws could cut these metals, tooling costs were skyrocketing because of the incredible wear the tools incurred. This lead for the market to look for a new way to perform these operations, which, in turn, led to the creation of such alternative machining methods as plasma cutters and lasers. Although both cut material better than traditional methods, they were fettered by different limitations. For instance, lasers are generally limited to cutting material no more than a half inch thick. However, the answer to all of these questions was born in the abrasive waterjet. Abrasive waterjets pressurize water to incredible levels (approximately 60,000 PSI) and insert abrasive (like garnet) to cut all types of material with ease. Also, unlike their traditional counterparts, abrasive waterjets have virtually no tool wear because water does the actual work. In light of the ability of waterjets to be versatile in both cutting and hole making operations, waterjet cutting has become a more viable alternative in many areas of business from food manufacturing to aerospace.

Major Points

- Traditional Methods
- Alternative Methods
- Plasma Cutter
- Laser
- Abrasive Waterjets
- History
- Technology
- Uses

Summary: In summary, abrasive waterjet technology is a rather new, quickly emerging trend in manufacturing. It would behoove us as manufacturing and technology professionals to be informed about this technology, its history, and uses so that we may be better equipped to make insightful decisions in our own jobs.
Have Technology Programs Succeeded Where Engineering Programs Have Failed?

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Dr. John T. Berry

Dr. Taylan Altan

Need: This paper addresses the significant gap that exists between what mechanical engineers and industrial technologists are taught, with regard to manufacturing.

Overview: This paper examines contemporary Mechanical Engineering programs together with those of curricula in the areas of Manufacturing and Industrial Technology and reports on how they each relate to current industry needs. At present a significant gap exists between what Mechanical Engineering students are taught and what manufacturing industry requires. Currently, this gap is being filled by Technology graduates. However, no opportunity is being offered for Engineering and Technology students to work together as they will be required to do on joining manufacturing industry.

It also makes a special effort to examine developments in the Engineering and Technology programs of a number of European and Asian countries and concludes with recommendations for collaboration between Engineering and Technology programs.

Major Points:

• Nationally it has been recognized in the US that weakness in design and manufacturing capabilities is a critical factor in the decline in the nation’s international competition.
• There has been serious external pressure on engineering educators to reduce the number of contact hours. (The ‘120’ hour syndrome)
• Manufacturing has an image problem (‘Dumb, Dirty, Dangerous, and Disappearing’)
• Additionally, there has been a change taking place in the profile of the young engineering educator through “publish or perish” necessity to achieve tenure.

Summary: The problem is partly assuaged through the rise of the manufacturing technology programs. It is suggested that the following trends be followed for manufacturing success:

• Students of Technology need to be made more appreciative of the physics underlying the many suites of process simulating software now available, without becoming expert in the writing of such code. The same is true in terms of their understanding of the analytical and computational limitations of such software.
• They also need to be afforded the opportunity of working alongside engineering students, implementing a truly concurrent engineering approach, just as they are to work on joining industry.
• Where possible, such programs should be housed in Engineering Colleges rather than in Colleges of Education and/or Business. Where this is not possible, internships, which allow them to meet and work with engineers in industry, would be highly desirable.
• It is inappropriate to regard the technology graduate as a second class citizen.
Manufacturing Process Optimization for Contoured Surface Using Laser Tracker

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Need: Although widely existing in many mechanical products, the manufacturing of accurate contoured surfaces remains a difficult challenge in the industry. This problem becomes especially significant for thin parts with contoured surfaces, or helical, irregular, and inclined surfaces. However, the common manufacturing process, such as milling of contoured surfaces has largely remain an “art”, due to the lack of understanding about how the quality, or geometric accuracy of the surface is affected by the combination of multiple cutting parameters such as the feed rate, spindle speed, and cutter profile. It is necessary to construct experimental models to represent their relationships, and identify the optimized manufacturing parameters with given design requirements.

Overview: An important challenge in the manufacturing parameter optimization for contoured surface is how to inspect and evaluate the quality of a machined surface. We utilized a laser tracker from Leica Geosystems Inc. for accurate measurement that was not easily measurable before. In this project, we designed a set of experiments to evaluate the possible associations between the manufacturing parameters and the surface quality. For every experiment, a contoured surface is milled from a three DOF CNC machine. Then a laser tracker is used to capture a set of points on the machined surface, from which a CAD model of the surface is constructed and compared with the idealized model for inconsistency. Color coded image of the comparing result is used to help users adjust the Design of Experiments so that accurate mathematical model can be constructed with less experiments. Finally, when all the data are collected, response surface model of the surface quality is constructed, the combination of manufacturing parameters that yields the highest quality surface is determined.

Major Points:
- Contoured surface inspection and measurement
- The framework for manufacturing process optimization
- Surface modeling and comparison
- Design of Experiments and optimization

Summary: We have tested the manufacturing process optimization framework using several engineering cases. The result is satisfying. Compared to the traditional surface inspection methods, such as CMM and photogrammetry, a laser tracker is capable of collecting a large amount of data accurately and quickly. Users can even measure the machined surface during the manufacturing process, and adjust the following process parameters to future improve the quality of the surface.
A PDA Remote-Commanded Robotic System: Procedure and Analysis

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Need: Manufacturing systems are becoming more autonomous, requiring less operator intervention in daily operations. This is a consequence of today’s market conditions, characterized by global competition, a strong pressure for better quality at lower prices, and products defined in part by the end-user. Industrial robots are good examples of flexible manufacturing systems. Manufacturing engineers need to integrate other technologies with the objective of extracting from robots the flexibility they can offer. This project built a remote-commanded robotic system through a PDA device by using software interfacing and wireless technologies.

Overview: This project is part of a university-funded research project in which the performance of data sockets in a remote-commanded system will be studied. In this project, a PDA (personal data assistant) remote-commanded robotic system is established by integrating GUI web-based interface and datagram communication into a robotic system. It provides a solution in system integration for flexible and efficient manufacturing systems. The development process and the completed system have also been used in teaching a 400 level robotics course in manufacturing technology program.

Major points:

• Literature review of the research
• Introduce the procedure and system integration
• Analyze the system performance
• Discuss of further study

Summary: The presentation examines the technologies applied in establishing the system, introduces the procedure, and analyzes the performance of the remote-commanded robotic system. Laboratory development based on this system for a 400 level robotics course in manufacturing technology program will be introduced and discussed. System analysis and related issues will also be addressed in the presentation.
Optimization of CNC Turning Parameters through Taguchi Method Using the Bio-Based Cutting Fluid

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Need: With the pressure from global climate change, environmental protection, natural resource limitation and government regulations, green manufacturing gradually is becoming a reality. Cutting fluids are extensively used in metal machining processes to enhance machined part quality at the same time reducing machining cost by extending tool life. As majority of existing cutting fluids are petroleum based products, these cutting fluids not only have cost issues related to use, storage and disposal, but also create health and environmental concerns. The bio-based alternate has a better renewability, sustainability, and growth potential.

Overview: A number of soybean based cutting fluids were developed by the National Ag-based Lubricant Center at the University of Northern Iowa. Through the Taguchi experimental design, this project aims to find the optimal machining parameters and concentration level of the soybean based cutting fluid in CNC turning operations, by varying the concentration levels and machining parameters. Two machining characteristics, the machined parts’ surface roughness and tool wear will be measured and analyzed via statistical analyses for the purpose of optimization.

Major Points:
• Environmental and health issues of using petroleum-based cutting fluids
• Benefits of bio-based cutting fluids compared to convention coolants
• Taguchi experimental design and selection of orthogonal array
• Data collection and analysis
• Identification of the optimal soybean cutting fluid concentration and machining process parameters
• Conclusion about the performance of the soy-based cutting fluids

Summary: Being a relatively new research area, the application of bio-based cutting fluids in industries is not prevalent although the bio-based cutting fluids are available in the market for quite some time. This study will try to contribute to this area by providing scientific evidence for evaluating the effectiveness of the soybean based cutting fluid, and if it would be possible for the manufacturing management teams to choose and apply the right fluid in a proper way to optimize the manufacturing process.
Safety
Key Factors for Consideration When Establishing an Emergency Response/Disaster Preparedness Component of a Collegiate Homeland Security and Crisis Leadership Center

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Need: The purpose of this presentation is to explain several key factors that need to be considered when establishing an emergency response/disaster preparedness component of a collegiate homeland security and crisis leadership center. The tragedy of 9/11 and the natural disaster of Haiti have exposed a tremendous need and opportunity for Universities to offer a lead role in the civilian homeland security assessment and training efforts. It is important for Universities to share information and become part of a new network of shared knowledge. Equally important is to understand a few pitfalls to avoid such as: spawning pockets of concerned academic opportunists who create entities without a collaborative and focused effort within a campus.

Overview: The research team aims to show an increasing need for education and training in homeland security and the role that may be played by universities. Whether man-made or natural, disasters require crisis leaders who can think and operate across the breadth of homeland security while at the same time bringing their expertise to the local community for emergency response/disaster preparedness. The research team will explain how the educational system in the United States has only begun to provide the knowledge base and training capabilities needed; and, how universities may create Centers of Excellence in Homeland Security to meet the demands for the desired homeland security professional in the local private and public sectors.

Major Points:
- Responding and reacting to threats/disasters, both man-made and natural
- Identification of information sources and integration into appropriate decision models
- Understanding of threats, areas of vulnerability, and consequences
- Providing assessment and counter operations to threats
- Providing training for assessment and certification of crisis leaders and crisis management

Summary: The conference participants will gain an understanding of the demands for crisis leaders who understand homeland security and are able to provide direction in local or regional disaster preparedness/emergency response efforts. In addition, the team will show how universities may play a lead role by establishing Centers for Homeland Security with education and training focused appropriately on developing the crisis leaders for prevention, preparedness, response, and recovery efforts.
Preparing for the Globally Harmonized System of Classification and Labeling of Chemicals

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Need: The United Nations adopted the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) several years ago. GHS is a new global system to standardize hazard definitions, safety data sheets, classification of materials, and labeling. OSHA is now in the process of adopting these requirements for US companies and workplaces. This standardization should help facilitate in the transporting of goods in the US and overseas because roughly 99% of countries already use this system.

Overview: Students in our industrial technology programs, especially those in the Occupational Safety and Health, Industrial Hygiene, Safety Management, Environment Health and Construction Management Programs will need to know these proposed new requirements. These new requirements will require changes in the Hazardous Communication Program (HAZCOM) and other safety programs, including new labels and Material Safety Data Sheets. US companies will need to know these new requirements in order to ship products and inventories globally.

Major Points:
- History
- What is GHS
- Why is GHS needed
- Why is understanding of proposed standard crucial
- How the proposed OSHA rule could affect the US workplace
- Changes that would be required in classification, labeling, and employee training
- How the HAZCOM standard may be modified to align with the GHS
- Training

Summary: This paper on the Globally Harmonized System (GHS) for Classification and Labeling of Chemicals will provide vital information for attendees in preparing for the proposed OSHA rule on the handling and shipping of chemicals in the US and globally. This paper will also provide information on completing the Material Safety Data Sheet (MSDS) or the proposed new Safety Data Sheet. Finally, this paper will also identify training requirements of the proposed rule.
Bridging the Gulf with Hearing Protection: A Classroom Study on the Effectiveness of Alternatives to Commercial Hearing Protection

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Need: Most people wear hearing protection improperly, if it is worn at all. What can be done if hearing protection is not available? How effective is a simple wad of tissue? What about holding your fingers in your ears or cupping your hand over your ears? No studies found tested tissue paper, fingers, or cupped hands for hearing protection.

Overview: In this presentation we will discuss the test method and results of the effectiveness of various alternative hearing protection compared to commercial foam hearing protection. The purposes of this study were to: Select hearing protection for comparison on their meeting any sound attenuation; Devise a method to test the hearing protection devices (HPD); Select a decibel (dB) level to be used for each frequency measured; Select the various frequencies to measure the attenuation.

Major Points:
- Inefficiency of alternative hearing protection is often mentioned without research sited.
- Need for hearing protection when commercial hearing protection is not available.
- Alternative hearing protection is effective in many instances.
- Practical classroom research can be done to demonstrate studies in safety and safety equipment.
- Research methods do not require expensive kits and programs.

Summary: Attendees will understand that there are alternative ways to protect hearing when commercial hearing protection is not provided. The difference in sound attenuation for each hearing protection device varied with the frequency used for the test.
Students’ Perspective on Safety Education using Second Life as a Tool for Effective Learning

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Need: Educators are searching for cutting-edge ideas to deliver effective instructional methods to students and employers on different aspects of training. The population of students in colleges and universities are different in terms of dependency on technology. Most students are visual learners and are dependent on the use of technology in their everyday lives to satisfy social needs. Educators are seeking methods to increase student learning and comprehension of classroom theory by integrating the students’ need of technology. Teaching industrial safety can often leave the instructor with a level of uncertainty as to whether the students have grasped concepts taught in the classroom. As educators begin to embrace new innovations in teaching and learning, researchers are examining Flow in virtual environments such as Second Life. The researchers see potential in developing collaborative activities which intrigue and lure students into an environment which induces Flow, thereby allowing students to “think outside the box” and analyze simulated situations which are representative of real-world safety issues.

Overview: A pilot study will be conducted in the spring semester of 2011 to determine students’ perspective on an emerging social-visual technology called Second Life. This technology will be used to teach a safety course using Second Life. The site for the pilot study will be conducted in the Department of Agricultural and Biosystems Engineering at Iowa State University. Results will be disclosed during the ATMAE conference presentation.

Major Points:

• Explain the Flow Theory and how it is used in learning
• Student inspection process of the plant facility
• Identify the features and functionality of the ‘classroom island’ using a safety course
• Reveal findings
• How can this study impact safety education and training

Summary: This instructional method of learning is a cutting-edge approach for possible lateral diffusion of this technology for higher education and for industry. Second Life is a feasible and practical approach to deliver distant learning education for safety training well into the 21st century.
Preventing an Industrial Disaster

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Need: Refineries, chemical plants, and other process related industries utilize process safety instrumented systems to take the process to a safe state in the event that predetermined conditions indicating potential for unsafe operations are met. OSHA, who regulates these industries, recognizes and generally accepts ANSI/ISA-84.00.01-2004 Parts 1-3 (IEC 61511 Mod) to be considered as good engineering practice for safety instrumented systems. This presentation will explore the utilization of the Safety Project Life Cycle methodology focusing on the periodic testing requirements of the safety instrumented systems and the need to address network security.

Overview: There are many refineries and chemicals plants located through the United States with a high concentration near the cities located on the Gulf of Mexico from Corpus Christi, Texas to Pensacola Florida area. Safeguarding the process operations of these refineries & chemical plants are safety instrumented systems. Without these safeguards, the potential for an industrial disaster becomes very probable. The standards for design of these systems are indicated in the ANSI/ISA-84.00.01-2004 Parts 1-3 (IEC 61511 Mod). Periodic post installation testing requirements are part of this standard; however, hardware & software testing have been the focus of this testing with little attention to network security. The ISA 64 committee has developed a task force to determine how to address this need.

Major Points:
• Potential for industrial disaster along the Gulf Coast
• History of past industrial disasters
• Regulations addressing process hazards
• Standards and Guidelines for process safety
• Testing Practices
• Network security as a vulnerability for safety instrumented systems

Summary: Attendees will have a better understanding of the issues assuring safe operations of refineries and chemical plants and guidelines related to process safety system life cycle.
Ergonomics Evaluation of Task Demands Among Kitchen Staff in a University Dining Center

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Need: Work related musculoskeletal disorders have been a primary cause of morbidity within the restaurant industry, which greatly affects work satisfaction, effectiveness, and productivity. It is also considered by specialists to be the main reason for work-related sickness absence. Although many ergonomics studies have evaluated workplace conditions, particularly on office areas, very few studies have evaluated the ergonomics conditions of dining center kitchens.

Overview: Ergonomics is an area of knowledge that aims at transforming the workplace, adapting it according to individuals’ characteristics, and the characteristics of their tasks. Thus, ergonomics focuses on analyzing activities during the real work situation. Its objective is to humanize the work defending the premise that it must be adapted according to users’ characteristics in conjunction with socio-technical requirements, objectives to be achieved, and the given working conditions. This study is to evaluate the ergonomics conditions in a university dining center through surveying and interviewing kitchen staff. The ultimate goal is to develop a training manual for instituting training procedures in the dining centers at the university and eventually improving the kitchen staff’s ergonomics conditions and work effectiveness.

Major Points:

- Evaluate the workplace demands faced by a group of kitchen staff at a determined dining restaurant;
- Survey musculoskeletal complaints among this sample of workers;
- Interview kitchen staff for identifying improvement spots;
- Develop training materials that will be used to well improve the staff knowledge and awareness regarding everyday ergonomics aspects.

Summary: The sample of workers selected to participate in the study will properly serve as a parameter to conduct a study for improving ergonomics in the workplace, therefore benefiting the entire group of staff members at the chosen unit. Consequently, the results of the study can be utilized to improve working conditions in similar establishments. The survey and interview agenda has been completed and it is expected the research result will be completed and shared in the ATMAE conference.
Improving Safety Effectiveness and Results in Tough Economic Times via the Balanced Scorecard

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Need: In today’s global and competitive work environment, current and emerging alternative energy manufacturing industries continue to pose safety challenges and opportunities for most organizations. Such challenges and opportunities, however, are exerting enormous pressure on safety personnel who are accountable for injury reduction and corporate social responsibility. Increasingly, organizations are tasking safety personnel with responsibility and accountability for minimizing adverse incidents; reducing costs; and sustaining a safe workplace culture. Consequently, these professionals are directed to incorporate both financial and non-financial measures to bridge the safety performance gulf.

Overview: The safety balanced scorecard is recognized as a tool for translating organizational vision and strategy in four perspectives. This presentation will focus on a strategic management and/or measurement system that incorporates both leading and lagging indicators of safety performance, linked to organizational mission. Relevant issues, scorecard development techniques and examples will be addressed in the presentation.

Major Points:
- Rationale for the safety management scorecard
- Balanced scorecard fundamentals
- The four safety perspectives
- Measures, targets, and Initiatives
- Implementing the balanced scorecard

Summary: In a highly competitive and fast-changing manufacturing industrial setting, the safety of personnel, assets, and a sustainable injury-free work environment are vital for all stakeholders. This presentation will provide attendees insight regarding the application of the safety management/measurement scorecard for driving performance.
After the Fall: Awareness and Prevention of Orthostatic Intolerance

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Need: Safety planners at all levels are aware of the importance of fall protection and prevention on construction job sites and in industry. However, few are as informed regarding the potential dangers of orthostatic intolerance, which can occur after a fall occurs. While a safety harness may prevent a fatal fall, the reduced blood flow caused by being suspended by the harness can result in loss of consciousness and even death within 10 minutes. These injuries, also called “suspension trauma” or “harness-induced pathology” can be prevented through a program of awareness, education, and planning.

Overview: Much of the current fall protection emphasis is justifiably focused on prevention and mitigating the risks of the fall itself. Better work practices, safety harnesses, and shock absorbing lanyards have all contributed to an increase in avoiding or surviving a fall. However, much of the planning for fall ends at this point, with the result that many organizations and individuals are not aware of the significant dangers that are still present after the fall. Through training, planning, and adoption of best practices, injuries associated with orthostatic intolerance can be reduced and mitigated.

Major Points:
- Definition, symptoms, and description of orthostatic intolerance
- Fall and suspension trauma statistics
- Awareness
- Planning
- Best practices of fall rescue
- Educational and leadership approaches
- Conclusions and recommendations

Summary: Attendees of this presentation will understand the dangers, causes, and symptoms of orthostatic intolerance as well as how they can quickly develop into life-threatening conditions. Planning and best industry practices to mitigate these risks are covered as they relate to safety planning professionals in a variety of organizations.
The Impact of Employee Trust on the Perceptions of Organizational Safety and Quality

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Need: Human factors play an important, but often overlooked, role in the management of safety and quality in the work environment. One of these factors is the level of trust employees have in their supervisor and the management of the organization. Anecdotal evidence has linked a stronger safety climate with a more robust quality climate as both programs depend on team-oriented employees who can spot potential issues and correct them on the job. An increased understanding of factors influencing employee perceptions of the priority of safety and quality within the organization is an important consideration when planning safety and quality educational intervention.

Overview: This presentation will discuss the influence employee trust has on safety and quality climates as well as examine the relationship of organizational safety and quality. Data findings will be summarized on the effects of trust on employee perceptions of the priority given to organizational safety and quality within a high hazard work environment. Implications for managers, policymakers and researchers will also be discussed as they relate to the success of occupational safety and quality programs.

Major Points:
• Previous research on employee trust
• Theoretical linkages between safety and quality
• Synopsis of data findings
• Implications and recommendations for safety and quality professionals

Summary: Data on the effects of employee trust on organizational safety and quality climates will be summarized and implications for safety and quality professionals will be shared. Information from this presentation may assist managers, supervisors, and researchers as they develop safety and quality programs for a high hazard workplace.
Improve Organizational Safety by Implementing a Standardized Crisis Management Program

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Need: Hazards to personnel, property, the environment, and the general public are inherent in the industrial workplace. Effective risk management may control or mitigate these hazards, but sometimes the best efforts do not suppress a mishap or safety crisis. When this occurs, an organization’s crisis response is the key to avoiding a progressive mishap or crisis situation. This presentation will address the importance of standardized crisis management in avoiding a progressive mishap. Additionally, the presentation will address key issues in the development and implementation of a crisis management program for both private and public industries.

Overview: In terms of industrial safety, crisis management involves the actions an organization takes after an uncontrolled hazard turns into a mishap. The aim is to establish actions so the mishap does not present a progressive harm to personnel, property, the environment or the public. Crisis management consists of the strategy used to identify, assess, understand, and handle a mishap once it occurs. The time period concerned is between the instant of calamity to initiation of a recovery. Standardization of crisis management insures all levels in an organization speak in the same language and operate with the same guiding principles when an incident occurs. This is a concept that can be easily transferred across different industries.

Major Points:
- Definition, type and elements of a crisis.
- Models and theories of crisis management.
- The importance of standardization in crisis management
- Examples of successful crisis management within both private and public sectors.
- Recommendations on the implementation of standardized crisis management in industry.

Summary: Attendees will be exposed to the key elements of crisis management along with recommendations for implementing a standardized crisis management plan. This topic is of value to any organization seeking to minimize the progressive dangers associated with crises.
A Review of Fire Protection and Life Safety Arrangements Onboard a Deepwater Oil and Gas Drilling Rig in the Gulf of Mexico

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Need: With the demand for energy, more emphasis is being placed on increased oil and gas production, including offshore. For the production workers, stationed miles from any emergency assistance, the need for safety and fire protection is great. This paper examines safety and fire protection issues aboard an offshore drilling rig.

Overview: The inherently hazardous nature of deepwater drilling, high population density of a drilling installation, and spatial, temporal and weather impediments to safe evacuation dictate a systematic and organized approach to the planning and management of fire and life safety risks. The foreseeable emergency scenarios include fire and explosion, blowout, marine/helicopter collision, loss of stability, structural damage, hydrocarbon and/or H2S, exposure, and severe weather. Specifically, an offshore drilling rig, the ‘Noble Paul Romano’, was inspected approximately 125 nM from the coast of Galliano, Louisiana, at a water depth of 2,950 ft.

Major Points:
- Formal evaluations were conducted, and addressed through safe design, construction, installation, operation, maintenance, and management processes. In particular, the following items were evaluated:
  - The passive and active fire protection arrangements of the ‘Noble Paul Romano’ include fire and blast-protected bulkheads and decks
  - Hazardous area ventilation,
  - Automatic fire and gas detection systems, fire suppression systems, and portable fire extinguishers
  - Fire and gas-protected means of egress, areas of refuge, emergency lighting/power, alarm and communication systems, code-compliant interior finishing, fire drills, and an incident command system.

Summary: A few areas of concern were identified, and recommendations are made to meet the Life Safety Code and US Coast Guard regulations.
Developing a Wind Turbine Safety Program for Wind Technician Training Programs

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Need: With the emerging renewable energy fields are new concerns regarding safety and relevant safety training. In the wind turbine technology field the vital consequences of an accident are magnified by high angles, heights, and voltages. An OSHA-10 general industry or construction course designed for manufacturing or residential construction does not adequately emphasize the importance of these dangers.

Overview: This presentation will explain the aspects of the job of a wind turbine technician and the dangers that exist in this field. Existing OSHA-10 courses for general industry and construction exist and provide room to accommodate a more focused approach for specific industries. This presentation will outline where this room exists and how to implement wind technician specific training. Time will also be spent outline opportunities and barriers to a successful implementation.

Major Points:
- Explain aspects of the wind turbine technician field that are inherent dangers
- Explain how an OSHA-10 course can be modified to emphasize wind turbine safety and continue to meet the OSHA training requirements
- Describe important supplemental training to the OSHA-10 course for a wind turbine safety program
- Outline opportunities and barriers to effective implementation

Summary: Modifying an existing OSHA-10 training course by the methods OSHA allows can provide the foundation for trainees to be better prepared for future careers in the wind turbine industry.
Teaching Innovations
Using the Agile Organizing Framework to Create Adaptive Learning Environments for Technology Development

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Need: Effective pedagogy for teaching people how to program has remained an elusive target for many years. Evidence of this is the existence of an entire “CS1” mini-track that is always a part of the Annual Meeting of the Computer Science Education Special Interest Group of the Association for Computing Machinery (ACM SIGCSE). In a recursive way, the responsiveness-to-change ethic of agile software development points the way toward a more agile pedagogy, replacing the structures that are perhaps overly rigid both in traditional software development and software development education.

Overview: Software development is inherently a learning process. Agile software development seeks to cultivate an environment where individuals and teams embrace the learning process to deliver higher quality products rapidly. Vidgen & Wang (2009), using theoretical constructs from the literature in complex adaptive systems (CAS), observed that agile software development teams demonstrate six emergent capabilities. These are: coevolution of value, sustainable working with rhythm, collective mindfulness, sharing and team learning, process adaptation and improvement, and product innovation. They developed the Agile Organizing Framework (AOF), which outlines the characteristics of technology development environments that enable and inhibit the emergence of these capabilities. We have adapted the concept of agility using the AOF and further grounding in social constructivist learning theory, to outline the characteristics of an undergraduate technology development course that realizes co-evolving, self-renewing principles. The goal is to identify pedagogy fostering emergent capabilities, especially sharing and team learning, within problem-solving teams where work practices are similar to those encountered in software development. We conclude by presenting an approach to visualizing the results to determine the relative strength of each of the self-renewing principles.

Major Points:
- Establish the need for, and benefits of, a complex adaptive learning environment for technology development courses at the undergraduate level
- Integrate relevant learning theory into the Agile Organizing Framework
- Summarize the key elements and capabilities of the AOF
- Present an adaptation of the AOF as a pedagogical approach
- Provide an assessment tool for educators to evaluate whether they are achieving an environment that effectively cultivates emergent capabilities of an agile team

Summary: Attendees will understand the principles required to create an adaptive learning environment in technology development courses at the undergraduate level, how they relate to theory in learning and complex adaptive systems, and how to assess whether a course realizes agile emergent capabilities.
Transformative Learning: Humanizing the Digital Natives

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Need: As students increasingly use social networking, the power of these tools must be explored to expand high interest investment in learning. The strength of interpersonal learning communities provides a balanced approach of technology and the human, interactive element of transformative learning. Technology tools such as online textbooks, e-portfolios, and wikis, combined with powerful transformative learning experiences must be thoughtfully merged to help transition students from the use of technology predominantly for social networking to a more powerful lifelong learning model. This presentation will demonstrate the power of this curriculum model.

Overview: Sustainability in the Built Environment is a course being taught at Minnesota State University Moorhead. The principles of sustainability are taught utilizing a four-part transformative learning model by Mezirow (1981): experience, critical reflection, reflective discourse and action. One of the overriding goals of the course is to help students consider social action as it pertains to sustainability issues. A three-step process for social action begins with: awareness of a need to change, camaraderie with others committed to change and learning actions that are appropriate to help facilitate that change (Mezirow, 1993). Effective uses of technology to research, critically reflect, and create a shared database of information for the learning community allows the four-part transformative learning model to unfold through the semester.

Major Points:
- Use of Questia.com for all literary sources of information supports sustainable principles
- Creation of a wiki provides a warehouse for students to file research and presentations on a wide variety of themes within the course
- Inclusion of service projects such as needs assessment on campus create an action emphasis
- Current events and brainstorming sessions identify areas of interest for students’ research
- Speakers convey expert opinions for student evaluation and discourse
- Film reviews from differing perspectives allow for debate and reflective discourse
- Careful selection of artifacts from the student constructed database are culminated in electronic portfolios of student experiences in the course that reflect their academic and social growth.

Summary: The participants in this presentation will understand the various elements utilized to create a powerful blend of online technologies and in-class transformative learning that can be incorporated in a wide variety of course topics that will enrich and transform students. Demonstration of student satisfaction and course content retention will underscore the power of these methods.
Modeling Instruction for the Net Generation: The Use of New Media to Frame Classroom Conversation in a Graduate Seminar Course: Possibilities and Predicaments

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Need: Recent studies have indicated a steep rise in media use by children, teenagers, and young adults. At the same time studies show continued disengagement and shorter attention spans of young learners. This presentation demonstrates the use of new media activities in graduate classroom, to enhance the learning experience, and promote student interest and engagement.

Overview: Several studies in recent years have suggested a substantial increase in youth, and young adults’ media use. This presentation will discuss instructional strategies to better address the young learners of today. The discussion will be supported by illustrative new media activities designed for a graduate seminar class. The presentation will draw on the Web 2.0 model of interactivity, and argue for a multi-directional flow of information, instead of the one-way lecture format in a traditional classroom. Interactivity invites participation, where young people more than most like to voice their opinions, and join the conversation. The ubiquitous phenomenon of social networking for instance, which has no doubt contributed to the greatly increased media use by the young people today, is used as a model to formulate instructional strategies. The experiment supports using the online component of any course in creative ways to generate greater interest, interaction, and extended learning environment conducive to exploration and risk taking. This presentation will highlight some strategies employed in a young adult face-to-face graduate seminar class that employ and encourage enhanced new media use for instructional purposes. Common threads to apply the lessons from this case to broader instructional forums will be discussed. The presentation will also discuss possible problematic consequences of encouraging media use in and beyond the classroom, and some ways to counter those effects. The discussion will attempt to distill the learning from the specific case application to broader arenas, in the context of the classroom of the future.

Major Points:

- Introduce the evidence for:
  - The enhanced media use by young people today
  - The lack of student engagement, attention, and interest in the classroom
- Outline strategies to incorporate new media and online interactivity in the classroom
- Illustrate the case of TEC 5173 Global Technology graduate seminar course in implementing these strategies
- Discuss results based on student evaluations; extending the discussion to include any unintended and/or negative consequences
- Contextualize media use as a significant feature of the classroom of the future

Summary: The presentation will illustrate the use of new media, and interactivity in the context of enhanced media use by young learners, as a proactive strategy to promote student engagement in the learning process.
The Future of Learning - Engaging Generation i - The “Internet Generation” In the Classroom

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Need: More so than ever before, technology impacts the educational process of a new generation of students. Dubbed the Internet Generation (Gen i), these students, born after 1994, present multiple challenges in the classroom, and many educators have noticed a shift in the attitude and culture of today’s students. While technology itself cannot improve the educational experiences of these students, its effective use can enhance learning. Sadly, only a small percentage of educators feel prepared to use readily available technologies in their classroom. The presentation will equip educators with the necessary knowledge and skills to effectively use technology to engage Gen-i in the classroom.

Overview: Students of the Internet Generation are: technically savvy - many could program a phone before they could read; have a short attention span - too much information for too long doesn’t work; and independent thinkers - with direction, they are resourceful and innovative in their approach to problem solving. Due to these attributes and others, the classic approach to teaching is less effective. Thus, our teaching methods require modification so that lessons are appealing to this new generation of learners, while at the same time, providing an effective learning environment. In addition to examining several techniques related to the use of technology in the classroom, other teaching strategies, such as breaking lessons into cubes, or 22-minute segments, are discussed.

Major points:
- Effective use of video clips, such as YouTube, to illustrate concepts
- Use of a Wiki to engage students in learning new vocabulary
- Creation of Avatars and their use in virtual worlds to learn about new cultures
- Use of Web Search activities and WebQuests to engage Gen-i learners in the research
- Explore ways where any course can benefit from the effective use of technology in the classroom.

Summary: Attendees of this presentation will leave with an understanding of the profile of Generation Internet students and why there is need to provide effective use of technology in the classroom. A variety of suggested techniques and projects, which can be used to improve any course, are reviewed, as well as implementation strategies. As a result, when effective use of technology is incorporated into the classroom, students become motivated, more involved in the learning process, and learning is enhanced.
Engaged Learning with a Technology Presence: Bridging the Gap between Classroom Theory and Professional Experience to Fulfill Societal Needs

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Need: Engaged learning is a teaching and learning methodology that connects curriculum with identified community issues and needs. Engaged learning engages projects that serve the community and build their social and academic capacities. Engaged learning was based off the views of John Dewey, a philosopher and educator who advanced the concept that active student involvement in learning, insisted that this is an essential element in effective education. He viewed the community as an integral component of educational experiences for both enhancing a student’s education and for developing future societies. The need for engaged learning and an implementation of technology will further develop training for students in technological discipline, and will fulfill a societal need.

Overview: Engaged Learning is an educational strategy that allows classroom skills and knowledge into practice while serving the community. It combines civic involvement with academic coursework in a manner that benefits both the student and the community. Engaged Learning promotes a community partnership while course objectives are met, students turn classroom theory into practice and gain professional experience, and a pertinent community need is fulfilled.

Major Points:
- Develop technological theory and application for students in a technology discipline
- Identify a society/community need where is a lack of a technological presence and means
- Develop a technology project where students can provide instruction and training for the community
- Enhance technology applications for students and community at large

Summary: Engaged learning combines experiential learning and community service opportunities. This can be distinguished in the following ways: curricular connections, student voice, reflection, community partnerships, authentic community needs, and assessment. Curricular connection is integrating learning into an engaged learning/service project is key to successful engaged learning. Student voice is beyond being actively engaged in the project itself, students have the opportunity to select, design, implement, and evaluate their service activity, encouraging relevancy and sustained interest. Reflection is structured opportunities are created to think talk, and write about the service experience. The balance of reflection and action allows a student to be constantly aware of the impact of their work.
Making the Leap of Understanding: Metaphors for Expanding Student Learning in Technology

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Need: Technology faculty members often find that students experience difficulties while trying to make meaningful connections with the topics being discussed, especially abstract and complex concepts. This is partly due to the wide range of learning styles and interests which students entering technology programs have, and these may not be addressed for all through conventional instructional techniques. By using suitable metaphors embedded within class and laboratory activities, the material can be related to student interests at a personal level. Metaphors enable us to understand one concept in terms of another. Metaphors or even simple analogies help students make the connections and foster creative thinking. Creative and inventive thinking is important for motivating and inspiring students to engage actively in learning process. Recognizing that parallels exist between different domains can make learning meaningful and memorable for the students. For example, after seeing the layout of a computer system board a student may point out that that the layout of components and interconnecting tracks looks like the aerial view of a city. This in turn will point to the need for equivalents of one-way streets, traffic control mechanisms, or area headquarters, being needed in the system board as well. As students attempt to make these new connections they will be immersed in learning. Identifying counter-metaphors can be helpful as well in developing boundaries. Taken together these activities will enable students to see how technology spans across and connects different realms.

Overview: Teaching and learning across the technology curriculum is structured for progressively expanding students’ understanding. Drawing on parallels between different areas, instructors can point out not only how these are functionally similar, but how the solutions developed in one realm could, with suitable modification, be applied in a totally different area. Similarities that exist between electrical, mechanical, and hydraulic systems are well documented and along with familiarizing students with these, students can be encouraged to develop their own metaphors about different technology topics. This often extends students in unexpected, occasionally humorous, but nonetheless insightful ways. The presentation will provide suggestions on classroom activities that can assist identifying metaphors, thereby forming new learning linkages in a variety of technology topics.

Major Points:

• Exploring the use of metaphors in visualizing and internalizing learning by technology students.
• Ideas for encouraging students to develop personal metaphors based on personal interests enabling students to see the interconnections between different domains.
• Modifying the questioning and feedback method used as part of in-class, demonstration, or laboratory activities based on the manner in which different students view learning.
• Use of metaphors for promoting critical thinking suggested by ongoing cognitive research. Higher level learning is built on existing foundations of knowledge. The connections between new concepts and the existing knowledge in the human brain is a part of the biological process of learning that is critical for making learning effective and permanent.
• Samples of metaphors related to computer electronics and manufacturing technology instruction.

Conclusions: Thinking in terms of metaphors helps to abstract out some key component of a technology-related topic in a very tangible and vivid manner. Metaphors also allow students additional opportunities to take ownership of the material and of their learning. By using metaphors in conjunction with existing instructional methods, technology faculty members will be able to reach students with a broader range of learning preferences. As students get more proficient in finding metaphors they will also be able to identify similar behavior between otherwise dissimilar systems. The ability to transfer the essence of their learning experience from one realm to another will deepen and personalize their learning experiences.
A Programmed Flowcharting Approach to Lesson Planning for Technology Courses

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Need: A majority of courses in technology related programs are taught using a combination of lecture, demonstration, simulation, and laboratory activities. The lesson plans developed by instructors for these courses are predominantly in a linear format. Classroom teaching experience in contrast reveals that instructors frequently need to transition between content areas, adding short reviews of material from an earlier section or even from a previous course, all while accommodating advanced learners and those at remedial stages with different learning preferences. A traditional lesson plan thus may not be able to represent the complexity of a dynamic technology classroom. By including a flowchart based approach to lesson planning, instructors can plan out various phases of the lesson, and include various scenarios that may occur in the technology classroom, resulting in better classroom management and learning for the students.

Overview: Faculty members in technology programs often rely on prior experience for identifying the content, the level of students’ understanding, the difficulty of the material, and the amount of practice needed while constructing lesson plans. Lesson planning goes beyond the conventional slides and printed laboratory activities. New faculty members may find the process of lesson planning somewhat enigmatic, as these often require the ability to shift between coverage of content based on student needs using different techniques. It also requires continuous probing of students’ understanding and providing prompt feedback. The presentation will provide ideas drawn from programming and flowcharting to enhance the classroom learning experience for the students, while making lesson planning more manageable. Conventional and updated lesson plans will be compared and the issues associated with developing these will be discussed.

Major Points:
- Conventional technology lesson plans for lecture, demonstration and laboratory activities
- Need for updating lesson plans for including dynamic nature of technology classroom
- Programming and flowcharting constructs applied to lesson planning
- Emphasizing organization and safety through lesson planning
- Differentiation learning using scenarios and case studies integrated into lesson plans
- Updated sample lesson plans using flowcharting for lecture, demonstration, and laboratory
- Challenges and rewards of implementing a flowcharting based approach to lesson planning in technology courses.
- Faculty reflections on the lesson planning process in computer electronics and publishing technology classes

Conclusions: Interleaving theory, simulations and applications in technology courses while continually monitoring student understanding, requires instructors to go beyond the conventional lesson plan. The presentation will discuss how a flowcharting based approach to lesson planning can be used for dealing effectively with students at various understanding levels, while maintaining interest and linkages with the topic.
Advanced Technology for High Performance Teaching and Managing Industrial & Engineering Technology Classes and Laboratories

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Need: The millennial generation’s learning styles and ever increasing performance expectations for both students and faculty require that we advance our instructional practices and that we capitalize on new and emerging capabilities with technology. At the same time, increased time pressures of faculty require that we maximize the efficiency with which we employ new instructional and management technologies.

Overview: This presentation will highlight a series of new and emerging instructional technologies and provide vignettes of their use in Industrial Engineering Technology classroom and laboratory instruction. We will provide an informative handout (in addition to our paper) and a list of resources that facilitate implementation by interested colleagues.

Major Points:
- Classroom/Electronic Response Systems
- Curriculum Alignment via Assessment Databases
- Podcasting and other forms of communication facilitators
- Performance stimulating enhancements to WebCT/Blackboard such as Signals (Progress & Early Intervention System) and HotSeat (In-process [instruction] Electronic Interaction)
- Assessment databases & online systems
- Web 2.0 Instructional uses of Twitter & Facebook
- Cloud Collaboration, Editing, Storage and Access (e.g., Google Docs, Adobe Buzzword, MS Office Live)
- Video & Other Conferencing Tools
- How advanced technologies interact with the millennial student
- The demands and benefits of advanced technologies for faculty

Summary: Highlights of successful implementations of advanced instructional and management technology will be shared as they apply to Engineering and Industrial Technology. Q&A time and resources will be provided.
Spatial Visualization Skill Assessment Strategies in Introductory CAD Courses

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Need: CAD is an integral component in curriculums related to engineering and technology. However, CAD courses have taken on a much broader role and, in addition to the development of technical skills, typically include learning outcomes that emphasize the development of cognitive skills related to perception and visualization. With the elimination of manual drafting courses, the College of Technology at BGSU has shifted fundamental concepts such as orthographic projection and related 3D-to-2D visualization concepts to introductory interdisciplinary CAD courses. This presentation documents the outcomes of a study structured to investigate the potential for using spatial visualization skill assessments to assist faculty in evaluating success in meeting learning outcomes in these CAD courses. The study also looked at the extent to which the pre-class test was effective as a predictor of academic performance.

Overview: The ability to conceptualize three dimensional space and form is fundamental to development of 3-D spatial visualization skills and is often cited as one of the major goals of engineering and design education. In order to investigate the effectiveness of an introductory CAD course in meeting goals related to development of visualization skills, this study utilized the Purdue Visualization of Rotations (ROT) test, which has been widely used in research related to multiple disciplines. Students in the course were from varied academic programs enrolled in three separate sections of the course. The study used a pre-test and post-test to analyze and assess changes in spatial visualization performance among students over the duration of the class in comparison with students in a control group. The outcomes were also analyzed relative to other factors such as prior coursework, as was the relationship between the pre-test results and class grades in order to determine the extent to which the results predicted academic performance.

Major Points:

• Overview of the need for spatial cognition outcomes to be incorporated into introductory CAD courses
• Overview of the literature related to the Purdue Visualization of Rotations test.
• Outcomes of the pre-and post test, including statistical analysis.
• Outcomes of the analysis relative to the pre-test as a predictor of academic performance.
• Recommendations for how faculty can implement spatial visualization skill instruments to evaluate learning outcomes.
• Recommendations for early-intervention strategies for improving academic performance.

Summary: Attendees will be presented with a framework for assessing the success of an introductory CAD course in meeting learning objectives related to spatial skills development. This will assist faculty in determining the extent to which spatial skills assessment instruments evaluating the application of similar strategies in their courses. Attendees will be presented intervention strategies for assisting students with test scores suggesting a deficit in spatial visualization abilities.
Industrial Management Instruction: A Study of Live Versus Online Course Applications and the Use of Blended Techniques to Enhance Learning in Both Environments

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Need: A recently released study sponsored by the Department of Education using meta-analysis states that “on average, students in online learning conditions performed better than those receiving face-to-face instruction” (Means, Toyama, Murphy, Bakia, & Jones, 2009). Few would argue against the utility of teaching management theory online but are we limiting learning to the lower levels of understanding? This presentation identifies and contrasts results between otherwise identical live and online courses for senior/graduate level students rather than relying on meta-analytic techniques. The study groups will consist of students enrolled in courses hosted by the University of Central Missouri.

Overview: Is online instruction truly superior to live course work at all levels of learning? The answer to that question goes to the core of this study. What are the limits of online education, the efficacy of classroom video with online course work, and how it compares when contrasted with student application and mastery to the areas of ethics, leadership, and decision making? These three aspects of a senior/graduate level course require more than simple background knowledge, they require choices, actions and a peer reviewed defense of the course chosen. As a minimum, this project will use an online course as a control group, a second online course as a test group, and a third in a live course setting.

Major Points:

- Are hierarchical learning levels equivalent in online and live classes, and if not, where is the break point?
- Do students value aspects of live and online training are blended together?
- Will technological difficulties interfere with mixing applications?
- Do grades differ between questions written at different hierarchical learning levels?

Conclusions: Information presented in this study will serve as a reference to help establish an empirical baseline of best practices for live and online instruction. The goal will be to establish guidelines for faculty to incorporate instructional methodology to management course work.
Using Cross-Disciplinary Virtual Student Corporations to Model Cybernetic Organizational Systems

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Need: Throughout history human beings have found that the most effective and efficient way of managing the uncertainty of information is through the formation of organizations. Organizations opting to follow the open systems typology draw their strength from interdependence between their operations and the environment. Contingency theorists explain that organizations whose internal features match the demands of their environment achieve the best adaptation and results. The purpose of this presentation is to provide an explanation of how and why cybernetic open systems can exist and in which environments they can effectively operate as management systems. A Kent State University student led virtual corporate simulation serves to illustrate concepts.

Overview: University faculty have created an environment in which students are required to create a virtual corporation through which the development of cross-disciplinary skills is an integral part of the curriculum. Students enrolled in Cost Accounting, Business Management, Computer, Electrical and Mechanical Technologies participate in the virtual corporation. All concepts currently taught in respective discipline classes are applied to strategic planning and day-to-day operation. Students are required to develop the infrastructure and synthesize management techniques. This presentation incorporates specific student decisions and explains student rationality in selecting the open systems cybernetic subclass as their optimal organizational form. The presentation concludes with a discussion of applications in which cybernetic system concepts provide unique solutions.

Major Points:
- Description of cybernetic open class management systems
- Application of instructional simulated cybernetic management systems
- Discussion of how TQM has led scientific management to embrace cybernetics procedural controls
- Explanation of how application of cybernetic systems are enabling institutions to successfully achieve accreditation

Summary: Organizations opting to follow the open systems typology draw their strength from interdependence between their operations and the environment. Several key characteristics of open systems typology enable the cybernetic system subclass to exist. These include their focus on information gathering, loose coupling of the organization’s structural components, the presence of feedback loops and their ability to fight entropy. KSU Technology Faculty have created a student led virtual corporate simulation which serves to illustrate concepts and equip students to prepare students to design and operate cybernetic systems upon graduation.
Increasing Student Attainment and Satisfaction in Large-Sized Lecture Classes Using the Game Shows Cognitively Active Learning Method

Ms. Margaret S. Lee
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Need: Short duration lecture periods (sixty minutes or less) and large class sizes (fifty or more students) typically render classical active learning techniques unmanageable and ineffective. Further, those techniques which actually can be implemented in such settings, e.g. think-pair-share activities, one minute papers, and the like, are problematic when the learning task consists of applying math- and science-based technical knowledge. I will present a classroom tool I developed which I call Game Shows and demonstrate how I used it successfully to increase both student attainment and satisfaction in several short duration and large class size technical applications courses.

Overview: The Game Show method is my own adaptation of the cognitively active learning method known as practice-with-feedback. I will discuss the pedagogy of cognitive active learning in general, the practice-with-feedback method, and the challenges with implementing these in a lecture setting with high student counts. I will present the specific components of the Game Shows method, with examples, and discuss which specific aspect of learning and/or motivation each component engenders. I will present both grade performance and student self-assessment statistics indicating the effectiveness of the method.

Major Points:

- Brief background of active learning, with review of the distinction between cognitively active learning and behaviorally active learning and why cognitively active learning is more efficacious for application-type coursework
- Overview of the traditional practice-with-feedback cognitively active method
- Discussion of the barriers to implementing these methods in short-duration large-size classroom settings
- Explanation and examples of my own Game Shows method, including discussion of why each component of the tool is present and the particular role it serves
- Presentation of both assessment-based and student self-reported attainment and satisfaction statistics in courses where I have employed the Game Shows method

Summary: Attendees will learn why cognitive active learning is beneficial to student attainment and satisfaction, and how the Game Shows method can be used to bring this type of active learning into a large-sized short-duration lecture format classroom.
Bridging the Gap between the Industrial Environment and the Classroom via Project-Based Learning

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Need: Recent engineering education research has concluded that most engineering curricula do not promote attainment of many characteristics desired in practicing engineers. Methods to attain these characteristics include both project-based learning (PBL) and simulation of workplace situations in the educational environment. The presenter will outline the use of both PBL and workplace simulation through the implementation of a semester-long project in a senior-level Data Acquisition course taught out of the Department of Engineering Technology at Northern Michigan University.

Overview: A typical undergraduate experimental analysis or data acquisition course will review topics including; sensoring, hardware requirements, testing techniques, computer integration, software use, and possible application of these concepts to actual acquisition of data from a process control test bench or other defined system. While the above topics are being covered in a data acquisition course at NME, they are incorporated into a semester long project which very closely resembles a project that might have to be done in the work environment. The students are asked to determine something they want to know about how their personal vehicle operates. Project ideas are reviewed by the instructor and may be modified based on the project complexity and facility/equipment support required. Students are then put to the task of implementing a test to answer their question. This includes; determination and procurement of sensoring equipment, development of test plan, execution of the test plan, analysis of results, and presentation/documentation of results. Examples of projects include; analysis of RESTORE© on cylinder pressures, effect of brake pad material on brake rotor temperatures, characterization of alternator output, vehicle warm-up time, fuel economy vs. tire pressure, etc. Efforts to “Bridge-the-Gap” in other courses at NMU, including Quality Control, Mechanical Design, and CNC Manufacturing, will also be briefly discussed.

Major Points:
• Need for courses to mimic real world engineering applications
• Review of project based learning concepts
• Details of project implementation
• Examples of projects
• Student Feedback
• Implementation of this concept to other courses at NMU

Summary: Involving students with real world applications projects can better prepare them for an engineering career. Implementation of a project to attain this goal in a data acquisition course, as well as other engineering technology courses, is reviewed.
Engaging the Technology Student Through the Use of Web-Based Video Broadcasts

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Need: The potential exists to invigorate the classroom and the participation of its students by envisioning the use of a new generation of portable hand-held video and audio technology in conjunction with innovative internet services such as Skype. For design and construction technology students, the on-site building experience has in many instances been logistically problematic. When large student groups try to take field trips to building sites, issues such as location, safety, poor visibility, limited access and individual participation are often encountered and make the learning experience less than it should be. The standard model of classroom lecture can induce passivity in the student’s attention to activities which should be very interesting and engaging. This presentation will report on experiments in allowing the student to become the “instructor” through the imaginative use of this technology in a flexible but structured arrangement that is more peer oriented and recognizable as a mainstream media format.

Overview: Students in construction technology as well as building design courses have traditionally benefited from exposure to the real-world field experience of building activity. However, the “field classroom” still employs the same instructor-audience method to communicate basic knowledge of the activity albeit outside the classroom. Based on a process of selected student proposals, we are exploring the technique of small student teams “hosting” a program of construction activities through an interview format with site supervisors from remote locations throughout our surrounding community. This is a real-time, video/audio broadcast over the internet into the classroom that is intended to be an interactive and engaging learning experience for students.

Major points:
- Review research on the effectiveness of classroom instruction techniques using video technology
- Identify the course instruction and need for real-time field observation of construction activities
- Explanation of evaluating the suitability and cost benefit of available off-the-shelf video/audio equipment and internet services
- Present structure and format of student presentations
- Present findings through classroom evaluation surveys and their effectiveness

Summary: Attendees will learn how design & construction technology student teams are using new portable, hand-held video and audio equipment in conjunction with new web-based services such as Skype to broadcast real-time into the classroom a variety of building construction activities from remote site locations. The utilization of this new and less expensive technology has broad applications for many classroom environments looking to develop more engaging student presentations and projects.
Reflective Course Design to ‘Bridge the Gulf’ between Student Dependence on Electronic Delivery of Core Content and a Decline in Student Reading

Mr. Thomas M. Mitchell
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Need: Current literature suggests the ubiquitous and injudicious use of PowerPoint-type presentations to deliver core content in higher education classes may have a deleterious effect on student learning. The significance of this issue is exacerbated by a continual shift of student focus away from class preparation and self-learning fostering an environment where students forgo assigned readings and independent research.

Overview: As the development of life-long learning is a principle embedded in the college experience, it would be counterproductive to blindly continue a practice which circumvents educational goals of scholarship, student responsibility, and encouragement of free thought. Reflective course design and integration of information computer technology (ICT) can ‘Bridge the Gulf’ between traditional student preparation for class and the visual learning power of computer integrated classrooms, software, and interfaces.

Major Points:
• Decline in completion rates of student assigned reading for classroom instruction.
• Increased and unreflective use of ICT technology (PowerPoint) encourages student to avoid reading and other measures critical for active learning to occur
• Potential power of visual learning modalities to increase propensity for constructivist learning opportunities
• Methods of assessment to encourage student preparation for active classroom sessions
• Compare and contrast teaching and learning styles using ICT technology

Summary: Participants will become empowered to realize reflective and purposeful design of ICT integration into course instruction to encourage class preparation and enhance active learning. This curriculum design method can be integrated in all disciplines and is particularly effective in the applied arts and technology field.
Discussing Controversial Topics in the Technology Classroom: Benefits, Strategies, and Challenges

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Need: Using controversial topics for teaching and learning has several benefits identified in the literature. Skills such as applying knowledge to real world applications, critical judgment and evaluation, social and ethical considerations, and oral and written communication are important learning outcomes of this practice. Utilizing several models of teaching and learning, this presentation will present the benefits of discussing controversial topics in the classroom, as well as strategies and challenges of handling these types of discussions with technology students.

Overview: Although students often consider topics in science and technology to be objective and unchanging, controversies have existed for hundreds of years in most fields of study. Limiting students the opportunity to debate controversial topics in the discipline denies students the chance to critically analyze, think, reason, and justify their thoughts. However, instructors may have some hesitation about introducing controversial ideas in the classroom for several reasons. This presentation will give examples of controversial topics that might be discussed in the technology classroom, the benefits of these types of discussions for student learning, strategies for managing the challenges of classroom discussion and debate on controversial topics in the field of technology.

Major Points:
- Controversial topics in the field of technology
- Benefits of using controversial topics in teaching and learning
- Strategies for effective management of classroom debate and discussion
- Handling the challenges of integrating controversial concepts into technology coursework

Summary: Attendees will learn how to use discussion and debate of controversial topics in the technology classroom to increase the understanding and engagement of students. Strategies and best practices for integrating controversial topics into technology-based courses will be shared.
Curricular Tools for Enhancing Workplace Relevancy: A Response to Industry Input

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Need: As educators in continually evolving fields such as technology and engineering, we are tasked with ensuring the skills our students master do indeed meet the needs of their employers. Finding ways to apply instructional techniques for students to meet those needs is a daunting task. As a result, we must develop instructional techniques that teach necessary skills, yet are cost effective.

Overview: The results of an extensive industry survey provide understanding of specific skills desired by current workplace personnel. These results provide insight for technology educators to enhance curriculum and better prepare students for entry into industry. Once defined, educators can begin to build practical applications for the classroom as well as laboratory activities that develop the particular skills sought by industry. Based on input gathered from the survey above, two exciting educational labs will be presented for discussion. The first involves an application for the construction industry where students are able to design, estimate, and construct a full scale “lab house”. The second application focuses on the manufacturing industry where students design “production planning”, and actually produce parts from that planning as a simulation. Both of these applications are a direct result of industry input.

Major Points:
- Need to seek continuous improvement in educational techniques
- Need for collaboration between education and industry
- Dissemination of results from an industry survey seeking desirable skills of new hires
- Practical application of industry research results through a simulation of industry scenarios
- Preparing students with the skills necessary to succeed in industry

Summary: Attendees will understand the skills sought by industry through dissemination of current survey results. A discussion of how these findings are being successfully applied to “bridge” the gap between education and industry through practical applications will be presented.
Using Desire 2 Learn and MS Excel to Facilitate First Exposure

Dr. Leonard Pederson  
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Need:  Barbara Walvoord came to the UW-Stout campus in June to deliver a one day seminar titled “Assignments, Tests, and Grades: More Learning, Less Time”. The selling point of this seminar was to give insight and tips on how to make faculty time more effective and efficient, and give back some time to faculty for other endeavors such as research, service and personal time. I had already been using some of her suggestions, and some were new. This presentation is a summary of her most salient suggestions and tips, how I have implemented them, and how it has worked in the classroom, and how it has given me back some of my time for other purposes.

Overview:  The classical instructional paradigm is to use the class period for the first exposure to the subject. This is followed up by assignments created during the students study time, and graded by the instructor. This paradigm reduces the time available for discussion and further investigation during the class time, and causes the instructor to invest time outside of class in evaluating the written assignments submitted. My approach is move the first exposure to the students’ study time. I warn the students from the beginning that I am not going to teach them the material that they can read in the text or assigned articles. In order to encourage the students to read the text, I give detailed quizzes from the text and other assigned articles. In problem oriented subjects such as engineering economy or materials management, I create MS Excel spreadsheets for students to work and turn in (dropbox) on Friday. During the week, the students work in groups, solving problems that are similar to the problem required to be completed by Friday but with different data. When Friday comes, the students turn in the completed assignments. I grade the turned in assignments for effort, which takes minutes versus hours if I was to grade and correct each problem. During that class period, we work through the assignment as a class, by having students work the problems on the board with my assistance. The students are encouraged to correct their copy on their PC’s. They are allowed use this corrected copy on the mid-term and final examinations, which is totally dedicated to the problems and those concepts. Thus having done the assignments, they must show competency on these exams with problems that are similar but with different numbers.

Major Points:
- First exposure concept
- How it was implemented in my classroom
- What effect it had on student learning
- The student’s response to this classroom process.
- How I am using this concept this semester.

Summary:  Attendees will be presented with these results, and given possible hypothesizes as to why the results of this study are different from prior studies, and what this could mean.
Enhancing Digital Learning Experience through Tablet-PCs and Integration of Interactive Activities/Flash-Based Simulations in Computer Networking Courses

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Overview: The undergraduate programs, especially engineering and technology, face various challenges such as difficulty in accommodating diverse student background, difficulty in getting students to engage and interact intellectually, understanding how students approach technology-based learning and what encourages them to communicate, collaborate, and reflect on their learning. In 2009 the author received Innovations in Education grant from Hewlett-Packard to enhance digital learning experience for students in undergraduate engineering technology courses. Four courses in the area of computer networking were redesigned to integrate Tablet-PCs and include interactive activities, jeopardy style quizzes/games, interactive puzzles, subject videos, and flash-based animations. The course redesign was aimed at increasing student participation, improve collaboration, promote attentiveness, increase interaction and enhance overall digital learning experience in both classroom and laboratory. Using interactive activities within lectures helped instructors to create an instant feedback loop to get information about student learning earlier than the exam date. In addition, instructors used flash-based simulations/animations to help students grasp technically challenging concepts.

Major Points:
- Tablet-PC based instruction and Classroom Management Software
- Mobile classroom and digital learning environment
- Course redesign goals and strategy
- Interactive activities and flash-based animations used in computer networking courses
- Project evaluation and results

Summary: A stimulating digital learning environment fosters collaborative learning and promotes personalized, interactive/active and media-rich content-based learning. Students working with each other through aid of technology and technology-enhanced course content can increase their involvement in participation and improve critical thinking. Student learning/engagement results captured through pre-test and post-test, students reported surveys on interactive activities and flash-based animations, and frequency of timely completion of activities will be presented in the paper.
Integrative Learning as a Technique of Bridging the Gulf between the Classroom and Corporate America

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Need: Since May 1994, when the School-to-Work Opportunities Act was passed by Congress, schools and communities across the nation have been creating career exploration programs for students. The National School-to-Work Office, which falls under the U.S. Departments of Labor and Education, encourages educational and career opportunities for all students by providing funding for business and educational partnerships at the state and local level. These partnerships help create a connection between the classroom and the business community, and students are able to transfer their classroom knowledge into the workplace and prepare students for careers and educational opportunities beyond high school. One of the most appropriate pedagogies undergirding the Opportunities Act is “integrative learning.” Integrative Learning is a learning theory describing a movement toward integrated lessons helping students make connections across curricula. This higher education concept is a component of “integrated curriculum” movement.

Overview: Integrative Learning is a classroom teaching technique where students weave their learning into various studies and formats, reaching into spheres of knowledge previously unavailable. The instructor facilitates learning through the components of integration, leading the students into areas of inquiry that invite collaboration, cooperation, and construction of knowledge. The daily lesson plans aim for understanding, but in new and exciting ways, challenging students and teacher alike, supported by corporate-infused learning method. The students connect with Corporate America --discovering, sharing, and communicating current issues in order to direct their learning experiences of classroom to the workplace. Students explore ideas in new ways—with experts in the field. In fact, the concept of “school” becomes much more expansive, extending into other areas where networked learning is accessible. Students are able to learn with assistance--experiencing real-world situations. Teachers are able to accommodate individual learning styles through the use of different technologies enhanced by real world application. Finally, assessment and evaluation take on a new meaning, addressed in part by meeting the learners’ needs. Educators can now offer students choices that transform instruction and learning via interactive learning by making a connection between classroom and Corporate America.

Major Points:
- Methods of Integrative Learning in corporate America
- Integrated Curriculum
- Opportunities Act.
- Instructional Examples

Summary: Integrative learning help undergraduates “connect the dots” and develop habits of mind that give them the ability to transfer skills and knowledge from one setting to another as well as prepare them to make better informed decisions. The instructor creates opportunities for more integrative, connected learning through seminars, learning communities, interdisciplinary studies programs, individual portfolios, advising, capstone courses and other initiatives.” The instructor fosters students’ abilities to integrate learning -across the curriculum, over time and between class and practical “real world” corporate situations.
Integrating Active Learning into Construction Education: An Experiential Case Study

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Need: Businesses and industries throughout the United States are discovering that their employees and new graduates are entering the workplace unprepared for the newer technological changes, competition and globalization. These problems have generated discussion between industries and educational institutions. Industries are depending upon higher educational programs to help increase basic employability skills for students entering the workplace. By implementing active learning exercises in coursework from construction experience; students can gain employable skills such as: problem-solving, critical-thinking, communicating, teamwork and leadership skills. It is important that faculty members gain relevant industrial experience in order to assist their students and increase these much needed employability skills. This paper presents how active learning can be integrated into construction education based on presenters’ on the job experience.

Overview: This presentation will provide data on how faculty members can enhance their teaching through an internship program, to better prepare students for the workforce. The faculty internship industry program is designed to allow selected faculty members in higher education to gain day-to-day knowledge on the jobsite while broadening the faculty member’s professionalism and discipline in the construction field. The presentation will also provide recommendation on how to promote continuous learning and quality program in the classroom setting. This experiential learning partnership is beneficial to the faculty through enhanced teaching and scholarly engagement.

Major Points:
- Concept of Active Learning
- Employability Skills through Active Learning
- Faculty Internship Industry Experience Program
- Changes In Construction Industry Practices
- Integration of Active Learning into Construction Education
- Benefits of the Faculty Internship Industry Experience Program

Summary: This paper presents an opportunity to provide data on how to close the gap between disciplinary teaching and real-world experiences through a faculty internship industry experience program. The employable skills obtained will be instrumental in teaching and preparing students to meet the needs and expectations of the construction industry through active learning. Active learning is an effective method that university professors can use to engage university students in the learning process.
2010 Conference Proceedings Papers

“Bridging the Gulf”
Wednesday October 27 - Saturday October 30, 2010
Edgewater Beach Resort - Panama City Beach, Florida
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Administration
Developing a Continuity Management Plan for Technology Programs

By Dr. James W. Jones
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Abstract
Administrative leadership in modern technology programs is presented with multiple and wide-ranging challenges. Faculty availability and turnover continue to be significant issues for administrators of technology programs, and there has been little practical information or research made available as to how best to manage program continuity in the face of these problems. The result is that much institutional knowledge remains at the individual faculty member level rather than at the program level. This knowledge is often not shared and is lost as faculty members leave the program, and little of the knowledge brought in from new faculty members is fully utilized. Drawing from university, industry, and military experience and practice, this paper prepares administrators to lead the continuity management process and integrate other existing processes, such as accreditation and assessment efforts, into their overall plan to insure their program’s future success.

Introduction
Employee turnover plagues virtually every organization, including academic institutions. When an individual leaves an organization, they take with them their accumulated knowledge of their position, including everything to how to complete their assigned responsibilities to whom to call when something goes wrong to their perspective on the organization’s history. In short, they know why things are done the way that they are done and why things are the way that they are, good or bad; they are a part of the organization’s evolution whose value is often lost when they depart.

As the old adage goes, those who fail to learn history’s mistakes are doomed to repeat them. Yet, how often does this occur every day in technology departments? Procedures are developed in response to specific events and occurrences, and the procedures live on long after the event is forgotten. An instructor trying to address concerns of absenteeism might make a change in a course to require students to sign in at every class. Tragedies at institutions cause plans to be developed or re-evaluated. However, the procedures or changes made will not be as meaningful or as useful to a successor in the same position unless there is a transfer of the knowledge behind them. Continuity management attempts to address these concerns and maintain organizational knowledge and stability. This paper examines how administrators of technology programs can capture this knowledge and put it to use more effectively for students, faculty, and programs.

The Need
Gappa (2000) states that “a paramount concern of higher education institutions with their increasing enrollments and declining resources is ensuring that members of the new faculty majority are consistently high quality performers in the classroom as well as other assignments” (p. 77-78). However, much of this “new faculty majority” in technology programs is comprised of nontenure and adjunct faculty (Jones, 2009). Without the traditional foundation of tenured, retained faculty, and their collective knowledge, concerns about how these organizations will fare as the faculty and their knowledge base are turned over with increasing frequency. Green (1998) raises this issue of transferring collective culture with some alarm:

One of the functions of higher education in our society - its primary function, some might argue - is to help transmit an ever-changing culture from one generation to the next. Indeed, the transmission of our culture - though not necessarily the uncritical acceptance of its ideas, values, beliefs, and understanding of acceptable behavior - is essential for a society to continue. How we educate our students, therefore, is critical to the continuity of American culture. So, as we tackle the problems of schooling for the twenty-first century, we rightly are also wrestling with the question of what aspects of our culture we want to pass on to students. (p. 31)
If colleges and universities are viewed as generators of knowledge, then this loss of collective knowledge and culture is even more acute in these organizations. Beazley, Boenisch, and Harden (2002) state “Knowledge has replaced capital as the scarce factor of production and so has become the dominant economic force in business. It is the source of new wealth - an asset category to be invested as carefully as capital itself” (p. xii). If industry believes in the importance of investing in knowledge, surely technology programs should be doing the same.

The effects of losing this corporate knowledge are felt on many levels. The new adjunct faculty member who is thrown into teaching a course at the last minute without any resources is certainly aware of the deleterious effects. Perhaps more importantly, so are the students. Ives and Rowley (2005) found “continuity of supervision is important in relation to thesis completion times and satisfaction with supervision and can be interrupted by student and/or supervisor issues” (p. 537). They go as far as to recommend two advisors for graduate students to help insure this continuity.

Just like business organizations, technology programs in higher education should consider managing their continuity as “an asset category to be invested” to continue operations in crises and to prevent the loss of both information and knowledge.

What Continuity Management Is

The term continuity management has several meanings in current use. If continuity management is viewed as a continuum of preparedness from the organization level down to the individual, business continuity management would be at the uppermost organizational level. Companies and other organizations refer to business continuity management (BCM) as “an interdisciplinary peer mentoring methodology used to create and validate a practiced logistical plan for how an organization will recover and restore partially or completely interrupted critical function(s) within a predetermined time after a disaster or extended disruption” (Business Continuity, 2007). In short, the business continuity plan:

Is how an organization prepares for future incidents that could jeopardize the organization’s core mission and its longterm health. Incidents include local incidents like building fires, regional incidents like earthquakes, or national incidents like pandemic illnesses. (¶ 1)

Interest in business continuity management was spurred by the events of September 11, 2001, particularly the impact on the financial firms that were located in the World Trade Center. BCM is becoming more common at all sizes of organizations, as evidenced by the United States Department of Homeland Security Web site on the topic, which they refer to as continuity of operations planning (Continuity, n.d.). They offer a downloadable sample emergency plan that includes items such as identifying natural and man made disasters, emergency payroll procedures, and critical suppliers (Sample, n.d.). They state, “How quickly your company can get back to business after a terrorist attack or tornado, fire or flood often depends on emergency planning done today. Start planning now to improve the likelihood that your company will survive and recover” (Continuity, n.d., ¶ 1). The generic plan is a simple tool to identify potential situations and prepare contingency plans as possible responses.

Although the term business continuity plan evokes visions of “reams of documents and an exhaustive collection of ‘plans’ [to] satisfy an external audience” (Hughes, Bushey, Hubbs, and Nakles, 2006, p. 23), the product is perhaps not as important as the process. A good plan will involve the entire organization, even if the focus remains on a few critical areas or departments. As Booth (2003) stated in a review, “The authors argue that effective BCM requires cultural change. It is to be welcomed that there is an increasing recognition that there is a need for a whole company approach” (p. 48).

The academy has also started taking note of business’s continuity management practices. As described by Hughes, Bushey, Hubbs, and Nakles (2006), “Hurricane Katrina and other natural disasters, the ongoing threats of terrorism, and the auditing profession’s increased emphasis on business continuity planning have captured the attention of higher education executives” (p. 23). This has become a more important issue within recent years, as high profile cases like the Virginia Tech shootings highlighted administration’s responses to emergency situations (Virginia Tech, 2007). Although Virginia Tech had a continuity management plan in place “to handle a variety of emergency situations that may impact business operations” (Office of Sponsored Programs, 2004, p. 3), the
administration was criticized for its handling of the emergency. Many other institutions are now developing and/or re-evaluating their own plans (Windle, n.d.).

The focus of business continuity management is the survivability of the overall organization in the face of some sort of critical event. It therefore does not usually deal with department or individual-level concerns unless they are critical to the overall organization’s continuity. For example, if an individual is a critical leader (such as the president, provost, chief operating officer, etc.), then a chain of command succession would be designated for these key personnel. Certain departments and/or functions might also be designated as “critical,” such as the information management department.

Information management is a related subspecialty of the business continuity plan (BCP). While information management handles the day-to-day information needs, the perseverance of organizational data is particularly important in a BCP. Information management components of a university BCP may include routine procedures such as backup of data, redundant storage, etc. as well as antivirus protection, anti-hacker measures, and student information safeguards. Access and unauthorized usage may also be addressed by the BCP, which “may be a part of an organizational learning effort that helps reduce operational risk associated with lax information management controls” (Business Continuity, 2007). For example, George Mason University developed a special team that is chaired by the vice president for information technology for dealing with information management and security concerns, including an information technology special response team (Hughes, Bushey, Hubbs, and Nakles, 2006).

Knowledge continuity management is described by Field (2003) as “an offshoot of the field of knowledge management. Where knowledge management concerns capturing and sharing know-how valuable to colleagues performing similar jobs throughout the company, knowledge continuity management focuses on passing critical knowledge from existing employees to their replacements” (¶ 5). Although Field draws a distinction in intent, knowledge continuity management approaches will benefit both present and future members of an organization, so this distinction is lost in actual practice. Knowledge continuity management, or more simply continuity management, is therefore more likely to be encountered, practiced, and useful to most individuals in an organization. The rest of this paper focuses on examples of specific continuity management practices for administrators and faculty in academic settings.

Continuity Management in College and University Technology Programs

While the term ‘continuity management” may be unfamiliar, everyone is familiar with the daunting task of starting in a new position. New professors often have to wrestle with experiences similar to those of a new freshman on campus: learning what the campus buildings are, where to park, where to eat, how to get an ID card, etc. However, the new professor is also often trying to learn the department and university culture and procedures and prepare for classes. It often seems a little overwhelming at first.

Perhaps without even realizing it, many new professors practice continuity management on a small and very personal scale. Asking for an electronic version of a colleague’s syllabus provides a snapshot into the functions of the department as well as saving a little typing time. Just looking through one or two peers’ examples can show what the norms are for attendance, makeup work, absences, accessibility, etc. Although the new professor might not know exactly why a particular professor uses a seating chart or why another uses a sign-in roster, the document is undoubtedly an evolution that reflects the providing professor’s experience. As such, it is also a window into the culture of the department and institution and a useful starting point for dialogue into how it came to be in its present form.

Even better than a syllabus from just any course is a copy of a syllabus for your course. Why reinvent the wheel? Mabrouk (2006) advises new faculty to seek this information:

> Once you learn what your teaching assignment will be for the year, find out who in your department previously taught those courses. Ask them for a copy of their course syllabus, the names of the local book representatives, and any other teaching materials that they may be willing to share with you. (p. 1030)
Another individual practice that enhances continuity management is critical reflection. While authors such as Brookfield (1995) often cite the individual benefit of critical reflection, they also acknowledge it as a grassroots starting point for peer dialogue, improvement, and collaboration. As Brookfield writes, “Although critical reflection often begins with autobiographical analysis, its full realization occurs only when others are involved” (p. 140). The critical reflection process is further enhanced when it is recorded in some medium. Mabrouk (2006) suggests a journal both for reflection and for use in the tenure and promotion process:

You will find it extremely useful to keep a journal about your teaching endeavors in which you record, assess, and reflect on your activities. It’s very likely that you’ll be asked to write a self-evaluation at the end of each year that will be included in your tenure and promotions folder. Having specific evidence to support statements will strengthen your self-assessment. (p. 1030)

Although some individuals might want to keep their reflections private, the same process works on an organizational scale. For example, departmental procedures change and evolve during this history of the organization, in response to new situations and transgressions. These procedures are now often available online or through an intranet system, which make them available instantly to everyone in the department. While this can be extremely useful, as noted earlier, this does not capture all of the knowledge behind the myriad of changes and updates.

Many word processing programs now allow an editing history to be included, and it is a relatively simple step to include the reasoning behind any revisions in case they are needed. While this has been common practice with many organizations who annotate important changes to bylaws and other important documents, it can also be easily be done on a much wider scale. In fact, it can even be done globally, such as the collaborative online encyclopedia Wikipedia, which allows users to see the final version of an entry as well as the process behind it. Beazley, Boenisch, and Harden, (2002) encourage that knowledge profiles can be created down to the individual employee level to capture this information and reflection. This is a key step in becoming a learning organization, as described by Senge (1990). Later coauthors Ross, Smith, Roberts, and Kleiner (1994) describe this process of capturing and making knowledge available:

Once we start to become conscious of how we think and interact, and begin developing capacities to think and act differently, we will have already begun to change our organizations for the better…. Learning in organizations means the continuous testing of experience, and the transformation of that experience into knowledge - accessible to the whole organization, and relevant to its core purpose. (p. 48-49)

For many programs, this is actually already being performed in some degree as part of accreditation and assessment processes. Virtually all accrediting bodies require documentation down to the course level, with many requiring sample work for individual students. For example, the Association of Technology, Management, and Applied Engineering’s (ATMAE) 2009 Accreditation Handbook requires course syllabi, graded student work, and reference materials be retained as part of the accreditation process (ATMAE, 2009). Administrators can capitalize upon the accreditation requirements to maintain organization records and institutional knowledge as part of their overall continuity management plan.

In addition to some sort of knowledge repository, whether a journal or electronic system, mentoring is another practice that serves several important roles, including continuity management. Mentoring is actually a preferable method, as stated by Beazley, Boenisch, and Harden (2002):

Continuity management relies on two basic sources for knowledge transfer: documents and people. The processes through which these sources are utilized in knowledge transfer are: people to documents to people….[and] people to people….Continuity management uses people-to-people knowledge transfer processes whenever possible, because not all relevant tacit knowledge can be made explicit and codified in documents….Phased mentoring [is] utilized whenever possible. (p. 208)

Field (2003) also recommends that organizations “foster mentoring relationships” (¶ 16) in order to “ensure mission-critical expertise doesn’t leave your company when workers do” (¶ 12). A wide range of mentoring
programs are currently in use in higher education, from the informal to brief orientation programs to very formal and structured programs. Bennett (2006) describes one short course program as “boot camp” with an agenda that includes curriculum development, mentoring, and “a personalized evaluation of their personality traits” based on the Myers/Briggs Type Indicator test (¶ 10).

Other good management and administrative techniques can also contribute to increased retention, such as listening to faculty concerns and taking an interest in individuals, regardless of employment level. Some programs go as far as rotating the department chair in one-year terms, exposing more members to the position and diffusing its knowledge and responsibilities (Committees, 2006). Advantages of this system must be weighed against the lack of knowledge and experience depth that accompanies such short stints. Other practices and may be formally or informally proceduralized, as Morgan (2004) suggests is common in military settings. Examples of these are the many standardized operating procedures (SOPs) in Army units and so-called “smart books” developed to answer questions on common problems.

In summary, although the term continuity management might be relatively new, its practice has long been part of good management. Particularly in today’s high-turnover academic environment, it deserves consideration for its own merit by administrators in technology programs. However, continuity management need not be practiced in isolation, and its practices have many other benefits as well.

References
Integrating Faculty into a Technology Program Team: Perspectives from Current Faculty and New Team Members

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Abstract
Administators in technology programs recognize that when the recruiting and hiring process for new faculty is finished, the more difficult process of integrating the new member into the team just begins. Although the difficulty of integrating new members into an existing team is recognized throughout every organization, little research and information is available to assist program administrators in leading the integration process. The result is often a half-hearted or half-developed process that does little to start the new team member on the right road and does not bring them on board as quickly or efficiently as could be achieved with better practices. Drawing from the viewpoints of existing program faculty as well as new team members, including both tenure-line and contract, this paper helps administrators lead the process of integrating new faculty into their instructional teams. This process of welcoming, preparing, and unifying the new member into a cohesive technology program team can set both the new member and the program on a path to success if done thoughtfully and properly.

Introduction
Many technology programs incorporate assignments and even entire courses that are based on student teams. The value of this approach is self-evident, as the majority of graduates of these programs will work on teams in industry. For example, Achor and Achor (2000) state:

The majority of construction projects and tasks in the construction management industry are accomplished by teams of employees, both in the home office and in the field. Therefore, it is essential that students in construction management programs are provided the opportunity to learn how to work in teams. (p. 219)

Similarly, Ncube and McWilliams (2008) comment on student teamwork as preparation for the manufacturing sector by stating, “Since businesses are typically vastly outnumbered by their customers and potential customers, product development would be greatly enhanced by providing the teams with techniques that can collectively harness the collective intelligence and creativity of the teams” (p. 45).

While the team concept has been readily adopted by industry and academia with regard to students, little information is available to administrators about teaming of faculty, particularly with regard to integrating new faculty members into an existing technology program faculty team. Faculty teamwork cannot be relied to happen by chance, as Barwick (1990) states “Teaching faculty are, by nature, not team players” (¶ 9). In an endeavor to address this issue, this paper provides the administrator best practices to integrate new members into the team through the process of welcoming, preparing, and integrating.
Welcoming
The process of welcoming a new faculty member to the team actually begins long before their arrival on campus. Administrators should consider the team perspective before the faculty search even begins, starting with the existing faculty team. Is it already a functional team, or is it really just a group of individuals that serve in the same program or department? Team building might have to begin with the current faculty before any new members can be effectively integrated.

Thoughtful preparation at this point sets the stage for a successful search. The search committee will normally be the first contact that the new member has, so members should be selected with care: positive first impressions work both ways. The “teamwork” concept might even be added to the position posting as an expectation in order to emphasize its importance. While postings typically ask applicants to furnish a mountain of personal information, remember that they are also assessing your organization and how they might fit in with the current faculty. Having a fully developed and integrated website for the department and program with updated information about all faculty, including education, background, research interests, industry experience, publications, etc., allows potential new faculty members to discover common interests and experiences even before applying for the position. This allows them to see potential commonalities before they even send in their packets. It represents the first means by which candidates can familiarize themselves with the team and evaluate the appropriateness of their role as a team member. Just as your existing faculty members would be interested in knowing if an applicant studied under one of their former professors, the potential new team members would like to be aware of that as well.

During the screening and interviewing process, teamwork should still remain an important consideration. The demonstrated ability or at least expressed willingness to “play well with others” can be just as important as teaching skills or research ability in building a successful faculty team. Naturally, the existing team should also explain and demonstrate how teamwork functions in their realm, including illustrating team teaching projects, collaborative research, and similar activities. The campus visit is an excellent opportunity to show prospective applicants how your team functions effectively. While these are hectic times for all, make sure that the applicant is made to feel welcome. For example, applicants were offered the option of either renting an automobile or being picked up by a team member upon their arrival to the airport: all accepted the ride. This alleviated the stress of having to drive in unfamiliar territory and also gave them a personal, informal atmosphere to start to get to know the existing team. This approach, suggested by one of the authors, was selected by every applicant who came to campus during the most recent faculty search.

Once the new team member is selected, he or she should be welcomed aboard as soon as they have accepted the offer. Whether by telephone, e-mail, text, or other method, let them know that they are already considered part of the team and congratulate them on their wise decision. In order to keep the lines of communication open and flowing, keep in regular contact with them, especially if they are completing a thesis, dissertation, or other big project. Let them know that you care and help them celebrate their successes. If you are adding more than one team member, let them know about the other(s) and provide contact information so that they can also communicate if they choose.

Welcoming a new member starts before the job description is posted and continues throughout the entire hiring process. These important first steps lay the foundation for successful preparation and integration into the faculty team.

Preparing
Preparing the new team member usually starts as soon as they are ready to start actually getting ready for their new position, which may or may not be as soon as they accept the offer. If they are still concentrating on finishing their dissertation, it might not be wise to deluge them with a mountain of information during what is usually already an overwhelming and stressful time. To that end, whenever they are ready, the new team member should be provided with information regarding which courses he or she will be teaching. Typically, this will initially include course titles, descriptions, times offered, locations, etc. Later, it will also include syllabi, assignments, textbooks, etc. in electronic format. Informing them with what is expected (including accreditation topics and documentation requirements) and what they can adapt and make their own is an essential step in facilitating
their integration in the system and posting their efficiency. In addition, linking new members with the faculty who have taught their courses previously and providing them with copies of the textbooks used or to select from, particularly if they cannot order sample copies themselves, familiarize them with the system and post their confidence. All of the above points aid the integration process, for they alleviate the stresses associated with the new position and ease the transition process.

Furthermore, the new team member should be encouraged to come to campus as soon as possible and as many of the small but important administrative matters finished, including getting the identification card, e-mail address, telephone number, voice mail, and a myriad of other details. Even better is to have their office “move in ready” with name plate posted and supplies available, and their business cards printed and ready to make them “official.” If they are new to the area, link them up with an existing team member who can familiarize them with the region and its highlights as well as help with housing arrangements.

The preparing process is centered on pushing out relevant information to the new team member and continuing to keep communication open. While much of this is associated with teaching and coursework, it extends to grant opportunities, conference submissions, and other related features. For example, one organization in the authors’ discipline announces its call for papers in the summer months (when new team members are typically joining the team), and these announcements can easily be forwarded to new members. Even if they do not submit, they are made aware of the opportunity, requirements, and when it is presented for consideration next year.

A crucial aspect of the preparing process should also include strengthening any areas of concern for the new team member. For example, if the new team member has little grant-writing experience, encourage them to enroll in your institution’s grant-writing workshops. A common area of concern for new faculty is teaching. As Jones (2000) states: “New faculty have likely had little exposure to the theory or practice of teaching” (p. 94). Jones encourages the use of teaching and learning centers by new faculty, and there are often other resources that are also available.

Integrating
While the new faculty member is being integrated into the team throughout the entire process, it typically begins in earnest when the entire team returns to campus for the start of the new school year. Many institutions now have an orientation program ranging from a few days to a week or more, and cover both administrative issues (signing up for payroll, etc.) as well as orienting them to campus, resources, and opportunities.

Mentoring, both formal and informal, can be a key to integration into the team during the first year. In a study of 259 faculty members, Schrodt, Cawyer, and Sanders (2003) found:

- “New faculty who are mentored feel more connected to their work environments than their non-mentored peers” (p. 26)
- New faculty members “report greater levels of satisfaction with academic socialization experiences than their non-mentored peers” (p. 26)
- “Higher loyalty to the work place is also a characteristic of the protégé” (p. 26)

Mentors explain the formal and unwritten expectations (the difference between “must do,” “should do,” and “could do”) which are often stressors for new faculty members. As Lewallen, Crane, Létvak, Jones, and Hu (2003) stated, “Expectations are often unclear or evolving. The struggle to differentiate between actual and perceived expectations may contribute to schedule overload” (p. 258). While mentors are often formally assigned, the entire team should participate in this role, stopping by informally just to see how things are going, chat, and answer questions. These relationships often extend to social events such as lunches, football games, and golf outings to help socialize the team in relaxed settings.

There is some debate whether a mentor should be assigned from within the department or from an external one. Cramer (2006) believes “Natural mentoring is often difficult to accomplish within a department where everyone knows a little too much about each other’s business, discipline, and private lives” (p. 534). Smathers (2004) suggests using emeritus faculty in the mentor role to overcome this bias. However, Savage, Karp, and Logue (2004) point out:
The need for mentoring from within a new faculty member’s department is well documented. Researchers stress the need of new faculty for support, especially in the areas of pedagogy within a specific discipline, identification of levels of importance within the departmental culture to specific professional organizations, and learning the subculture of the department. (p. 22)

Therefore, if a member of the existing faculty team is not formally assigned the mentor role, the team should identify member to accept an informal mentor role to integrate the new member.

The final aspect of integration is involvement: the new team member should start working with other team members and contributing to the entire team as soon as possible. Look for opportunities to collaborate with the new faculty member or to pair them up with other members on papers, presentations, and grants. Solicit their feedback and implement their recommendations. Put them on meaningful committees that are action-oriented. Expect them to be involved and value their contributions.

The team-taught class offers an excellent opportunity for this type of involvement. The team involved can vary in size from two members to the entire program faculty, and the involvement might cover specific sections or an entire course, but the process can quickly get new faculty members involved and working in the team. As Bondy and Ross (1998) state: “Teaching teams are problem solving groups. . . . Team members work together to examine the problem and explore alternative solutions. The collaborative problem solving orientation includes a commitment to experimentation” (p. 233-234).

**Tenure-Line Perspectives**
Most team building approaches are appropriate regardless of whether the new faculty member is on a tenure-line or a contract appointment, but there are some additional emphases that the administrator should consider for each perspective. The tenure process generates a lot of stress in most new faculty, and this is where the administrator and mentor can often be of greatest benefit. While most institutions have a formal document outlining the process, an involved mentor or administrator can really explain the process and expectations, including those that are unwritten. As Higgs, Graham, and Mattei (2006) state: “It was said that there is a ‘magic number’ that most departments have in mind when evaluating the research component of tenure. This number may not be formally written down” (p. 135). The mentor or administrator can assist with the following tenure concerns:
- Timeline for submission
- Format
- Documentation
- Proofreading
- Relative value of different journals, proceedings, etc.
- Relative value of collaboration

Similarly, these individuals can assist the new faculty member with travel procedures (particularly reimbursement), graduate student use, time expected to be spent in scholarly pursuits, and other aspects that typically impact the tenure-line team member to a greater degree.

**Contract Perspectives**
The team member appointed to a contract position also has unique needs that are often best addressed by the mentor or involved administrator. Typical contract faculty concerns include:
- Evaluation process
- Timelines
- Renewal considerations
- Opportunities
- Collaboration
The best way to integrate the contract faculty member into the faculty team is to eliminate the tenure/contract distinction wherever appropriate. Contract faculty members should be involved in team teaching, assessment, accreditation, professional development, collaboration, grant-writing, and every other aspect that impacts the team. In other words, there cannot be any “second class” team members, only team members.

Conclusion
While integrating new faculty members into existing technology program teams does not happen by chance or accident, there is much that can be done by an administrator to facilitate the process. By viewing the entire process, even before the position opening is posted, as all part of the process of bringing a new member onto the team, the likelihood for success is increased. Based on best practices from industry and academia, coupled with the experience of new and existing faculty members, this paper presented welcoming, preparing, and integrating processes to facilitate this successful integration.

References
Preparing the Self-Study for Accreditation of a Masters Degree Program

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Abstract
Preparing the self-study for accreditation requires a well-thought plan, seamless execution, and extensive work from involved stakeholders. The purpose of this paper is to share information with institutions planning to choose graduate program accreditation by the Association of Technology, Management, and Applied Engineering (ATMAE). This paper presents a logical series of the tasks, evaluation criteria and standards, workload, and data gathering necessary for a successful site visit.

The evaluation criteria used in organizing a self-study primarily includes three major sections: program inputs, program operation, and outcome measures. The accreditation team will visit the campus and meet with administrators, faculty, staff, students, program advisory board members, and alumni. After the evaluation process, the visiting team will provide recommendations and final report suggesting a decision either for accreditation, accreditation with condition, or non-accreditation. Being accredited from ATMAE is a landmark achievement for all related parties. More and more businesses and industries are seeking industrial management, technology and applied engineering graduates from ATMAE accredited schools because they know these institutions have met certain professional goals and standards.

Introduction
The goal of accreditation is to ensure that education provided by institutions of higher education meets acceptable levels of quality (US Department of Education, 2010). Having accreditation is very beneficial to any organization. It is not only a measure of the quality of an institution and its services, but also the curriculum. The recommendations from the peer-review of the accreditation team helps to reveal the organization’s strengths and weaknesses for better strategic planning, implementation, and further evaluation of a variety of key components. Moreover, accreditation allows institutions to strengthen their standards of performance excellence, while providing high quality and consistent education to their students. This study is designed to assist other institutions and faculty in the creation of the self study document. The authors wrote this paper focusing on the accreditation of two Masters Degree Programs by the Association of Technology, Management, and Applied Engineering (ATMAE).

ATMAE (previously named NAIT - National Association of Industrial Technology) is recognized by the Council on Higher Education Accreditation as the professional accrediting agency for technology, technology management, and applied engineering degree programs in the United States. The primary purpose of ATMAE accreditation is to encourage and recognize the attainment of certain professional goals and standards for Industrial Technology (ATMAE Accreditation, 2009). To assure the competency and effectiveness of the Master of Science Degree programs in the School of Technology at the University of Central Missouri, all stakeholders have put forward effort to prepare the self-study for internal review and the ATMAE accreditation team. The MS in Industrial Management and MS in Technology received full accreditation at the National Convention in Louisville, KY, November 2009. These were the first graduate degree programs to be accredited by ATMAE. This study is organized into three (3) major points:
- What are the self-study document and the preparation process?
- ATMAE evaluation criteria for Masters Degree program accreditation
Accreditation of the graduate programs accompanied reaccreditation of Bachelor of Science degree programs in Automotive Technology Management, Construction Management, and Electronics Technology. Initial accreditation of the BS degrees in Graphic Arts Technology Management and Computer Aided Design Technology programs were also approved. Each of these programs received accreditation through November 1, 2014.

**What Are the Self-Study Document and Preparation Processes?**

The self-study presented by the department describes the programs submitted for accreditation. This report is the product of the administration, faculty, students, and staff of the department with preparation directed by the coordinator, leader, and/or department chairperson. The chair, program coordinator, and involved faculty contributed to the document by collecting and analyzing data and writing a final report. The Dean’s Office and the administration of the University provided assistance and support. The Industry Advisory Boards and students in the programs were a source for validation of the materials. Finally, the School’s office professionals and student assistants, contributed to the production of the self-study document.

Preparing a self-study is the most important step in the entire accreditation process. Not only time and effort requirement, but also an extensive commitment of the stakeholders is needed. The lead person should have both power and authority to work and coordinate with all parties. The programs created a plan and spent nearly two years preparing the self-study for a three day site visit by the ATMAE accreditation team. These are the steps created in the plan for accreditation and the self-study preparation process:

- Meet with faculty and staff to discuss and brainstorm a preliminary plan for accreditation process
- Provide the faculty with the opportunity to learn about the accreditation standards and process at the ATMAE convention.
- Request the updated accreditation standards
- Meet with faculty and staff to finalize a plan for the self-study preparation; tasks are divided with the responsible faculty and staff.
- Gathering general information about the institution, such as number of students enrolled, total full-time equivalent faculty, operating budget, institutional mission and goals, relation of institutional to superior governing body, and others.
- Collecting data from the advisory board members and graduate follow-up study. Meeting with the advisory board members occur be one to two times per year to distribute program information, brainstorm program outcomes/competencies, and discuss ways to improve the programs so students can meet the market’s demand. The graduate follow-up study was conducted every five years; the questionnaire was sent to the alumni to evaluate course materials, campus services, instructor performance, and analyze the strengths and weaknesses of the program.
- Gathering specific information directly related to the program, such as program outcomes and competency matrix, course syllabi, survey evaluation for employers of graduate (from Career Services), abstracts of students’ theses, a list of library holdings for the program, resumes from faculty and adjunct instructors, graduation and retention rate, among others.
- Create report documents to respond to the ATMAE evaluation criteria included in the three parts of program inputs, program operation, and outcome measures; the details are presented in the next section.
- Arranging appointments for the ATMAE accreditation team site visit. Normally, three to five members constitute a team which visits campus for two to three days. During their visit, the team may ask to schedule meetings with administrators (president, provost, dean, and chairperson), faculty, students, alumni, and advisory board members. If alumni and/or advisory board members cannot be on campus on that day, a telephone interview or teleconference can be arranged.

*Note: Since there are only two to three days for the site visit and several groups of people to meet, arrangements for breakfast, lunch and dinner need to be arranged and verified by the visiting team leader.*

**ATMAE Evaluation Criteria and Final Decision**

This section presents the ATMAE evaluation criteria for a Masters Degree program accreditation, and the details of the preparation process. The program prepares a self-study report for the visiting team to review. This self-study report should follow the guideline and comply with the evaluation criteria. This report outlines actions the school
has taken to meet more than sixty different ATMAE standards, ranging from faculty qualifications and laboratory equipment to funding for support personnel, industry involvement in programs, and success of graduates. The ATMAE accreditation standards are divided into three major sections: 1) program inputs, 2) program operation, and 3) outcome measures. The self-study document should be prepared to be compatible with the evaluation criteria. The visiting team will evaluate the program against these ATMAE Standards. This describes how each program and option complies with, or fails to comply with these standards - the final line shall indicate whether the program or option is in non-compliance, partial compliance, or compliance.

Program/Option: ........................................... □ Compliance □ Partial Compliance □ Non-Compliance

The table below presents the items for evaluation and criteria

### Program/Option: .............................................

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Compliance (C)</th>
<th>Partial Compliance (P)</th>
<th>Non-Compliance (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preamble 1 Preparation of Self-Study Report</td>
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<td>Preamble 2 Program Definition</td>
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<tr>
<td><strong>Section 1: Program Inputs</strong></td>
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<tr>
<td>1. Program Title, Mission, and General Outcomes</td>
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<td>2. Competency Identification &amp; Validation</td>
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<td>3. Transfer Course Work</td>
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<td>4. Identification of Competency Measures</td>
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<tr>
<td>5. Program Structure &amp; Course Sequencing</td>
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<tr>
<td>6. Student Admission &amp; Retention Standards</td>
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<td>7. Student Enrollment</td>
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<td>8. Administrative Support &amp; Faculty</td>
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<tr>
<td>10. Program Goals</td>
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<tr>
<td><strong>Section 2: Program Operation</strong></td>
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<tr>
<td>11. Program/Option Operation</td>
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<tr>
<td><strong>Section 3: Outcome Measures</strong></td>
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<tr>
<td>12. Student Satisfaction with Program/Option</td>
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<tr>
<td>13. Initial Employment of Graduates</td>
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<tr>
<td>14. Job Advancement of Graduates</td>
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<tr>
<td>15. Employer Satisfaction with Job Performance</td>
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<tr>
<td>16. Student Success in Advanced Program</td>
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<tr>
<td>17. Student Success in Passing Certification Exams</td>
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<tr>
<td>18. Advisory Council Approval of Overall Program</td>
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<tr>
<td>19. Outcome Measures Used to Improve Program</td>
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</table>

After the evaluation process, the visiting team will provide recommendation and a final decision with the following conditions:

- **Accreditation - Report in Two Years:** A written progress report is required in two years which details the
corrective action taken to meet standards.

- **Accreditation Report and On-Site Visit in Two Years:** A written progress report by the institution and an on-site visit by one of the initial visiting team members are required in two years.
- **Non-Accreditation:** Denial of accreditation occurs when a program does not substantially comply with standards. If a program receives Non-Accreditation status, the application for reaccreditation will be considered as an initial application and the maximum period of accreditation granted will be four years.

**Major Documents Accompanying the Self-Study**
The documents in this section will vary from institution to institution; the focus should be placed on the records presenting the program operation and effectiveness of the organization, administration, teaching, and learning. The following list presents documents posted in the Appendices section of the self-study report; there are also paper copies and details including a CD with the other supporting documents.

- School of Technology - Organizational Structure
- Student Outcomes - Competency matrix
- 2007 Follow-up Study of Program Graduates
- Masters Program Student Handbook
- Course Roll-out Schedule 2007-2011
- Abstracts of Students’ Theses
- Resume - Faculty and Adjunct Instructors
- Faculty Search Approval Form
- A Sample Vacancy Notice, Faculty/Academic Staff Application
- A list of Library Holdings for the Masters Programs
- Career Services - Survey Forms for Employers of Graduates

In addition, some general information about the institution and the administration units housing the program should be described in detail, for example

**About the Institution**
- Name and Address
- Number of Students Enrolled
- Total Full-Time Equivalent Faculty
- Operating Budget
- Institutional Accreditation Organizations
- History of Accreditation by NAIT
- Administration of the Institution
- Major Academic Units within the Institution
- Institutional Mission and Goals
- Relation of Institutional to Superior Governing Body

**Administration Units Housing Industrial Technology**
- Name and Address of Administration Unit
- Number of Students Enrolled
- Names of other Departments in the Administrative Unit
- Name of Program Head
- Names and Titles of Others with Program Administration and/or Coordination Responsibility
- Title of Degrees, Programs, and Concentrations for which accreditation is being requested.

**Summary and Conclusion**
In summary, this paper is designed to be a primer for any institution planning for graduate program accreditation by ATMAE. After spending numerous hours in self-study preparation for ATMAE accreditation, a lot of people asked the same question: “Is it worth it?” This enormous task can not be accomplished in a short period of time, nor with work from only one person. The Master’s programs in Industrial Management and Technology created a plan to involve all related stakeholders in the program’s structure and operation, from 2002 until the present, these tasks cover:
• Advisory board members: The program has yearly meetings with the fifteen to twenty advisory board members which include representatives of business and industry and some graduates of the programs. The advisory board members contribute to a continuous process improvement system which helps faculty determine which types of curriculum changes or equipment upgrades are needed to meet employers’ current and future needs.

• Current student: Every semester, each course in the program also distributes a quality survey to the students taking classes. The questionnaire surveys current students to evaluate the course objectives/contents, instructor’s performance, delivery methods, and campus services. The survey results are used for discussion among the course instructor, program coordinator, and department chairperson and college dean.

• Program graduates: The department conducts a follow-up survey to each program’s graduates every five years. The results include both quantitative and qualitative data. Graduates were asked to answer a series of questions created to assess the program’s effectiveness, strengths, and weaknesses. This survey also collects data related to the graduates’ occupation, first and current job title and annual salary.

• Faculty and staff: The program coordinators meeting is often held twice a month; the M.S. program faculty and staff often meet to discuss strategic plans, problems and solutions. The program has created an instructor’s manual for all adjunct faculty and graduate handbook for prospective and current students.

The self-study is a final product of the hard work from all of the team members including administrators, faculty, staff, and students, which put forth effort for this long term project. The teams answer to the question above, “Absolutely, it is really worth it!” Being accredited from ATMAE is a landmark achievement for all involved parties. More and more businesses and industries are seeking industrial technology graduates from ATMAE-accredited schools because they know these institutions have met certain professional goals and standards. UCM joins eighty-four institutions nationwide offering programs that meet these standards (Sutton, 2008).

References


Community Colleges
Results, Findings, and Recommendations from a Needs Assessment Study Focusing on Niche Manufacturing Companies in a Rural Area with No Major Industrial Base

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Eureka, CA 95501, 707-476-4350, mike-peterson@redwoods.edu

Introduction  
Humboldt County lies in the far north coastal region of rural California. This area of California has a low population and is geographically isolated by its distance from any large cities. There are no large manufacturing companies in this region of the state. This region is served by the College of the Redwoods (CR) in Eureka, California, offering post-secondary training in many technical disciplines including manufacturing technology. Although this training is considered to be state of the art and appropriate for the needs of local niche manufacturers, there had been no rigorous analysis of the needs of the manufacturing community served by the college. This document is a summary of the results from a Master’s Degree project at Purdue University that sought to identify the needs of these niche manufacturers.

The global demand for well-trained employees in technical fields continues to grow while experienced workers continue to retire, creating a shortage of qualified personnel to fill jobs. Manufacturing companies are facing a shortage of skilled employees to perform the work needed to meet the demands for their products. There are jobs available that pay good wages yet employers have difficulty finding qualified people (Bolch & Galvin, 2001; Clouse, 2006; Katz, 2007; Skilled Worker Crisis, 2006; Vinas 2005).

Members of the Manufacturing Technology Advisory Committee at the CR have consistently commented that it is difficult to find skilled production employees in this region of California. This problem causes employers to lose profitability because they must spend additional resources training their newly hired employees. Product quality suffers as a result of the lack of employee skills. Additionally, there is a trend at the CR where few graduating students are placed in local niche manufacturing jobs. To better serve these niche manufacturers, there must be alignment between the college curriculum and employer needs. If educators who teach industrial skills do not change their program content to align with employer needs, then the trend of low student placement will continue. Also, the effectiveness of existing programs may be poor since the needs of employers are not well established.

The CR serves three counties on the northern coast of California. These are Del Norte, Humboldt, and Mendocino Counties. These three counties are highlighted in Figure 1. The bulk of the durable goods produced in this region are manufactured in Humboldt County.

Because the area in Northern California that is served by the CR is somewhat isolated, most manufacturing is performed by small companies producing limited quantities of specialty products. Additionally, there is a lack of information about what the niche manufacturers need in their newly hired employees. These employers produce specialty items, so their needs may not match the needs of typical industrial manufacturers.

This project began by adapting the needs assessment survey instrument created by McAndrews (2008) to meet the requirements of the CR. The interview instrument in this study was not piloted, however McAndrews used it successfully in Indiana and it was based upon prior research by Dyrenfurth (n.d.) in Missouri. The skill needs assessment interview instrument is attached to this document in the Appendix. A database of employers was provided by Dennis Mullins at the North Coast Region Labor Market Information Division (LMID) of the
California Employment Development Department. This database contained 200 manufacturing companies in three counties served by the CR. This database was filtered to show 98 niche manufacturers producing durable goods in Humboldt County only. The list of manufacturers was then evaluated to select companies that had relevant technologies appropriate for the MT program at the college. For example, this list had six art glass-blowing companies and three sign manufacturers. The list contained four sales and service branches of large manufacturers located outside of Humboldt County. Also, at least three of the manufacturers had moved out of the area or gone out of business. These companies were removed from the sample. In an email, Dennis Mullins wrote “LMID does not vouch for accuracy or completeness of the list and it should be screened for duplicate employer records and other errors. An example is a number of businesses may have started or closed after the database was compiled” (D. Mullins, personal communication, February 11, 2009). Given this, the researcher augmented the sample with additional well-known manufacturing companies by searching for them by name on the California Employment Development Department’s website. The final sample consisted of 67 manufacturers producing durable goods in Humboldt County.

Subsequently, employers were contacted by telephone calls soliciting participation in this project. Some companies were not reachable or did not return calls. Other companies were not interested in participating. Seventeen manufacturers were interested in participating and letters authorizing participation in the study were obtained. This sample represents 25% of the niche manufacturers identified as appropriate for this study. All of the subjects had supervisory responsibilities and experience hiring and working with production employees.

Data Analysis
The interview instrument used in this study consists of 52 questions in five sections. The five sections of the instrument are listed in Table 1.
Table 1. Five Sections of the Interview Instrument

<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>General information about the company</td>
</tr>
<tr>
<td>Information about the skill level of newly hired production workers</td>
</tr>
<tr>
<td>Rankings of specific skills and satisfaction level with those skills</td>
</tr>
<tr>
<td>Requirements and methods relating to skills training</td>
</tr>
<tr>
<td>The relationship between the company and the CR</td>
</tr>
</tbody>
</table>

General results from the interviews provide aggregate data that gives insight into what these niche manufacturers need in employee skills.

**General Information about the Companies**

The first section of the interview instrument asked for general information about the company’s products and production methods. It also asked for information regarding human resource requirements and utilization. Participants in this study were selected from a wide range of business types. The number of production employees ranged from one to 50 with a median value of six production employees. This list of participants indeed represents small manufacturing companies. Additionally, most products produced by these niche manufacturers are highly specialized. These products are produced in relatively small quantities by small manufacturers with few production employees. The frequency of responses to a question regarding what technologies are used by these manufacturers is detailed in Figure 2.

![Figure 2. Frequency of Manufacturing Technologies Identified.](image)

No participants identified Mechatronics, Automatic Storage and Retrieval, Machine Vision, RFID, Robotics, or SPC as technologies used. Since these are all small companies, these advanced technologies are not cost effective. Of the 17 participants, the main method of production reported was 24% manual, 24% slightly automated, 41% moderately automated, and 12% highly automated. One manufacturer noted that his business was “highly
automated” yet he had no CNC, PLC, Mechatronics, or Robotics. His business was based upon cam driven automatic screw machines only. This departure from traditional modern automation is typical of the niche manufacturers in Humboldt County.

Manufacturers have had to cut back on the number of employees working at their facilities. When asked how many employees the companies hire each year, the results are not encouraging initially. Table 2 shows that individual niche manufacturers in this study are not hiring many production employees in the current economic climate. Participants in this study indicated an average of about 1.6 new production workers will be hired each year per company. However, considering that at least 67 companies make up the entire population of niche manufacturers in Humboldt County, even under a less than optimal economic situation, 106 new employees will be hired this year.

Table 2. Number of New Production Workers Hired Per Year

<table>
<thead>
<tr>
<th>Company</th>
<th>New Hires</th>
<th>Company</th>
<th>New Hires</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17</td>
<td>0</td>
</tr>
</tbody>
</table>

General information about the niche manufacturers in this study indicated that they are small, produce highly specialized products and have had to react to the uncertainty in today’s economic climate by becoming more efficient, hiring less, and adjusting the work hours of production personnel.

Information about the Skill Level of Newly Hired Production Workers

The second section of the interview instrument asked for information regarding the skill level of newly hired production workers, in relation to the needs of the companies. Employers indicated that they are generally satisfied with the communication abilities of their newly hired production workers. Regarding technical abilities, 53% of subjects said that they were satisfied, while 35% were dissatisfied. Subjects indicated that because their products are so specialized, they must spend a great deal of effort training new employees. This is illustrated in Figure 3 which indicates both the level of difficulty in finding skilled employees, and the gap between the skills and requirement of new employees.
Almost none of the subjects said that employee skill deficiencies prevent their company from expanding into new manufacturing technologies; however, 47% said that these skill deficiencies negatively impact company profits. Several subjects indicated that this is because they are spending time training employees which impacts profits. They do not see the skill deficiencies as affecting their expansion because they are able to train for new technologies. Thirty-five percent of the subjects said that employee skill deficiencies impact product quality. Seventy percent of subjects said that it is important for production employees to have technical skills beyond the high school level.

**Rankings of Specific Skills and Satisfaction Level with those Skills**

The third section of the interview instrument asked participants to rate the abilities of their average newly hired production employees in several areas, and then to indicate the importance of each skill. Each skill was rated as low, medium, or high importance and employees were rated as poor, satisfactory, or good in ability. The data was analyzed using a weighted scoring model.

Weights for all skills were calculated and a rank was given based upon the difference between the weighted score of skill importance minus skill ability. For example, if a subject identified a skill to be important but new employees are good at that skill, there is no skill gap. However if a subject identified a skill as important and new employees are poor at that skill, then there is a large gap. A high positive weighted score means that there is a large gap between the importance of a skill and the ability of newly hired production employees. A high negative weighted score means that newly hired employees are good at that skill, but employers do not value that skill as important. These skill gaps are shown in Table 3.
Table 3. Ranked List of Gap between Skill Importance and Employee Ability

<table>
<thead>
<tr>
<th>Rank</th>
<th>Description of Skill</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Can determine when a product does not meet specifications.</td>
<td>64.71</td>
</tr>
<tr>
<td>2.</td>
<td>Accurately executes directives given verbally.</td>
<td>58.82</td>
</tr>
<tr>
<td>3.</td>
<td>Relates product quality to customer satisfaction.</td>
<td>58.82</td>
</tr>
<tr>
<td>4.</td>
<td>Is able to make machine adjustments when necessary.</td>
<td>52.94</td>
</tr>
<tr>
<td>5.</td>
<td>Knows what OSHA regulations pertain to the operation.</td>
<td>47.06</td>
</tr>
<tr>
<td>6.</td>
<td>Accurately executes directives given in writing.</td>
<td>35.29</td>
</tr>
<tr>
<td>7.</td>
<td>Can diagnose mechanical problems in production machinery.</td>
<td>29.41</td>
</tr>
<tr>
<td>8.</td>
<td>Can monitor machine output for quality trends.</td>
<td>29.41</td>
</tr>
<tr>
<td>9.</td>
<td>Can effectively communicate verbally.</td>
<td>29.41</td>
</tr>
<tr>
<td>10.</td>
<td>Operates machinery in a safe manner.</td>
<td>11.76</td>
</tr>
<tr>
<td>11.</td>
<td>Can function in a team environment.</td>
<td>11.76</td>
</tr>
<tr>
<td>12.</td>
<td>Understands the basic principles of pneumatic power.</td>
<td>-5.88</td>
</tr>
<tr>
<td>13.</td>
<td>Can interpret technical drawings and schematics.</td>
<td>-5.88</td>
</tr>
<tr>
<td>14.</td>
<td>Can diagnose electrical problems in production machinery.</td>
<td>-11.76</td>
</tr>
<tr>
<td>15.</td>
<td>Can operate computer controlled machinery.</td>
<td>-17.65</td>
</tr>
<tr>
<td>16.</td>
<td>Understands how sensors are used in safety applications.</td>
<td>-17.65</td>
</tr>
<tr>
<td>17.</td>
<td>Possesses adequate computational skills.</td>
<td>-29.41</td>
</tr>
<tr>
<td>18.</td>
<td>Can program computer controlled machinery.</td>
<td>-29.41</td>
</tr>
<tr>
<td>19.</td>
<td>Can produce written records or reports.</td>
<td>-47.06</td>
</tr>
<tr>
<td>20.</td>
<td>Understands how sensors interact with control systems.</td>
<td>-52.94</td>
</tr>
<tr>
<td>21.</td>
<td>Understands the basic principles of hydraulic power.</td>
<td>-58.82</td>
</tr>
<tr>
<td>22.</td>
<td>Possesses basic computer skills.</td>
<td>-76.47</td>
</tr>
</tbody>
</table>

Requirements and Methods Relating to Skills Training

The fourth section of the interview instrument asked subjects about their company’s requirements and methods as they relate to employee skills training. One hundred percent of all participants said that they train employees on-the-job. Since most of these manufacturers produce specialized products, their training needs are specialized. Subjects indicated that they use the CR for training employees in 53% of the companies. Some of the subjects selected “other” for training options, listing the local university and vendor training.

Subjects were asked to select from a list of barriers to providing technical training. The data in Figure 4 shows how they responded.
Fifty-three percent of all subjects indicated that classes offered are not pertinent to their company’s needs. This result is profound and points out that a very large portion of employers located in the area served by the CR do not see the college as offering courses that can help them. Clearly the college needs to address this fact because 59% of employers noted that they encourage employees to seek outside training by reimbursing them for the cost of training and by allowing employees time off during regular work hours to attend.

The Relationship Between the Companies and the College of the Redwoods
The fifth and final section of the interview instrument asked subjects specific questions regarding the relationship between their companies and the college. Forty-seven percent of the subjects said that their company has current employees who are graduates of the CR. An overwhelming 88% of all subjects indicated that they would give preference to the CR graduates over job applicants who only had completed high-school. No participant in this study said that the CR graduates are not well prepared, while 53% said that they are well prepared. However, 47% percent of the subjects said they did not know if the CR graduates are well prepared to work at their company.

Many of the manufacturers that participated in this study do use the CR to train their employees. Forty-seven percent of the subjects indicated that they have sent current employees for specific training at the CR. Fifty-three percent of the subjects said that they have encouraged their employees to pursue a degree or certificate from the CR. Seventy-six percent of all subjects indicated that they would be interested in programs sponsored by the CR designed to increase the skill level of their employees. These statistics indicate that niche manufacturers in Humboldt County value the CR, and many of them are using the college to train their employees.

The last question of each interview was open-ended in an attempt to capture general attitudes related to the appropriateness of skills training at the CR. Almost all of the subjects said that the training is appropriate. Many of the subjects discussed that their main problem with employee’s skills is not with technical training but with...
work ethics. One subject remarked that, “You can’t teach work ethic.” This sentiment was echoed by other subjects. Many manufacturers indicated that they could train employees for their specific needs but finding dedicated hard-working employees was difficult.

Conclusions & Recommendations
This needs assessment study has generated an aggregate set of employer skill needs for a moderately large sample of the entire population of niche manufacturers in Humboldt County. This data leads to the conclusions listed in Table 4.

Conclusions

Table 4.

1. Niche manufacturing companies in Humboldt County are small companies with specialized products and very specialized needs.

2. These manufacturers require production employees to have specialized skills that require training beyond the high school level.

3. Employers in Humboldt County have difficulty finding skilled employees.

4. Gaps exist between the skills requirements of these companies and skills that newly hired production employees possess.

5. There is a preference given to graduates from the CR when applying for production jobs in Humboldt County.

6. Specialized training programs at the college are needed to help the niche manufacturers served by the college.

7. Further research is required to examine the validity of the interview instrument and identify ways to improve it.

8. The sample size in this study should be increased.

Discussion
Humboldt County’s manufacturing community is comprised of niche manufacturers. Thus, all of the manufacturing that takes place in this unique community is done at small companies producing very specialized products. The fact that these companies are small is not a weakness; perhaps it allows them to weather the fluctuations in the global economy better than larger companies because of lower operating costs. The specialized products that these companies produce have limited competition and many of the companies included in this study are not facing drastic lay-offs or severely reduced production levels. However, the current economic environment certainly impacted this study, especially regarding data on hiring and production level changes over the last five years. Specialized products require specialized skill sets in production employees. All of the subjects said that they utilize on-the-job training and many indicated that a specialized program at the CR would be welcome. The population in Humboldt County is small and the region is geographically isolated, employers in general have difficulty finding qualified employees. Subjects in this study indicated that technical qualifications are lacking in newly hired employees, but more importantly, dedicated personnel with strong work-ethics are difficult to find. This study found gaps between skills required and skills desired in production employees.

Manufacturers in Humboldt County support and rely on the college. Preference is given to the CR graduates, employers use the college for specific training, and employees are encouraged to seek degrees and certificates from the CR. The college is respected and valued in the community that it serves.

Recommendations
Because of the uniqueness of the products manufactured in rural communities, many manufacturers’ employees require technical training in the traditional sense as well as specific training to produce unique products. This author recommends that further research be conducted in Humboldt County to attempt to more completely capture the needs of niche manufacturers because most companies located in Humboldt County are not typical of
the U.S. manufacturing population. Future research should also attempt to include service companies as well as manufacturers because the MT program at the CR provides skills that can be applied in service jobs.

The interview instrument used in this study was accurate in capturing general employer needs; however, a revision to the interview instrument must be done to tailor the questions to smaller companies. Methods for focusing on skill gaps that are more specific to the unique needs of this region must be developed. Additionally, validity of the instrument must be established for further research because certain interview questions captured only opinions and perceptions. These questions should be modified to induce responses that represent hard numbers that can be verified in order to validate the instrument. Many participants in this study indicated a need for employee soft skills and work ethic. For example, employers are concerned about the problem of not finding employees that have good attendance and arrive at work on time and prepared to work. An improved interview instrument should include questions that capture data specific to these soft skills.

Since all of the manufacturers in Humboldt County rely heavily on in-house or on-the-job training by other employees, the CR should consider offering specialized courses and programs that focus on training the trainer. Curriculum targeting higher-level supervisory employees should be developed that cultivates skills for educating production workers.

Many manufacturers in Humboldt County state that skills training at the CR is appropriate and good for giving students basic well-rounded skill sets for working in the manufacturing field. However, these companies are in need of further training in their production employees so that they can perform all of the job requirements. Thus, the college needs to continue with its general program, but enhance the skills taught by implementing a process of continual improvement guided by input from the manufacturers in the community.

References
Vinas, T. (2005, November 1). It’s time to fix the kitchen sink; Census data show that manufacturers that don’t invest in employees will have higher turnover rates - at a time when skilled employees are becoming scarcer. Industry Week, 254(11), 26-31.
Appendix - Interview Instrument

The Manufacturing Technology Program at College of the Redwoods would like your input in a skills needs assessment interview. The results from this study will help us to improve the content of our Manufacturing Technology Curriculum. Interview results will also be included as part of a graduate school project for the College of Technology at Purdue University.

This interview process requires that you are a management level employee and that you have the authority to decide if you should participate. By participating in this interview, you are giving College of the Redwoods and Purdue University permission to collect this data.

Participation in this interview is completely voluntary. Your may discontinue your involvement at any time during the process. All participants must be at least 18 years old. Any information that you provide will be kept confidential. No identifying information will be collected from you and all data from the interview will be kept in password protected, encrypted computer files. When the data from this sheet is entered into a computer file, this sheet will be destroyed by shredding. Results from this interview will be reported in aggregate form only, with no specific company or individual identified.

This section asks for general information about your company’s products and production methods. It also asks for information regarding human resource requirements and utilization.

1. Please describe the products manufactured by your business.

________________________________________________________________________________________________
________________________________________________________________________________________________
________________________________________________________________________________________________

2. How would you describe your main method of production?
   - Manual
   - Slightly Automated
   - Moderately Automated
   - Highly Automated

3. What technologies are used by your company? (Please check all that apply.)
   - CAD (Computer Aided Drafting)
   - PDM (Product Data Management)
   - SPC (Statistical Process Control)
   - Digital Manufacturing
   - Bar Codes
   - Rapid Prototyping
   - EDM (Electro Discharge Machining)
   - CAM (Computer Aided Manufacturing)
   - Welding
   - Plating or Anodizing
   - CNC (Computer Numerical Control)
   - PLC (Programmable Logic Control)
   - Robotics
   - SPC (Statistical Process Control)
   - Machine Vision
   - Automatic Storage and Retrieval
   - Industrial Lasers
   - Mechatronics
   - Plastic Injection Molding
   - Other (Please specify): _______________________________

4. In terms of product output per labor hour input, how would you describe the change in the level of production at your company over the past five years?
   - Large Decrease
   - Decrease
   - No Change
   - Increase
   - Large Increase

5. Approximately how many employees do you have who work directly in the manufacturing process? (Please exclude supervisors and maintenance personnel.) ____________________________________________

6. How has the number of employees who work directly in the manufacturing process changed over the past five years?
   - Large Decrease
   - Decrease
   - No Change
   - Increase
   - Large Increase
7. Is your typical production worker trained to perform one specific job or cross-trained to perform two or more different jobs?
   - One specific job
   - Cross-trained for two or more different jobs

8. Please describe the work week of your typical production worker.
   Example: 8 hours per day / 40 hours per week / always the same shift

________________________________________________________________________________________________
________________________________________________________________________________________________
________________________________________________________________________________________________

This section asks for information regarding the skill level of newly hired production workers, in relation to the needs of your company.

9. Approximately how many new production employees does your company hire each year?

________________________________________________________________________________________________

10. What is your level of satisfaction with the technical ability of newly hired production personnel?
    - Very dissatisfied
    - Dissatisfied
    - Satisfied
    - Very satisfied

11. What is your level of satisfaction with the communication ability of newly hired production personnel?
    - Very dissatisfied
    - Dissatisfied
    - Satisfied
    - Very satisfied

12. How difficult is it to find adequately skilled employees within your company’s region?
    - Very dissatisfied
    - Dissatisfied
    - Satisfied
    - Very satisfied

13. How would you describe the gap between the skills of your newly hired production workers and the needs of your company?
    - Large gap
    - Moderate gap
    - Slight Gap
    - No gap

14. Do employee skill deficiencies prevent your company from expanding into new manufacturing technologies?
    - Yes
    - No
    - Do not know

15. Do employee skill deficiencies negatively impact company profits?
    - Yes
    - No
    - Do not know

16. Do employee skill deficiencies negatively impact product quality?
    - Yes
    - No
    - Do not know

17. Approximately what percentage of your newly hired production workers have had technical skills training beyond the high school level?

________________________________________________________________________________________________

18. Is it important to your company to hire employees with technical training beyond high school?
    - Yes
    - No
    - Do not know
This section asks you to rate the abilities of your average “newly hired” production employees in each of the areas provided, and then to indicate the importance of each skill as it relates to your manufacturing operation.

Please use the following scale to grade employee ability:

- **P** = Poor
- **S** = Satisfactory
- **G** = Good

Please use the following scale to rate the importance of each skill to your operation:

- **L** = Low importance
- **M** = Medium importance
- **H** = High importance

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<tr>
<td>19. Accurately executes directives given verbally.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>20. Accurately executes directives given in writing.</td>
<td><strong>Ability:</strong></td>
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<td>21. Can produce written records or reports.</td>
<td><strong>Ability:</strong></td>
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<td>22. Can effectively communicate verbally.</td>
<td><strong>Ability:</strong></td>
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<td>23. Can function in a team environment.</td>
<td><strong>Ability:</strong></td>
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<td>24. Possesses adequate computational skills.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>25. Can interpret technical drawings and schematics.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>26. Possesses basic computer skills.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>27. Can diagnose mechanical problems in production machinery.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>28. Can diagnose electrical problems in production machinery.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>29. Understands the basic principles of hydraulic power.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>30. Understands the basic principles of pneumatic power.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>31. Can operate computer controlled machinery.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>32. Can program computer controlled machinery.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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<td>33. Understands how sensors interact with control systems.</td>
<td><strong>Ability:</strong></td>
<td><strong>Importance:</strong></td>
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34. Relates product quality to customer satisfaction.  
   Ability: P □ S □ G □   Importance: L □ M □ H □

35. Can determine when a product does not meet specifications.  
   Ability: P □ S □ G □   Importance: L □ M □ H □

   Ability: P □ S □ G □   Importance: L □ M □ H □

37. Is able to make machine adjustments when necessary.  
   Ability: P □ S □ G □   Importance: L □ M □ H □

38. Operates machinery in a safe manner.  
   Ability: P □ S □ G □   Importance: L □ M □ H □

39. Knows what OSHA regulations pertain to the operation.  
   Ability: P □ S □ G □   Importance: L □ M □ H □

40. Understands how sensors are used in safety applications.  
   Ability: P □ S □ G □   Importance: L □ M □ H □

This section asks you to provide information regarding your company’s requirements and methods as they relate to employee skills training.

41. Does your company offer pay increases or promotions to employees who participate in outside training programs?  
   □ Yes  □ No  □ Do not know

42. What is the largest barrier that your company faces in providing technical training or education to its employees? (Please check two choices from the list below.)  
   □ The cost of training  
   □ Classes are offered at inconvenient times  
   □ Classes offered are not pertinent to our company needs  
   □ Lack of interest on the part of employees  
   □ Lack of interest on the part of management  
   □ Lack of adequate transportation for employees  
   □ Other (Please specify) ____________________________________________________________

43. How does your company provide training for production personnel? (Please check all that apply.)  
   □ On the job, by other employees  
   □ On the job site, by commercial trainers  
   □ Send employees to a commercial trainer off-site  
   □ Use of local technical or vocational college  
   □ Other (Please specify) ____________________________________________________________

44. Does your company reimburse employees for the costs of attending outside training programs?  
   □ Yes  □ No  □ Do not know

45. Does your company offer employees time off during regular work hours to attend outside training programs?  
   □ Yes  □ No  □ Do not know
This section specifically addresses the relationship between your company and College of the Redwoods.

46. Does your company currently employ any College of the Redwoods graduates?
   - Yes  ☐ No  ☐ Do not know

47. When hiring production workers, does your company prefer College of the Redwoods graduates over applicants with only a high school diploma?
   - Yes  ☐ No  ☐ Do not know

48. Do you find College of the Redwoods graduates to be well prepared to work at your company?
   - Yes  ☐ No  ☐ Do not know

49. Have you sent any current employees to College of the Redwoods for specific training?
   - Yes  ☐ No  ☐ Do not know

50. Have you encouraged any current employees to pursue a College of the Redwoods degree or certificate?
   - Yes  ☐ No  ☐ Do not know

51. Would your company be interested in a College of the Redwoods sponsored program designed to increase the skill level of production personnel who work in an advanced manufacturing environment?
   - Yes  ☐ No  ☐ Do not know

Please give any comments related to the appropriateness of skills training available at College of the Redwoods.

________________________________________________________________________________________________
________________________________________________________________________________________________
________________________________________________________________________________________________
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________________________________________________________________________________________________

This concludes the College of the Redwoods Manufacturer’s Skill Needs Assessment interview. Thank you for taking the time to participate. The information that you provided will allow us to offer a richer educational experience to our students and better serve the community’s needs.
Construction
The Applicability of Using Closed Crawl Space Construction Technologies

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Introduction

Whether or not to ventilate a crawl space is probably the most controversial issue concerning crawl space design today. Approximately 250,000 new homes are built on crawl spaces every year, with an estimated 26 million such homes already in existence. Unfortunately, wall-vented crawl spaces can host a variety of serious moisture problems (Dastur & Davis, 2005). From their introduction into construction practice in the northern United States during the 1940’s, crawl space homes were viewed as trouble-prone, and over the years many crawl space moisture problems have been reported (Rose & Wolde, 1994). Also, in the past few years, mold has emerged as a major issue for the entire building industry.

Most building professionals agree that the area most prone to grow mold is the typical crawl space with foundation vents (Davis & Warren, 2003). The International Residential Code (IRC) states that, in order to comply with modern day building codes, a builder should provide a minimum net area of ventilation openings of not less than one square foot for each 150 square feet of crawl space floor area, with one such vent opening within 3 feet of each corner of said building. Since the 1940’s residential codes and many builders have suggested that passive ventilation with air from outside the building be used as the means for moisture control within the crawl space (Dastur, Davis, & Warren, 2005).

As indicated in the review of literature contained in this paper, one could conclude that there is ample evidence to support the need to use closed crawl space construction techniques in residential building. However, most actual research has been conducted in Princeville, North Carolina. This “in the field” research project was very thorough and strongly supports a conclusion of the benefits of using closed crawl space construction technologies in the Princeville, North Carolina Area. To gain a better understanding of whether these techniques would be favorable in other geographic areas, a closer look at the known problems associated with vented crawl spaces should be examined.

Problems Associated with Vented Crawl Spaces

Homes that are built over an exposed crawl space have been linked to serious health and environmental issues. Some of the most common problems related to crawl spaces are:

- Musty odors in the home
- Mold or moisture damage in the crawl space or living areas
- Excessive humidity levels in the living area
- Condensation on air conditioning ductwork within the crawl space
- Condensation on foundation walls, water pipes, or insulation
- Radon levels exceeding EPA standards
- Rodent and insect infestations
- Wood rot on crawl space joists or framing
- Warped hardwood floors
- Cold ceramic tile or hardwood floors above the crawl space
- Higher than normal utility bills
Many builders would say that the typical cure for these problems has been to add more ventilation. This would be done by adding more wall vents or by installing fans to move more outside air through the crawl space. Common among most of the observed problems associated with ventilated crawl spaces is excessive moisture. This is often the result of the movement of more outside air into the crawl space.

To understand why this problem occurs, we need to discuss a few properties of air. In particular, an understanding of temperature, relative humidity, and dew point will provide the basis for explaining the root cause of moisture related problems in ventilated crawl spaces. Most of us understand and are familiar with temperature. This is simply a measure of heat in the air (Dastur, Davis, & Warren, 2005). Relative humidity is a little harder to understand. At any given moment, the air outside the crawl space holds or contains a certain amount of water vapor. Water vapor is water in a gaseous form. At the current temperature; there is a limit to how much water vapor air can contain before the vapor condenses into liquid water. This liquid water is also known as condensation or rain. Relative humidity is a term used to describe the quantity of water vapor that exists in a gaseous mixture of air and water (Wikipedia, 2006). Relative humidity is also defined as the ratio of the amount of water vapor actually present in the air to the greatest amount possible at the same temperature (Merriam-Webster, 2006). The dew point is the temperature to which a given parcel of air must be cooled, and at constant barometric pressure, for the water vapor component to condense into water, called dew (Wikipedia, 2006).

Dew point is a more direct indication of how much water vapor is in the air. If the temperature of air is changed without adding or removing water vapor, the dew point stays the same. If water vapor is removed, the dew point goes down whether or not the air temperature changes. If the relative humidity in one location is 90% and the relative humidity in another location is 40% the location with more water vapor cannot be known unless the air temperatures are also known. Cold air can hold less water vapor than warm air, so if air gets cooler without losing water vapor its relative humidity increases.

In general, conditioning a crawl space involves designing or improving an existing crawl space which provides control for moisture, saves energy, and promotes a healthy and comfortable living environment. Listed below are the four recommendations made by the Forest Products Laboratory, a division of the United States Department of Agricultural (USDA), in the summer of 2004, as published in Techline (2004):

1. If a building is constructed on piers or posts and is working acceptably, leave it as is. If energy costs are excessive or thermal comfort is unacceptable - the building is not “working acceptably” - then floor insulation is often the best option. Skirting the building to form a crawl space and then venting the crawl space to code requirements could result in moisture problems, especially where summers are warm and humid.
2. Keep bulk water out of the crawl spaces. Site grading is probably the most important consideration. Drainage from pavement and roofs is a huge potential water source. Plumbing maintenance is also critically important.
3. Use a “vapor barrier” soil ground cover to inhibit evaporation into the crawl space. Running the vapor barrier up the foundation walls is recommended. In locations where termites are prevalent, the height to which the vapor barrier can be run will be limited by concerns for termite inspection. If the vapor barrier is run up the crawl space wall to the level of the floor joists, termites could build mud tunnels on the foundation wall that would be hidden from site.
4. In the eastern United States, seal crawl spaces from warm humid air, especially if the building is air conditioned.

**Princeville Research Project**

In a recent study commissioned by the U.S. Department of Energy (DOE), Advanced Energy, (2005) a private non-profit corporation located in Raleigh, North Carolina, was asked to study and publish their findings concerning the issue of crawl space problems. The study began in 2001 in the North Carolina town of Princeville, with an actual experimental study conducted in the summers of 2003 and 2004. Below is a summary of the findings, which have since influenced many building codes that govern crawl space construction.

The first part of the Princeville study was a characterization of ten homes that were from 2 to 9 years old, all built with crawl space wall vents. Using a variety of instruments and visual observations, the study team characterized the homes in three general areas: moisture, thermal and indoor air quality. The findings revealed that all ten homes had multiple moisture problems, unexpected high levels of respirable, viable mold spores, and
compromised thermal performance due to poor insulation and excessive shell and duct leakage (Dastur, Davis, & Warren, 2005).

Following the ten home characterization study, 12 homes were selected, located within the same housing development, with similar square footage, and built using the same construction techniques. These 12 homes provided the basis for a true experimental design study, using three groups, one as a control group, and two for experimentation. Each of the four houses in the control group had eleven 8” by 16” foundation vents, six mil polyethylene ground cover secured with turf staples, with a 6” overlap of all seams. In the eight experimental homes, rigid polystyrene foam and duct mastic or spray foam were used to seal the vents. A mechanical drying system was installed in the form of a 4-inch duct that provided 35 cfm of air-conditioned air to the crawl space from the supply plenum whenever the air handler was running. Four of the experimental homes were insulated with R-19 Kraft-faced fiberglass, and four were insulated with 2 inches of R-13 foil-faced polyisocyanurate foam on the perimeter walls. Both groups had six-mil of polyethylene for a vapor barrier on the ground.

The Princeville experiment has been monitored for more than three years. The ongoing measurements clearly indicate that the closed crawl spaces consistently outperform the wall vented crawl spaces in terms of moisture control and energy use.

Represented in Table 1 are data showing a comparison of relative humidity between open and closed crawl spaces from the Princeville project for three consecutive summers.

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<th>Suggested Research Methodology for other Geographic Areas</th>
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<tr>
<td>In general, multiple studies should be designed which replicate the Princeville research across all geographical areas, which will involve building two similar sized and design homes in the same subdivision instead of ten. The houses should differ only in the construction of the crawl space.</td>
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<td>The data to be collected should include square feet of living space; cubic feet of crawl space; cost of each unit and specifically the cost of each crawl space; the energy consumed by each house with all variables the same, such as thermostat, number of lights, appliances, and their uses; insulation types and quantities; moisture content of crawl space structural members; and relative humidity both outside at periodical intervals and inside each crawl space at each interval.</td>
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<tr>
<td>Data should be collected for a two year cycle and should be presented by means of indicators relevant to central tendencies. Data should also be correlated when appropriate. An example of this would be the correlation between relative humidity outside and the moisture content of crawl space structural members.</td>
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| Table 1. Princeville Research Project Summary for Relative Humidity (2005) |
|------------------------------------------------|-----------------|-----------------|-----------------|
| **Summer (June-August) Relative Humidity Summary** | **2002** | **2003** | **2004** |
| RH Threshold | Vented | Closed | Vented | Closed | Vented | Closed |
| Above 90% | 0% | 0% | 23% | 0% | 7% | 0% |
| Above 80% | 39% | 0% | 86% | 0% | 70% | 0% |
| Above 70% | 79% | 0% | 98% | 5% | 92% | 0% |
| Above 60% | 94% | 0% | 100% | 64% | 100% | 13% |
| Above 50% | 100% | 100% | 100% | 100% | 100% | 100% |
Summary
There seems to be strong evidence in support of the notion that a closed crawl space is preferable to an open or vented crawl space. The Princeville research project also supports this idea with an added caveat that the closed crawl space must be designed or retrofitted properly. Attention to the design factors is crucial to the success of either crawl space systems. However, research in the area of closed crawl spaces needs to be expanded to include data from throughout the country on the environmental conditions within an open vented crawl space and a closed space.

References
dpoint
humidity
At What Threshold are Buildings Considered Energy Efficient?

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Abstract
There is continuing concern over meeting the energy needs of the United States and the global economy, and how these energy needs will be supplied. There are two ways of meeting the current and future need for energy: either the supply of energy must be increased or consumption must decrease, or more likely a combination of both. To control and decrease energy demand in buildings calls for an understanding of energy consumption in the built environment and defining what constitutes energy efficiency in buildings. LEED, Energy Star, and other green building rating systems typically gauge energy efficiency by percent savings or percentile rank compared to other similar buildings by construction type. While these current rating systems may be useful for ranking building performance, they do not provide benchmark energy consumption data that can identify energy efficiency thresholds to more easily quantify usage and predict energy costs. This paper presents the results of an analysis of buildings identified by the Department of Energy as “energy efficient” to determine a performance metric that can quantify consumption thresholds, predict energy costs, and therefore be used by design professionals to justify energy related planning decisions.

Introduction
In 2006, the United States consumed 100 Quadrillion British thermal units (Btu) of energy. By 2030, consumption levels are projected to increase to over 113 Quadrillion Btus (Energy Information Administration [EIA] 2009). More than 83% of U.S. energy consumption comes from fossil fuels (EIA, 2009) that emit carbon dioxide (CO₂) into the atmosphere. CO₂ is a greenhouse gas (GHG) that, according to many scientists, causes global warming and climate change (IPCC, 2007). Buildings account for 39% of the total U.S. energy consumption and projections indicate consumption by buildings will increase by over 40% by the year 2030 (Department of Energy [DOE], 2009).

Increasing demand for energy from the commercial building sector will cause a strain on energy supply, burdening the nation’s energy system resulting in larger amounts of harmful GHG emissions unless actions are taken (EIA, 2009; Griffith, Long, Torcellini, Judkoff, Crawley, & Ryan, 2006; 2007). Net-zero energy buildings represent one opportunity to reduce energy consumption of buildings, reducing energy demand and subsequent GHG emissions by producing as much energy on site as they use annually (Frechette & Gilchrist, 2009; Griffith et al., 2007; Torcellini, Pless, Deru, & Crawley, 2006).

To facilitate the ambitious goal of net-zero energy for most commercial buildings by 2025, energy consumption targets have been established by DOE (Griffith et al., 2007). In order to reach those targets, effective energy consumption metrics need to be developed, deployed, benchmarked, and constantly updated to track the progress of the newest high performance buildings (U.S. Green Building Council Research Committee, 2008).

Energy Rating Systems for Buildings
Deru and Torcellini (2005), Glazer (2008), Kinney and Piette (2007), Olofsson, Meier, and Lamberts (2004), and Turner and Frankel (2008) all list and explore a selection of commercial building energy rating protocols such as ASHRAE, Energy Star, LEED, CBECS, Arch, Cal-Arch, ASTM, Green Building Challenge and Architecture 2030. However, none of these protocols provide stakeholders with a clear consensus benchmark, nor share a consistent performance metric to understand the current threshold at which a building is considered energy efficient.
**Building Energy Rating Protocols**

The U.S. Department of Energy (2008) identified as a technical challenge and barrier to commercial integration of increased energy performance in buildings, that there is “No single definition of ‘good’ building energy performance (p. 2-17).” Building energy performance rating protocols provide a way to compare the energy consumption of buildings between each other and provide guidance for designing and building energy efficient structures (Glazer, 2008). However, as cited above, more than 45 protocols for rating energy performance for commercial buildings are in existence, each targeting their own audience, but none offer a clear, consistent, consensus benchmark, nor share consistent quantifiable performance metrics. Glazer reported that the most common protocol methodology is to compare the proposed building to a database of existing buildings. With the many different building energy performance rating methods available, no single common rating method for consumers and business decision makers is available. In addition, this plethora of rating protocols has led to confusion among stakeholders and regulatory bodies regarding the energy performance of buildings and what level of energy consumption constitutes energy efficiency (Glazer 2008; Perez-Lombard, 2009).

**Benchmarks of building energy consumption**

Benchmarking energy efficiency is important to promote reduced energy consumption in commercial buildings (Chung, 2006). A benchmark is a point or standard of measurement for comparison and benchmarking is the process of comparison to that standard or average (Sartor, Piette, Tschudi, & Fok, 2000; Kinney & Piette, 2002). Building energy benchmarking simply involves selecting an appropriate metric and comparing buildings using the chosen metric, after normalizing for parameters such as weather (Mathew, Sartor, Geet, & Reilly, 2004). Comparison of the measured performance data in the most meaningful way is the biggest challenge in benchmarking (Sartor et al., 2000).

The National Renewable Energy Lab (NREL) reported that benchmarking can be improved by using clearly defined absolute metrics determined by the NREL metrics protocol procedures (Barley, Deru, Pless, & Torcellini, 2005). Performance metrics can be used for building design and for comparison to benchmarks to evaluate the performance of a building. For a metric to be clearly defined and useful for benchmarking, factors such as what is specifically being measured, the means of making the measurement, and units to be expressed must be determined and consistent.

**Energy Metrics**

Deru & Torcellini (2005) described a metric as “a standard definition of any measureable quantity” and performance metric as “a standard definition of a measureable quantity that indicates some aspect of performance (p. 5).” Hitchcock (2003) describes performance metrics as explicitly representing the performance objectives for a building, using quantitative criteria, in a dynamically structured format. The U.S. Department of Energy, Performance Metrics Project (Deru & Torcellini, 2005) and a separate NREL report by Barley et al. (2005) focused on reporting absolute numbers for building energy consumption such as the quantity of Btu consumed. The benefit of utilizing only absolute numbers is the ability to directly compare energy consumption of buildings and to project energy costs from the numbers.

The AIA Committee on the Environment (COTE) noted that energy use intensity (EUI) is the primary performance metric and Btu is the standard unit of measure (2007). To determine the EUI, the energy consumed in a building, regardless of source, is converted to Btus and then the total energy consumption is divided by a building’s total square footage to yield a measure in Btu/ft². The EUI could then be compared to other buildings to gauge performance. However, buildings are complex systems and overly simplified metrics are also problematic. Kinney and Piette (2002) stated that mean EUI is a poor metric to use when comparing to a population of similar buildings or a benchmark because the distribution of mean EUIs is not typically a statistically normal distribution. Sartor et al. (2000) explained that whole building EUI alone does not convey the entire scope of energy consumption and that a low EUI may not mean that a building is energy efficient. A whole building metric is a necessary component but does not convey enough information for an accurate and useful comparison among buildings.

Deru and Torcellini (2005), Griffith, et al. (2007), Hitchcock (2003), and Mathew, et al. (2004) discussed levels of metrics from simple to more complex. Whole building metrics are simpler and encompassing, as opposed to system level metrics such as lighting and conditioning that are more complex, specific, and can be very numerous.
depending on the number and types of systems measured. Griffith, et al. (2007) and Turner and Frankel (2008) both noted that plug and process loads, which is described as occupant-driven energy use for activities other than lighting and conditioning the building, can vary greatly from building to building depending on the building use. For a useful comparison between buildings of different uses the plug and process loads would need to be accounted for to normalize for the building’s usage. Sartor et al., (2000) explained that, many performance metrics can be useful and comparable; however the measurement data are not available or are expensive to obtain, making the metrics not practical. For a proper comparison of buildings a combination of whole building and system level metrics normalized for the appropriate factors may be necessary.

Building Energy Data and Analysis Procedures

U.S. Department of Energy (DOE) and the National Renewable Energy Lab (NREL) maintain a database of 125 high performance buildings. The database is a central repository of in-depth information and data on high-performance green building projects across the United States and abroad. Information is comprised of energy use data, environmental performance, design process, finances, design and project team, and other aspects of each project submitted for review by an editor for publishing consideration. Buildings representing many different green building programs such as LEED, AIA Top Green Projects, and Building Green are included in the listing. The DOE/NREL database was utilized in this study to determine the threshold at which buildings could be considered energy efficient.

The DOE/NREL database was sorted by buildings with actual energy consumption data as opposed to the design simulation data. The list was further sorted by buildings with detailed information including itemized data for system level functions including lighting, ventilation, heating and cooling energy consumption. For each remaining building the sum of the lighting, ventilation, heating and cooling energy was totaled and categorized as the shell energy. The shell energy was subtracted from the total annual consumed energy to find the assumed plug and process energy. The annual energy consumption data was divided by the square footage of the building for the total energy consumption and each of the system level subtotals providing whole building EUI and system level EUIs. Heating and Cooling EUIs were then divided by the heating degree days (HDD) and cooling degree days (CDD) respectively, as listed by NOAA average annual degree days 1971-2000 for the data collection site nearest the data building. The whole building EUI, lighting EUI, ventilation EUI, Heating energy/ft²/HDD, Cooling Energy/ft²/CDD, plug and process EUI, and Shell EUI for each building was compared using descriptive statistics, to find the range, mean, median, and standard deviation.

Analysis and Discussion of Building Energy Data

At the time of this research, the DOE/NREL High Performance Buildings Database was comprised of 125 buildings. Of this total, actual energy consumption data was provided for only 45 of these buildings. The number of buildings analyzed was further reduced by eliminating projects: (a) in the planning stage or under construction, (b) outside of the USA, or (c) with a floor space of less than a 1000 square feet. Also not considered for analysis were buildings that did not provide a breakdown of energy consumption by systems, such as lighting and HVAC. Only 11 of the 125 buildings in the database met the criteria for analysis. The data for these 11 buildings were entered in a spreadsheet along with the corresponding degree days from the NOAA data site closest to the building location. As operationalized above, the following group of metrics was calculated for each building: shell energy, plug and process energy, whole building EUI, and system level EUIs for lighting, ventilation, heating energy/ft²/HDD, and cooling energy/ft²/CDD. These metrics for each building were compared using descriptive statistics, to find the range, mean, median, and standard deviation. The results are displayed in Table 1.
Table 1: Annual Energy Consumption Statistics

<table>
<thead>
<tr>
<th>Description (Units)</th>
<th>Mean (n=11)</th>
<th>Median</th>
<th>Std Dev</th>
<th>Lowest</th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUI Building (Btu/ft²)</td>
<td>93,681.94</td>
<td>41,562.50</td>
<td>111,042.19</td>
<td>23,589.74</td>
<td>359,130.43</td>
</tr>
<tr>
<td>EUI Lighting (Btu/ft²)</td>
<td>10,587.94</td>
<td>11,312.50</td>
<td>5,889.91</td>
<td>3,191.49</td>
<td>20,210.53</td>
</tr>
<tr>
<td>EUI Ventilation (Btu/ft²)</td>
<td>11,150.27</td>
<td>2,210.53</td>
<td>19,979.68</td>
<td>0.00</td>
<td>65,826.09</td>
</tr>
<tr>
<td>Heating/ft²/degree day (Btu/ft²/HDD)</td>
<td>2.57</td>
<td>0.91</td>
<td>3.63</td>
<td>0.00</td>
<td>12.52</td>
</tr>
<tr>
<td>Cooling /ft²/degree day (Btu/ft²/CDD)</td>
<td>17.18</td>
<td>3.38</td>
<td>26.08</td>
<td>0.00</td>
<td>76.34</td>
</tr>
<tr>
<td>EUI Plug and Process (Btu/ft²)</td>
<td>42,738.12</td>
<td>16,362.61</td>
<td>69,978.52</td>
<td>26.85</td>
<td>226,782.61</td>
</tr>
<tr>
<td>EUI Shell (Btu/ft²)</td>
<td>50,943.82</td>
<td>30,484.23</td>
<td>46,196.35</td>
<td>8,321.92</td>
<td>139,095.74</td>
</tr>
</tbody>
</table>

The statistical analysis showed a large range in the building EUI with the highest energy usage over 15 times greater than the lowest. The large range would support the claims in the literature that the entire scope of a building’s energy consumption is difficult to understand from this number alone. Also as indicated in the literature, the distribution for building EUI is not normal, as the standard deviation is greater than the mean and a building cannot consume negative energy.

The lighting EUI mean and median have a difference of less than 800 Btus indicating a normal or near normal distribution. With a highest reported lighting energy usage almost six times the lowest usage, lighting EUI has the smallest range of the selected metrics. Without consideration of factors such as the hours of operation and number of occupants, the amount of lighting energy consumed per square footage has the least variance of all metrics among these buildings. To visualize the lighting EUI range, consider that at 3.412 Btu = 1 watt, the lighting EUI converted to watts, divided by 365 days, divided by 12 hours per day, equals the difference of approximately one (1) 60 watt light bulb per 120 ft² of floor space vs. (1) 60 watt light bulb per 288 ft² of floor space. For some of the buildings, the energy consumption for ventilation, heating, and cooling equaled zero Btus, indicating that factor such as design or climactic location greatly impact energy consumption. However, these differences also underscore the fact that all of these metrics are not required for all buildings depending on the specifics of each building.

As was expected, the plug and process EUI range was the most extreme with the highest reported building usage more than 8400 times greater than the lowest usage. A tremendous difference in this category supports the claim in the literature that the plug and process load can vary greatly depending on the purpose of the building occupancy, e.g. middle school vs. research laboratory. Given the enormous difference of plug and process load energy consumption in the sample of buildings, it is essential to be able to isolate this load when determining the threshold at which a building could be considered energy efficient.

A review of the building performance metrics identified two extreme outliers: the NREL Solar Energy Research Facility, with a whole building EUI almost 2.5 standard deviations above the mean; and the ORNL East campus with a whole building EUI 1.5 standard deviations above the mean. The standard deviation of the remaining nine buildings all have a building EUI less than the mean. The outlier buildings are both national laboratories with highly specialized functions. Table 2 presents a summary of the performance metrics based on the remaining nine buildings and excludes the two highly specialized laboratories.
Table 2: Annual Energy Consumption Statistics w/o Outliers

<table>
<thead>
<tr>
<th>Description (Units)</th>
<th>Mean (n=9)</th>
<th>Median</th>
<th>Std Dev</th>
<th>Lowest</th>
<th>Highest</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUI Building (Btu/ft^2)</td>
<td>45,400.55</td>
<td>40,821.92</td>
<td>20,222.29</td>
<td>23,589.74</td>
<td>90,384.62</td>
</tr>
<tr>
<td>EUI Lighting (Btu/ft^2)</td>
<td>11,098.28</td>
<td>11,312.50</td>
<td>5,937.17</td>
<td>3,845.64</td>
<td>20,210.53</td>
</tr>
<tr>
<td>EUI Ventilation (Btu/ft^2)</td>
<td>3,240.81</td>
<td>1,845.64</td>
<td>4,566.71</td>
<td>0.00</td>
<td>13,833.33</td>
</tr>
<tr>
<td>Heating/ft^2/degree day (Btu/ft^2/HDD)</td>
<td>1.75</td>
<td>0.91</td>
<td>1.57</td>
<td>0.01</td>
<td>4.76</td>
</tr>
<tr>
<td>Cooling/ft^2/degree day (Btu/ft^2/CDD)</td>
<td>7.55</td>
<td>1.76</td>
<td>14.60</td>
<td>0.00</td>
<td>45.64</td>
</tr>
<tr>
<td>EUI Plug and Process (Btu/ft^2)</td>
<td>13,296.27</td>
<td>12,357.89</td>
<td>9,657.64</td>
<td>26.85</td>
<td>32,500.00</td>
</tr>
<tr>
<td>EUI Shell (Btu/ft^2)</td>
<td>32,104.28</td>
<td>26,984.21</td>
<td>21,648.61</td>
<td>8,321.92</td>
<td>81,493.59</td>
</tr>
</tbody>
</table>

By removing the two outliers, the sample appears to be a normal or near normal distribution. It is clear that even with this adjustment the plug and process energy is the largest source of variation with the largest value more than 1200 times the low value. However, this is not problematic for benchmarking if the plug and process load can be isolated.

Conclusions

Based on the analysis of the DOE/NREL High Performance Building database, the following conclusions were derived:

1. Plug and process energy loads are the largest source of variance and can be the biggest difference in total building energy consumption.
2. Lighting energy consumption was the most consistent metric across the sample of buildings.
3. Isolating the shell energy requirements (basic lighting, ventilation, heating and cooling) from the plug and process energy (operations) is essential to understanding if the building is performing as designed.
4. The annual shell EUI of a building (shell energy/building ft^2) appears to be the most logical metric to compare buildings in general terms of energy efficiency. However, shell EUI does not consider the occupant load, hours of operation, or climactic factors specifically.
5. Based on the descriptive statistics calculated from the DOE/NREL sample, the mean plus one standard deviation would encompass approximately 84% of the most efficient buildings. Therefore, the mean shell EUI plus one standard deviation could serve as the threshold level at which building energy consumption is considered efficient.
6. As indicated in Table 2, buildings in various locations and serving a range of functional purposes can operate effectively with a shell EUI of 53,753 Btus or less. It must be realized that this value is calculated for a current sample of energy efficient buildings and that technological change will continually reduce this threshold.

References


Developing an Internationally Recognized Certification Exam for Construction Managers

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Abstract
The development of an internationally recognized and universally accepted construction management exam used to certify Construction Management graduates as competent future construction managers is a contemporary challenge for construction educators. Graduates of four-year construction-related programs are eclectic, diverse, and are not academically or experientially homogeneous. Appropriate content for a universally accepted exam will be discussed as well as its use as a method for assessing construction graduates and programs.

Introduction
Currently, there are 62 four-year construction management programs accredited by the American Council of Construction Education ACCE (American Council for Construction Education, 2010a). In addition ABET, formally known as the Accreditation Board for Engineering and Technology, accredits 30 construction engineering technology programs which have many curricular similarities to the ACCE construction management programs while ATMAE the Association of Technology, Management, and Applied Engineering accredits another 24 similar construction-related programs (ATMAE, 2010). Moreover, there are 136 members of the Associated Schools of Construction (ASC) which represents a cross section of construction management-related programs in the United States and several foreign countries (Associated Schools of Construction, 2010). These diverse programs produce well over 2,500 graduates per year. A study by Bilbo, Fetters, Burt, and Avant (2000) indicated similar but slightly smaller numbers in a study of Construction Management graduates that totaled 2,350 graduates, however, that was almost a decade ago when there were far fewer programs.

The contemporary construction industry is rapidly changing. Many new ways of doing business are developing from various topics in the field, such as Design/Build, Building Information Modeling (BIM), sustainable Green Construction (LEED) as well as newly introduced building materials and building systems, computer based project management and, most importantly, financial data collection and analysis. All of the tried and true construction traditions, established building industry practices, as well as the newly introduced topics must be taught in the construction classroom. These new topics must be integrated into the construction curricula. Because of the ever changing and challenging nature of the field of construction management, some type of comprehensive testing must be required to measure the competence of new graduates regarding all of these various topics.

Current Construction Management Exams
The American Institute of Constructors is an organization that was created in 1971 by a general contractor named Walter Nashert of Oklahoma City along with members of an education committee of the Associated General Contractors of America (American Institute of Constructors, 2010). In the 1990’s, the AIC developed the Certified Professional Constructor (CPC) certification exam and the Associate Constructor (AC) exam. These exams serve to certify knowledgeable veteran constructors as well as new constructors interested in professional construction management careers. The CPC certification is intended for professional constructors who have been in the construction field for several years. The CPC exam questions cover both education and on the job experienced based knowledge. The AC Associate Constructor exam is designed for new professionals entering the construction field, therefore exam questions are primarily based upon academic knowledge.
Although the AC and CPC exams have been available for many years, they clearly do not suit the majority of construction management programs. In addition, the content has not been revised to include the latest topics that are now important aspects of the construction industry. A new exam needs to be developed that will better assess the students graduating from construction management programs.

The Construction Management Association of America (CMAA) allows construction professionals to become a Certified Construction Manager (CCM), however, an individual must have at least four years of experience before becoming certified. In addition, there is an application fee of $275, an exam fee of $275, and a membership fee of $75 for a total certification fee of $625. The experience requirements and high certification fees would limit its use for college graduates (Construction Management Association of America, 2010).

**Content For The ATMAE Construction Management Exam**

The academic content for the various accredited construction management-related curricula is somewhat similar. Although the different sectors of the construction industry have a variety of expectations of construction management college graduates, in most cases the core curriculum is generic enough to suit their basic needs. While the core curriculum serves to provide the fundamental knowledge for a construction management major, it often lacks specific coursework dedicated to various industry sectors. Most construction management programs have developed a curriculum that follows the categories outlined in Document 103 that is posted under the accreditation section on the ACCE website (American Council for Construction Education, 2010b). The broad curriculum categories listed in Document 103 are general education, mathematics & science, business & management, construction science, and construction. The broad construction categories are broken down even further into topics that include estimating, planning and scheduling, methods and materials, construction graphics, surveying, construction accounting and finance, soil mechanics, analysis and design of construction systems, construction law, safety, and project management.

Project Delivery Systems, Green Construction, and Building Information Modeling are a few of the new dynamic aspects of the industry that most construction management programs have introduced into the curriculum. These concepts and others are becoming more and more important to construction companies. Most construction companies invest a lot of time and capital into graduates from university construction programs in order for them to meet the challenges of the ever changing construction industry; therefore, they are looking for well prepared individuals who can hit the ground running. Developing a universal testing instrument depends on incorporating the subject matter derived from academic coursework, the construction industry, and more specifically selected sectors within the industry. A new construction management exam would provide employers with better insight to the aptitudes a potential employee might possess.

The established construction management curriculum matures as innovative and energetic practitioners integrate future building and construction applications into the diverse construction course work. As noted by Beliveua and Knox (2002), “Every few decades a group of new technologies comes along and disrupts the old order” (p.69). The eclectic construction industry expects universities to prepare competent new construction management talent by incorporating all the traditional concepts as well as the new knowledge and practical experience needed to perform well in the highly competitive construction industry.

Academic researchers in the construction field continue to gather pertinent data from the construction industry on topics such as the rapid advances in project delivery, building materials, energy efficiency, and innovative construction techniques. This new data then becomes the premise for new content that is integrated into the construction curriculum by construction faculty in higher education. One example of such research was conducted by Hutchings & Christofferson (2000) who introduced construction concepts from the practitioner’s point of view. They noted that construction educators may presume to have an understanding of what is important to residential contractors, however, they go on to say, “the results of this research indicated that owners and managers of small-volume home building companies believed that the most important factors contributing to the success of their companies were quality workmanship and products, honesty and integrity, good subcontractors, customer communication and relationships, retaining good employees and completing projects in a timely manner” (Hutching & Christofferson, 2000, p. 110). This research left construction faculty wondering how they would test for intangible aspects of the construction industry, such as quality workmanship, selection of good subcontractors,
customer communication, employee retention, honesty, integrity, and relationship building. Because of this and other research relating to this area, most programs now integrate internships, service learning projects, and senior capstone experiences in order to provide opportunities for evaluating the construction student’s readiness for entry into the construction industry.

**Mastery Versus Awareness**

Structural concepts are often taught in a cold equation based format which often leaves students with neither mastery nor awareness of the subject matter. Construction management practitioners need to be aware of the fundamentals of the structural technology, but not to the extent where they know how to specify or design such systems as engineers must do. As noted by Dishough (2003), “Teaching structural technology for construction and architecture, the professor provides the curious student with an appreciation of the engineering process and prepares the student to competently discuss structures in the engineering language” (p. 30). If we are to test awareness of such concepts, professors must consider the differences between mastery and awareness as a starting point. Developing exam questions that provide evidence of awareness will be challenging, but it must be done to provide potential employers insight into the construction management graduate’s ability to contribute to the bottom line.

**New Topics Of Emphasis**

Green Construction is a fast growing area and it is here to stay. The construction industry across the sectors is adapting to this sustainable movement. The heavy/civil, residential, industrial, and commercial sectors have incorporated Green Construction into the fundamental design and construction of most projects. “The growth and importance of sustainable construction is undeniable. Thus, to keep up with the times, construction education programs must incorporate courses in sustainability so that their students will be able to participate and be valued in the workplace” (Burt & Tinker 2004, p. 29). As previously noted, it is imperative that construction educators take the next step by adding Green Construction concepts to future comprehensive construction management exam sequences.

**Traditional Construction Topics**

Estimating and scheduling are the mainstay of all construction management curriculums. These fundamentals are the bread and butter for the construction industry. Universities must provide significant courses and evidence of student mastery of the subject matter. “Accurate construction cost estimating is critical in order for construction companies to succeed in the highly competitive construction industry. Cost estimating is a foundation for many of the courses taught in all construction education curriculums” (Fuller and Kahn, 2003, p.156). Testing of these concepts should be universal and comprehensive. Industry is reliant on the construction management programs for emerging estimators and schedulers.

**Difficult Concepts For Assessment**

Construction law is a requirement of most construction related curriculums; however, construction negotiation is not mentioned in most classrooms. The art of negotiation is a needed attribute. As noted by Ellingson (2002), “While it is true that many graduates from undergraduate and even graduate construction programs may never be involved with directly negotiating a contract for their company, construction programs have an obligation to provide a curriculum which will prepare students to assume positions of leadership in the industry” (p. 133). The testing of negotiation skills will provide yet another challenge, however if a proper mechanism for testing for this important attribute is devised; then the needs of industry will be served.

One of the most important concepts taught in a construction management program is construction ethics. Often the ethics lessons are provided within one or two courses. ACCE even requires the integration of ethics in at least five construction or construction science courses (American Council for Construction Education, 2010b, p. 9). “Public attention regarding bid rigging schemes, elaborate kick back operations, fly by night contractor rip-offs, and horror stories about price gouging all add to the concerns regarding ethics in construction” (Jackson, 2004, p.113). Teaching ethics is another challenge for the construction educator, but testing for such knowledge is even more challenging.
Conclusions

Educators, construction industry practitioners, professionals from the design disciplines, building codes authorities, materials and methods professionals, bonding and insurance agents, bankers, marketers, accountants, financial analysts, safety and risk managers, are the content contributors for this new certification exam for construction managers. Acceptance of a universal construction management exam for college graduates by industry can only be expected if they are included in the preparation of the exam. Additionally, the exam will provide sector by sector measurement of competency so it can be used as a significant tool for selecting new talent. The concept of devising construction sector sections to the exam is important and integral to this new exam.

Measuring the intangible knowledge garnered from internships, coops, summer and part time jobs within the industry, semester away and capstone experiences, and service learning opportunities will be incorporated into a section of the exam. Each of the aforementioned experiences affords the student learning outcomes unavailable within the classroom. In fact, these risk free learning endeavors are often valued by students more than the traditional classroom. An exam sequence will provide for reflection of the learning that took place during the student’s academic career. This section of the exam will be identified as Hands on endeavors, thus allowing the student to provide evidence of the experience. Students will be required to turn in a portfolio relating to these experiences following a set of guidelines provided by the exam. This information would be required by the examinee prior to the taking of the exam. Additionally this section of the exam would document the transformation of a construction student into a construction professional.

No universally accepted construction management exam sequence currently exists for measuring construction management graduate preparedness. Many new and exciting concepts have been put into practice by the construction industry in recent years. These new areas should be included in a construction management exam sequence. Construction industry sectors have not been considered as curricular offerings and have not been included on other construction management-related exams. Residential, Heavy/Civil, Industrial, Commercial, and Sub-contractor emphasis will be included on the ATMAE comprehensive Construction Management exam. Professional organizations representing each of these construction sectors and those serving the industry will be queried for their input. The exam will be reviewed by department heads from construction management programs from across the country as well as by professional members of the various sectors of the construction industry. This exam is currently being developed by the Construction Management Commission of the ATMAE Certification Board.

References


Distance & Online Learning
Effective Web-Based Tools and Interaction in E-Learning Systems

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Abstract
Interactivity and group collaboration have been identified by research as the key success factors in designing and developing instructional materials of online education. An efficient feedback system is a critical interest that sustains a high level of engagement, whether between students and instructors, fellow students, or interfacing with the learning environment. This study gathered data from graduate level courses’ quality surveys and interviews to preliminarily present the levels of students’ satisfaction in web-based tools and learning activities. The finding showed that the majority group of graduate students spent 5-6 hours per week to study and prepare for the chat discussion in each on-line course. Results also showed that students highly agreed that the Internet and World Wide Web contributed to their understanding of course contents with 93.22%; and interaction between instructor-students was very significant with the value of 89.83%. The least satisfaction was the use of group activity 57.08%.

The effective web technology discussed in this study included the use of Internet and World Wide Web, Discussion Board, E-mail, Group Project, and Virtual Chat Meeting. The finding can assist course developers, curriculum designers, instructors, and administrators to plan, design, implement, and manage of successful E-learning systems in higher education and business training.

Statement of Problem and Purpose of Study
A substantial number of students in the online environment commented on lacking interaction with classmates and feedback from instructors; several students lost intention to do well and fail the course because of feeling alone and having no motivation. An empirical study of students at the State University of New York discovers a significant correlation between interaction and student satisfaction in online asynchronous courses. Also, the study finds a significant correlation between quality of interaction and student satisfaction (Shea, Swan, Fredericksen & Pickett, 2001). Creating interactive collaboration in learning online practices are challenging work for course designers and instructors. Advanced communication and technological tools in this information technology age, especially web-based tools (e.g. Discussion Board, Email, Group Project, Web Conferencing, Virtual Collaboration, and so on) become an important issue for educators to maximize their uses and to sustain a high level of engagement in disciplinary contents.

With the support of available technology and interactive devices, together with the high demand of online enrollments, the institutions must move forward to provide high quality online education. Same as other issues, online education has some flaws, and the main concerns are about not enough interaction between student-instructor and among classmates and also lacking immediate feedback to students. As faculty, we must strive for excellence for our students’ learning and the future of education. Since the web-based tools have been developed and highly advanced in collaboration and communication, many interactive learning activities can be designed and delivered via these effective tools. Any activities or methods that can help us to increase learning effectiveness and student satisfaction should put into practices. What are these tools? How can we implement them to win over some weaknesses of online education?

The purpose of this study was to research the web-based tools that students perceived to be useful for their understanding of course contents in the online course delivery. Also, the study analyzed and explained the methods on implementing these effective tools. This research gathered data from students’ quality surveys and interviews to preliminarily present the levels of students’ satisfaction in each web-based tool and learning activity. This web technology has been successfully employed in the online Industrial Management and Technology programs. These programs, with 15 courses, accomplished in number of enrollments, increasing majors by 107%.
between 2002 and 2010. There was also a strong evidence of high students’ satisfaction and learning effectiveness to the programs. The author has collected data from students every semester and regularly experimented with the new teaching systems. This study was organized into sections as follows:
- Interaction and feedback in online environment
- Students responded to the web-based tools and learning activities
- Design effective web-based tools and learning activities
- Conclusion and Recommendation

**Interaction and Feedback in Online Environment**

A number of studies found the significant relationship between quality of interaction and student satisfaction. Karen Swan (2004) states that learning effectiveness can be increased through interaction in four general ways; interaction with contents, classmates, instructors, and course interface. The following are some examples of these interactions:

- Interaction between students and contents - instructions of how to study the specific units, to download suggested websites, or to complete the unit's assignments.
- Interaction between students and classmates - group projects, virtual chat discussions, or to conduct peer review of reports.
- Interaction between students and instructors - providing feedback on assignments, research papers, or giving guidelines to complete a study (Swan, 2004b; Girard, Willoughby, and Berg, 2007).
- Interaction between students and course interface - Hirumi (2004) adds that “attention must be placed on how the interface enables learners to manipulate electronic tools, view and access content, and interact with others” (p. 50).

Another important issue in effective e-learning delivery is prompt feedback that gives student and trainee a sense of self-assurance toward the direction; it is a vital part of the learning process. Waldrop, Justen and Adams (1986) indicate that feedback helps to correct misconceptions on the discussed topic and it is most effective when the feedback is both immediate and sufficient details for the students to initiate corrective action. Spitzer (1996) explains very similar views that feedback can be dramatically improved by providing it continuously, reinforcing the positives and focusing feedback on how performance can be improved in the future. Sustained motivation usually results in an element of success. Students therefore need to be able to access feedback to ascertain how they are going or whether they are ‘on the right track’ (Reushle, Dorman, Evans, Kirkwood, McDonald, and Worden, 1999).

The web-based tools provide opportunities for the instructors to encourage interaction and feedback in the online course delivery. Students can interact not only with the course instructors and classmates, but also others (e.g. librarians, technical professionals, other professors,...) or environment (e.g. library, world wide web, computer,...). Learning activities can be designed in various forms responding to students’ diverse learning styles. Reushle et al. (1999) state that given the diverse needs and characteristics of learners, their differing skills, and the likelihood that these will change throughout the course of study, it is essential to incorporate maximum flexibility and interaction within the unit design. Some of activities that promote interaction and feedback are: virtual chat meeting/discussion, group projects, exams with feedback, peer-reviewed assignments, course survey evaluations, course contents with video presentations and information research via the academic online library.

**Students Responded to Web-based Tools and Learning Activities**

The survey data was gathered from eleven graduate courses in Industrial Management Program of 151 online students enrolled in Spring, Summer, and Fall 2007, and Spring 2008. Only 103 students who completed the courses and responded to the quality survey at the end of semesters, accounted to 68.21% response rate. The finding is divided into two sections:
Demographic Characteristics
The respondents included 15.33% undergraduate students and 84.64% graduate students, and 86.02% are male students. The largest percentage of respondents was in the 21-25 year old age (41.23%) and respondents with ages over 35 were 26.57%. Respondents reported their types of careers as: 38.26% student, 36.7% working in industry, 12% working in education and military and about 8% having their own businesses.

To focus on learning effectiveness and students’ achievement, the study further analyzed the students’ GPAs (grade point average) at the time they filled out the survey and also the amount of time per week students spent on the course. The questionnaire asked students to estimate the amount of time per week that they spent on the course for study. The largest group of respondents (26.39%) spent on average 5-6 hours per week and about 18.12% spent more than 7 hours in their study for the course. In addition, the students provided their recent GPA; about 62.99% of respondents were holding GPA of 3.5 or above. Figure 1 presents the average amount of time per week students spent on the course and their GPAs.

Uses of Web-based Tools and Learning Activities
Throughout the semester, the course’s instructors conducted virtual chat meeting with students, recorded chat discussions, and utilized Discussion Board and Email within the web commercial software, Blackboard. Part of this survey was established using Chickering and Gamson’s seven principles for good practice. Some of the practices were used as tools and learning activities to test students’ perception. The questionnaire asked students to rate their level of agreement with the web-based tools and learning activities which contributed to their understanding of course contents. The study used a five-point scale ranging from 1 through 5 (strongly disagree-disagree-neutral-agree-strongly agree). There were eleven items in the category of activities and web-based technology.

According to the survey results, students agreed that the use of some of web-based tools and learning activities helped them to better understand the course materials. Figure 2 presents the percent agreement from respondents on these tools. The values ranged from 57.08% to 93.22%. Results showed that students highly agreed that the Internet and World Wide Web contributed to their understanding of course contents with 93.22%. The lowest was the use of group activity with a value of 57.08%.
The finding in this section can assist both course developers and course instructors in the process of developing instructional materials and/or delivering course materials. Figure 2 shows that students did not seem to think that group activity (57.08%) and interaction among classmates (62.84%) would be a vastly helpful tool in their understanding of course contents. It is important to note that group activity and interaction among classmates are directly related to the teamwork, communication, and social skills. Educators should not avoid to emphasize these two items in their course development and delivery.

**Design Effective Web-based Tools and Learning Activities**

Designing the course materials, assignments and learning activities to facilitate diverse learning style is a challenging job for course designers. Delivering course materials by promoting interaction and feedback is more intricate and demanding for online course instructors. Fortunately, with helpful functions and applications in the web-based environment, we can maximize the use of these tools and learning activities in both asynchronous and synchronous formats. Girard, Willoughby, and Berg (2007) provide simple definitions of asynchronous and synchronous delivery methods.

- **Synchronous online education** - internet based education where the instructor and students participate in learning activities at the same time.
- **Asynchronous online education** - internet based education where the instructor and students participate in learning activities at the different times (p. 39).

According to Dr. Robin Mason from the United Kingdom’s Open University, there are four advantages to asynchronous delivery: flexible access to teaching materials, time to reflect rather than react, integrating ideas with the work environment, and cost effective technology. Conversely, she suggests that the advantages of synchronous delivery include: motivation to continue studies, real-time interaction, quick feedback, and pacing (Mason, 1998). The following is a summary table of some suggested implementation methods of selected web-based tools and learning activities, see Table 1.
<table>
<thead>
<tr>
<th>Web Tools</th>
<th>Function</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Internet and WWW        | Suggested links to online resources by instructors                        | Credible and accountable websites:  
- organization (.org)  
- academic institutions (.edu)  
- online database from libraries (e.g. Ebsco, Lexis-Nexis, WorldCat,...) |
| Discussion Board        | Posting assignments or subjects for discussion as a whole classroom, individual or group project | Good tool for interaction among students and extend body of knowledge and creative thoughts, feedback from instructor or peer-reviewed. |
| Email                   | Sending and receiving private email in the course, may enhance relationship between sender and receiver | A written form - formal communication  
Adding subject line with specific information; course #, student’s name and a brief topic (ex. IndM 4010-Brown-gradeassn4) |
| Group Project           | Project assignment to a group of students focusing on teamwork skill. Make the tools available for communication: group chat, email, discussion, and file exchange | Group evaluation among members may help to encourage students to work together, let them know ahead of time on the evaluation criteria. |
| Virtual Chat Meeting    | Virtual communication discussing the course contents and answering questions. | - Basic virtual chat - only texts without image, voice, or any other multimedia.  
- Advanced web conferencing - with camera and microphone, uploading PPT slides and files, video presentation, and Web links. |

In addition, Virtual chat meeting is a type of synchronous online education that allows instructors and students participate in learning activities at the same time. Virtual chat classroom is an excellent interactive tool between instructor-students and/or among students that can pick up learning problems at the point of occurrence. In a face-to-face classroom, only a few students answer the instructor’s questions or share their experience with the class; instructors do most of that talking in the class. Conversely, students in the virtual chat meeting are more likely willing to answer every question and also share their knowledge with the class. Guy (2007) explains the changing roles between instructors and students: in the online environment, teachers become expert questioners, rather than providers of answers. Students become complex problem solvers rather than just memorizers of facts (Berge 1999; Guy 2007).

If a course instructor prefers to use audio, camera, or Web conferencing in the virtual chat discussion, there are several types of software available on today’s market, such as Netmeeting, Webex, and Megameeting. The advanced online communication system often used in the higher education institutions is called Adobe Acrobat Connect Professional. According to a report from Purdue University, the Adobe Acrobat Connect provides tools for Web conferencing, online meetings, and multimedia presentation. Instructors can incorporate interactivity by adding quiz questions, live and recorded video, PowerPoint slides, and other software simulations (Purdue University, 2008). In one of the courses, the author discussed the topic of risk management by showing video clips from Youtube.com. The author also incorporated the camera and microphone into this virtual meeting. Figure 3 presents the screen from chat recordings in the Adobe Acrobat Connect Professional.
The chat recording is also a valuable source for students to review the course discussion. Some students who missed the chat meeting should be required to summarize a chat recording for a make-up assignment. Most courseware with virtual meeting function would have a recording function available. Instructors must make sure to select a “recording” button at the beginning of the chat meeting.

Conclusion and Recommendation

To strive for excellence in quality of online education, interactivity and timely feedback are the keys to learning effectiveness and students’ satisfaction. This study collected data from the students’ quality surveys, interviews with students, related literature reviews, and author’s teaching experience in both face-to-face and online delivery. Students were asked to rate the web-based tools that contributed to their understanding of course contents and also expressed their opinions on using the collaboration tools. The study further explained methods of utilizing the Web tools, such as Internet and WWW, format of materials, discussion board, email, group projects, and virtual chat meeting. Proper uses of these tools will enforce students to have better interaction and collaboration with instructors and classmates that would exceed the limitation of online learning.

The information derived from this study will support online course developers and educators in maximizing Web-based tools to promote the interaction and collaboration among students, and between students and instructors. Roblyer and Ekhaml (2000) state that “faculty must alter both course design and teaching strategies to take advantage of technologies and assure maximum interaction” (p. 2). The researcher recommends the following items to improve quality and increase performance in online education.

- Educators should consider ways to provide more feedback to students’ progress. The actions can be demonstrated by several means, such as providing responses to students’ assignments via Discussion Board or personal email, discussing projects with students via Web conferencing (showing images, PowerPoint slides, or video presentations), promptly replying to email from students, and opening more opportunities for questions and answers in the classroom virtual chat meetings.
- Based on the survey’s results, students seem to be satisfied with the course materials format and the use of Blackboard platform. It is important that instructors provide clear instructions for accessing the courseware and the locations/format of all areas of course materials in the first week of semester. The instructors should also provide the contact address, both phone and email, of technical helpdesk to students if they need assistance.
Further research may focus on evaluating more Web-based tools that highly contribute to students’ understanding of course contents and students’ achievement, specifically the Web conferencing that incorporates multimedia and allows texts, images, and voices from all participated parties. This will assess the effectiveness of utilizing Web-based tools to support Internet-based distance learning in higher education and business training environments.

References
Student Verification System for Online Assessments: Bolstering Quality and Integrity of Distance Learning

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Abstract
The rapid growth of online examinations using Internet-based assessment tools has continued. The inability to control a student’s environment while taking exams is still a major challenge for academia everywhere. A clear correlation exists between an increase in the number of acts of dishonesty and the failure of institutions and instructors offering courses to monitor and enforce policies on cheating. Education industry analysts expect the demand for online examination proctoring which incorporates student identification products will skyrocket in 2010 coupled with pressure from the U.S. Department of Education requiring schools ensuring the identity persons taking examinations is truly the student enrolled in the course (Webwire, 2009).

The purpose of this study is to investigate the current technology and biometric systems used in remote proctoring systems to verify and monitor students taking online exams. The study also proposes the model to support the integrity and quality of online assessment; the model integrates facial recognition software, video surveillance systems, and computer restriction software into one integrated system. In summary, online assessment and proctored testing deals with the issue of student identification and the environment in which materials are accessed effectively but it also negates much of the advantage of providing Internet based-course work. Utilization of biometric systems with updated technology in video surveillance in the online examination will lead to certainty and quality assurance of student achievement and school’s reputation.

Introduction and Rationale
A key challenge for online-based learning in the information technology era is academic surety. The explosive growth of online courses using the World Wide Web as the primary means of communication between instructors and students has rapidly outstripped the academic institution’s ability to retain quality control measures. Continued growth in distance learning and the inability to control the student’s environment is a complexity for colleges everywhere. Providing online access has also required college programs to give up much of the control over the materials and the environment in which they are used online and increases the temptation for students to act dishonestly. There is strong evidence indicating that cheating has increased today. The figures show that 84% of student say they need to cheat to move ahead in careers and 90% of the students say they never pay a price for cheating (Trenholm, 2007). Some examples of online exam cheating may include:
- Having someone other than the student take an exam
- Copying and collaborating with others during an exam
- Using materials that are not allowed, such as textbooks and web resources.

To deal with these issues, popular stop gap measures like proctored testing centers, access passwords, databases full of test questions randomly selected, to name but a few, have been developed. Each of these deals with symptoms of the real issue, loss of control of the classroom environment, in a piecemeal fashion and each comes with drawbacks of their own. According to the Chronicle of Higher Education, the U.S. Congress is concerned
about quality and integrity of distance learning and had added language into a part of legislation renewing the Higher Education Act that encourages schools to fight cheating more effectively (Lardinois, 2008). In addition, “The education industry analysts expect the demand for online exam proctoring with student identification products will skyrocket in 2010, together with the U.S. Department of Education starts requiring schools to make sure that a person taking an exam is actually the student enrolled in the course” (Webwire, 2009, p. 2).

Significance and Purpose of the Study
Technology has progressed to the point that biometric systems (e.g., facial recognition, fingerprint, and eye scanning) have been implemented successfully in many organizations and processes. Authentication done through a server with biometric and video surveillance systems has gained popularity in monitoring not only the small business, big corporation, government, but also households, municipalities and educational institutions.

The purpose of this study is to investigate the current technology used in remote proctoring systems to verify and monitor students taking online exams. The study also proposes a model to support the integrity and quality of online assessment; the model integrates facial recognition software, video surveillance systems, and computer restriction software into one system. Major contents in this paper cover:
- Different systems for remote proctoring examination
- Types of biometric identification
- Proposed model for online verification and monitor system

Different Systems on Remote Proctoring Examination
Proctored exams is one of the major concerns for online course delivery. A growing number of students choose online courses either as an alternative to the traditional college experience or as a supplement. Colleges and universities have started to worry about how to prevent these students from cheating on remotely administered exams.

What is a proctored exam? There are diverse definitions of proctored examinations. The University of West Florida, Online Campus, defined “A proctored exam is one that is overseen by an impartial individual (called a proctor) who monitors or supervises a student while he or she is taking an exam” (University of West Florida, 2009, p. 1). Another definition from the University of Colorado Denver, “Test proctoring is testing overseen by an authorized, neutral, proctor, who ensures the identity of the test taker and the integrity of the test taking environment” (University of Colorado Denver Online Help Desk, n.d., p.1).

In summary, the proctoring process helps to prevent dishonest students from cheating on exams and ensures the security and integrity of the exam process. According to a USA Today article, college students taking courses online is surging and creating is a tough dilemma for educators who want to prevent cheating. “Should we trust students to take an exam on their own computer from home or work, even though it may be easy to sneak a peek at the textbook? Or do you force them to trek to a proctored testing center, detracting from the convenience that drew them to online classes in the first place?” (2007, p.1). Utilizing the existing technologies in online exam proctoring is becoming the focal point of many institutions.

A variety of organizations are used as a proctoring service for free or a fee, for example, research centers, public library, campus testing and assessment center or Sylvan Learning Center which charges $50 for each exam (University of Colorado Denver Online Help Desk, n.d.). Today technology allows the online proctoring system to utilize software, hardware, fingerprint scanners, video monitoring personnel and so on to identify the online students and monitor while taking exams without commuting to the proctor locations. Some examples of providers of the remote proctor discussed in this section are: Secureexam Remote Proctor, ProctorU, ProctorCam, and Webassessor™. Table 1 and the discussion that follows: presents descriptions, technical specifications, and service costs for these four companies. Data on cost for ProctorU and ProctorCam were taken from contact email and interviews with the companies’ representatives.
Table 1. Today’s Remote Proctor Systems with Characteristics

<table>
<thead>
<tr>
<th>Systems</th>
<th>Description (identification and proctoring)</th>
<th>Technical specification</th>
<th>Costs</th>
</tr>
</thead>
</table>
| Secureexam Remote Proctor (SRP) [http://www.remoteproctor.com](http://www.remoteproctor.com) | fingerprint for student identification  
video surveillance system /audio recording with SRP device | - SRP equipment  
- Computer  
- High speed Internet | $125 for SRP equipment and $30 annual fee |
| ProctorU [http://www.proctoru.com](http://www.proctoru.com) (virtual online proctoring) | username - password, and ID photo for student identification  
human proctor in real-time and video surveillance system / audio recording | - Webcam 640x480  
- Computer  
- High speed Internet  
- headphones or working speakers  
- microphone  
- live proctor from ProctorU | $17.50 per 2 hours exam |
| ProctorCam [http://www.proctorcam.com](http://www.proctorcam.com) (virtual online proctoring) | username - password, and ID photo for student identification  
human proctor in real-time and video surveillance system / audio recording | - Webcam 640x480  
- Computer  
- High speed Internet | Average $20 per 1 hour exam, discount on the group of students |
| Webasseor™ | Facial recognition software and patterns of keystroke rhythms  
Secure Browser Control  
video surveillance system | - Webcam with audio  
- Computer with Webasseor application  
- High speed Internet | Webcam $50-$80 plus costs of application |

**Secureexam Remote Proctor (SRP)**
Troy University, Alabama, and some other colleges and universities currently adopted the Secureexam Remote Proctor (SRP) System from Software Secure, Inc. of Cambridge, MA. The Secureexam Remote Proctor addresses areas of exam security by:
- Authenticating the student with a fingerprint scanner prior to providing access to the exam
- Restricting the computer’s functions with Secureexam solution
- Monitor video and audio during exam, capturing all suspicious changes in sound and motion, just as a proctor would in a traditional exam environment.
Figure 1. shows the image of SRP which is a small stand alone device that connects to the test taker’s computer via USB. www.remoteproctor.com/SERP/Description.aspx

According to the Office of University Relations Media, SRP equipment will cost students about $125. The authentication is done through a server with a fingerprint scanner; the system verifies each test taker against the fingerprints provided at registration. This system also records the test-taker’s voice and image through a camera that records 360-degree real-time video and audio of the environment during the entire exam. All suspicious sound, activity and motion are catalogued during the recording, limiting the need for constant monitoring. Professors do not need to watch students taking the exam live; they can view the streaming audio or video at any time (Troy University).

ProctorU
Another commercial software system is called ProctorU. It was developed by Andrew Jackson University and spun off into a separate company. Jarrod Morgan, co-developer of ProctorU stated “We have improved the system by adding live certified proctors, real time audio/video using TokBox, technical assistance, practice exams, identify authentication and the ability to assist exam-takers by remotely controlling their computers during an exam” (Webwire, 2009, p. 1). The system has proctored 1,500 exams so far and attracted more and more interested colleges and universities each week (2009).

ProctorCam
ProctorCam is the name of a business system that provides a virtual online proctoring service. The test takers and organization that require proctored tests can use this service with their own equipment at their convenience and at their chosen location. The company has developed a software-enabled online exam proctoring service for online course publishers. Remote proctors, average US$20 per hour, hired under contract by the innovative company, monitor students and answer their questions via webcams (Moore, 2010). To use ProctorCam, the system integrates desktop sharing software, a web cam, a microphone and a reliable internet connection.

Webassesor™
Kryterion Inc. is an organization that specializes in secure test development and delivery (Case & Cabalka, 2009; Kryterion, 2009). They provide live proctoring for many distance learning programs and businesses (2009). The technology is called Webassesor™ and has the capability of secure online testing for proctoring students wherever they live, learn and work (Case & Cabalka, 2009). According to Kryterion this technology works with the various test engines and learning management systems. The Webassesor™ is capable of online proctoring employing webcams with audio features to monitor test takers. Test takers purchase the camera for between $50 to $80 which allows proctors to view a student’s face, keyboard and workspace (Foster, 2008). The technological features built into the Webassesor include: Photo Matching Authentication (Sentinel™ security technology), Secure Browser Control (System Lockdown), video surveillance system, and Data Forensics. Some of the institutions that have used this technology include Pennsylvania State University and Western Governor’s University (Kryterion, 2009; Foster et al, 2009).
Types of Biometric Identification
Biometrics has become a vital method of ensuring security against threats such as theft and malicious intents in this era of globalization. It involves the identification of an individual based on one or more unique physical attributes. Biometric identification can be physiological such as fingerprint, retina, DNA or behavioral such as handwriting, gait, speech pattern etc. A biometric method is evaluated based on specific qualities including its universality, uniqueness, permanence, collectability, performance, acceptability and circumvention (Wikipedia, 2010). Different parameters have been used to judge performance or accuracy of a biometric system. The extensively used parameters are:

- **Force Acceptance Rate (FAR);** the probability that the system incorrectly declares a successful match between the input pattern and a non-matching pattern in the database
- **Force Reject rate (FRR);** the probability that the system incorrectly declares failure of match between the input pattern and the matching template in the database (Laha, 2008).

Other performance parameters include Receiver (or relative) operating characteristic (ROC), Equal error rate (EER), Failure to enroll rate (FTE or FER), Failure to capture rate (FTC), and Template capacity (2008). Table 2 presents widely used biometric technologies including their advantages and disadvantages.

<table>
<thead>
<tr>
<th>Type of Biometrics</th>
<th>Advantages</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td><strong>Fingerprint</strong></td>
<td>Has a higher reliability and stability compared to iris, voice and face recognition methods. Equipments are less expensive compared to other biometric systems.</td>
<td>Dirt and twist can lead to noise and distortion problems. Some people feel offended when asked to put their fingers at where many other people have continuously touched.</td>
</tr>
<tr>
<td><strong>Retina</strong></td>
<td>It is a highly accurate method with an error rate of 1 in 10,000,000. There is no known way to replicate retina; varies from person to person (Wikia, n.d).</td>
<td>It is an expensive and intrusive process. Comparison of template records can take a long time depending on the size of the data base. Retinal pattern can be affected by disease like glaucoma, diabetes, high blood pressure, and autoimmune deficiency syndrome.</td>
</tr>
<tr>
<td><strong>Facial recognition</strong></td>
<td>Images can be acquired without posing; it is therefore non-intrusive and contact free process. Capable of integrating with existing surveillance systems. Capable of simultaneous multiple face processing. Capable of live face detection. Multiple samples of the same face can be acquired easily. Tolerant to face posture and capable of fast face matching.</td>
<td>Needs a well controlled light source in automated face recognition system. Technical challenges are associated with face authentication. Disguise can be used to circumvent an authentication process.</td>
</tr>
</tbody>
</table>
To establish an effective remote proctoring system, biometrics is one of the vital tools that has increased in use for online exams and needs investigation before implementation, for example, some concerns with biometric systems is forgery of the authorized user.

Proposed Model on Online Verification and Monitor System

Even though our academic programs have systems in place to discourage dishonesty, some students have developed methods to try to cheat on exams and outsmart the system. The Master’s degree program in Industrial Management in the School of Technology at the University of Central Missouri has offered a 100% online delivery since 2002. The program is successful with higher enrollments and consistent student satisfaction ratings with 36 majors in 2002 and 60 majors in 2010, an increase of 122.22% over an 8 years period. Continuous improvement is part of the program’s philosophy, establishing an Academic Surety Program (ASP) to identify students through facial recognition systems and proctoring students with video surveillance while restricting computer software, as a solution to ensure quality and integrity of the graduates and program outcomes. The line cutting the graphic below in half, as presented in Figure 2, represents actions taken to ensure the integrity of the programs since 2002 which is shown on the right and the ways the ASP will modify that program in the future are shown on the on the left.

Figure 2. Major task components of ASP

Currently, the Blackboard, commercial courseware, offers useful functions in the test/exam section. Instructors are able to set up the exam with a large pool of questions, random questions, and limit the time for taking exams. However, there are still questions regarding student cheating remaining, for example, having someone other than the enrolled student taking the exam, copying and collaborating with others during the exam, and using materials that are not allowed during the examination. The ASP proposes to solve these problems with three additional functions; using facial recognition to identify students, video surveillance in the exam proctoring, and software in restriction of the computer’s function. This proposed model includes the following steps:

- Step 1: access to the online exam using ‘username’ and ‘password’
- Step 2: read an instruction set for the exam and verification process
- Step 3: capture a student’s image via the webcam, then submit for verification
- Step 4: verify ‘image capture’ with the database. If a match is found the student will go on to take the exam (to Step 5). If no match is found the student will be able to retry. After three unsuccessful retries the student
will be asked to contact a course instructor.

- Step 5: while taking an exam the student is monitored and recorded by video surveillance. Also the Internet restriction software will not allow access to any other websites or application, except the exam.
- Step 6: If the system was interrupted (e.g. lost of Internet connection) while taking an exam, the system will ask the student to verify his/her image again. After passing the verification process, then the student will continue with the exam and be monitored by the video surveillance and the Internet restriction software.
- Step 7: after completing the exam, the student will click “Submit”, ending the exam and surveillance.

Figure 3 presents the process flowchart of the system beginning with the student log-in and ending the exam and surveillance.

*Figure 3. Flowchart of online verification and monitor system*
Summary and Conclusions
Harness technology, biometrics, software programming, and optics in a symphonic correlation expanding the reach of academic institutions to students without regard to geographic separation or intellectual compromise is this study’s promise. Academic merit is the yardstick by which every university measures the progress of every student but without physical contact. How does the instructor know whose work is being measured? This paper is not about developing new technology, but applying technology in a new way to solve what is perhaps one of the greatest obstacles to any university’s ability to offer academic programs online, dishonesty. The value of every degree is the reputation of the institution and the students produced. Without academic rigor, without confidence in the processes by which it is measured, are their values in the program?

Utilization of biometric systems, either fingerprint or facial recognition, with updated technology in video surveillance in the online examinations will lead to certainty and quality assurance of student achievement and learning effectiveness. This paper gathered the available technology currently used in proctored testing and proposed a model of online verification and monitoring system that mainly promotes the quality and integrity of distance learning.

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Electricity, Electronics, & Computer Technology
Development of a Single Axial Rotating Flux (SARF) Generator

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Introduction  
A popular form of renewable energy generator is the wind turbine. A wind turbine is an electro-mechanical device connected to a windmill to generate electricity. As the use of windmills increases, there is a need to create generators that are light weight, low cost and of high efficiency. This study aims to contribute to this need for small domestic turbines.

Theoretical background  
A wind turbine basically contains rotor airfoil shaped blades, a shaft, a generator system, and a tail fin. The generator contains an armature, which is a set of coiled wires rotating with respect to a magnetic field developed by permanent or electro magnets. As the armature coils or the magnets rotate, electromotive force (emf) is generated causing a current to flow through the coils.

Literature shows that small domestic wind turbines exclusively use a two-magnet rotor, i.e. a rotating magnetic field. Figure 1, illustrates such a design. The aerodynamic power generated by the wind turbine is given by the textbook equation:

\[ P = 0.5 \rho ACpV^3 \]  eqn. 1

Where:  
\( P \) = Power generated  
\( \rho \) = density of air  
\( A \) = swept area of the blade  
\( Cp \) = performance coefficient  
\( V \) = wind speed.

Density of air is usually considered to be constant. The area \( A \) is dependent upon the size and number of the blades. As the number of blades increase, the efficiency increases, however this increase in efficiency has diminishing returns. Taking aesthetic considerations into account, the windmills are often designed to have 3 blades. It is clear from equation 1 that for a given design, wind speed and hence the rotational speed of the windmill becomes the dominant factor in generating power.
An equation for the generated e.m.f, in general generated can be derived from basic physics principles as:

\[ E = \frac{(\Phi ZNP)}{(60A)} \]  

Where: 
- \( \Phi \) = flux/pole in webers 
- \( P \) = No. of generator poles 
- \( Z \) = Total number of armature conductors = No. of slots x No. of conductors/slot 
- \( A \) = No. of parallel paths in armature 
- \( N \) = armature rotation in revolutions per minute 
- \( E \) = e.m.f induced in any parallel path in the armature

So in general the generator output voltage is dependent on three factors: (1) the total number of conductor loops in series in the coils, (2) rotational speed, and (3) magnetic field strength.

**Small scale turbines**

The Small scale domestic wind-turbines usually operate at a maximum speed of 500 revolutions per minute (rpm). This is due to speeds of normal prevailing winds and the size of the blades in these mills. In these turbines’ generators the rotating magnets are placed around the rotor in an alternating pattern of north and south polarity. The stator consists of coils of metal wire within which the current is generated.

Hugh Piggott in his book, “How to Build a Wind Turbine: The Axial Flux Wind Turbine Plans”, provides three different plans. All three, produce an output of 12 volts, and have two rotors, but they use different magnet-to-coil ratios as summarized in table 1.
Equation 2 shows that one of the parameters controlling is the flux density. As can be seen in figure 2, the air gap between the rotor and the stator, as well has the flux pattern from block magnets attenuates the magnetic flux. A means of increasing the flux density is to include ferromagnetic materials within and behind the stator.

**Car Alternators**
A car alternator could be used as the electrical generator. A car’s alternator needs to turn at about 2000 rpm to produce an output of 12 volts. It is difficult to create enough speed with small scale wind turbines that have a maximum speed of about 500 rpm, even with use of gears.

**Description of the Study**
This study describes a new electrical generator that uses a single-rotor axial flux generation system. Using a single-rotor design, versus a conventional double-rotor design, eliminates the second rotor and parts thus reducing the cost and the mass of the generation system.

Using a single rotor should also reduce the assembly time, the cost of parts and labor during production of the turbines. In the conventional double-rotor axial flux generation system design, the components are arranged as seen in figure 1. In a single-rotor design, used by the researchers at ‘Force Field’, the components are arranged from front to back in the following order: the rotor, air gap, copper coils, and laminated steel band coiled tightly to form a spiral disc (Force Field 2005). The laminated steel band is the ferromagnetic material to densify the magnetic flux.

<table>
<thead>
<tr>
<th>Blade diameter (Ft)</th>
<th># of Magnets</th>
<th># of coils</th>
<th># of turns per coils</th>
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<tbody>
<tr>
<td>4</td>
<td>8</td>
<td>6</td>
<td>85</td>
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<tr>
<td>8</td>
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<td>12</td>
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</tbody>
</table>
The current study improves on their approach. We improved on their design by introducing steel tubes in the center of each of the coils with one end of the tubes in direct contact with the steel band. The steel tubes being ferromagnetic help the flux circuits to flow from a north side of a magnet through the coil to the steel band and back from the steel band to a south side of a magnet. The direct contact of the steel tubes with the steel band also eliminates any air gaps hence creating a more efficient flux flow loop. The lamination aspect of the band reduces the eddy currents being produced. The model of this design is shown in figure 3.

Figure 3. Model of the proposed design

Statement of Problem
So in summary, this study investigates the feasibility of developing a single-rotor axial flux generation system. It is based on improving the designs used with a nine foot diameter wind turbine from Force Field. (Force Field 2005)

Methodology and results
Apparatus and procedures
The study was conducted in an iterative manner. In other words, designs were created, tested and then improved as the subsequent design. The designs were based on the plans from the book “How to Build a Wind Turbine: The Axial Flux Wind Turbine Plans.” (Piggott, 2005). Two different rotors were made and a number of different stators were made during the study. The designs were tested using a lathe set-up. A bulb was used as the load cell. A laminated steel band was also used. In most tests the output wires from the stators were connected in an unconventional five-phase configuration. A number of stator designs were tested and some of these are described in the following sections.

12 magnet rotor
Initially a magnet rotor with 12 magnets was made. This consisted of neodymium block magnets placed around an automobiles brake rotor and arranged in an alternating array consisting of north to south around the rotor. The magnets were held in place using JB weld and the whole was encapsulated in resin to help protect the magnets from being damaged and from corrosion. J-B Weld is a hand knead able, steel-reinforced epoxy putty adhesive/sealant.
Load
We used a 5000 watt, 120-volt light bulb with a 2.88-Ohm resistive source as the load cell. It is shown in figure 4. It was connected to the generation device through copper wires that were long enough so that it could be placed on the end of the lathe or a table behind the lathe in the lathe set-up discussed below.

Figure 4. Bulb used as the load cell

Lathe set-up for testing
The different iterations of the system were tested using a lathe set-up. The rotor was held in the lathe headstock and the stator assembly was fixtured to the carriage of the lathe so the distance form the rotor could be adjusted. Figure 5 shows this arrangement. All iterations were tested with open and with closed load circuits at different speeds. The tests were also conducted with and without the coiled steel band disc, discussed below. Output voltage and amperage were recorded.

Figure 5. Lathe testing set-up

Coil winding
A device was made to aid in the coil winding process. It consisted of a one-inch wooden dowel rod with 2 wooden discs attached to it. The coil was wound using a lathe head stock, with the wire being wound on steel tubes held within the two wooden discs. A rotational counter was used to tally the number of turns in each coil. These are shown in figure 6 & 7.
Steel Band
The steel band was a 3/8 inch wide packing band. A jig was used to wind the band as a spiral disc and a holding device made to keep the steel band in place during the testing. These are shown in figures 8 and 9. The coil band was taped together to keep it from uncoiling.

Tests and results

Aluminum Stator
A sand cast aluminum stator shown in figure 10 was made. It was tested at a distances of 0.5 inches and 0.25 inches away from the rotor. Table 2 shows the results obtained. As expected the output voltage increases with rotational speed. The results also show that a 0.25 inch gap between the rotor and the stator increased the output by about 170% from the gap of 0.5 inches. However for safety reasons, this gap was not reduced further and it was decided to conduct all further tests with the stators being a quarter inch away from the rotor. Also the metallic nature of the stator caused eddy current heating, hence subsequent stators were made from non metallic materials.
Table 2. Results from Aluminum Stator- 75 turns in 12 coils using 12 magnets

<table>
<thead>
<tr>
<th>Test</th>
<th>RPM</th>
<th>Volts at 0.5&quot;</th>
<th>Volts at 0.25&quot;</th>
<th>.5 to .25</th>
<th>Difference Volts</th>
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<td>1</td>
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<td>2</td>
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<td>2.75</td>
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<tr>
<td>4</td>
<td>654.8</td>
<td>38.4</td>
<td>67.92</td>
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<tr>
<td>5</td>
<td>545.7</td>
<td>32.4</td>
<td>55.92</td>
<td>1.96</td>
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<td>272.8</td>
<td>15.6</td>
<td>27.6</td>
<td>1</td>
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<td>218.3</td>
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<td>21.72</td>
<td>0.77</td>
<td>9.24</td>
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</table>

Fiberglass Stator and 16/10 magnet rotor
This stator was machined as a shell or mold out of fiberglass for its strength. Twelve coils were again used but with 75 turns each. These were placed in the machined shell and the whole was sealed with resin. Photos of the stator are shown in figures 11 and 12. Before conducting the performance tests, the system was tested for cogging. This is the resistance to movement, created through alignment of magnets. In this case the alignment of magnets on the rotor and the induced magnetism in the steel tubes. The test showed that there was much cogging due to the 12 magnets and the 12 steel tubes aligning together.
To overcome this problem, we chose to build a new rotor. We machined an automobile brake rotor to accommodate either 10 or 16 magnets. The magnets had holes in them so these could be bolted on to the brake rotor. First the system was tested using 10 magnets followed by 16 magnets on the rotor. Both configurations reduced cogging significantly. Photos of this rotor are shown in figures 13 and 14. After conducting the 10 magnets rotor test and changing to 16 magnets, the whole rotor was sealed with resin. The results show that incorporating the load of 2.88 Ohms reduced the output voltage by more than a factor of 2. Also reducing the number of magnets reduced the output voltage, even though the number of turns in the coils had been increased. Therefore the next tests were done with 16 magnet rotor. The results of these tests are shown in tables 3 and 4. The results show that although use of 16 magnet rotor improved the output voltage, the voltage under load even at a speed of 600 rpm was only 7.93 volts. Hence it was decided to further increase the coils’ size. This was done in the All-In-One Stator described below.
Table 3. Results of tests using Fiberglass Stator and 10 magnet rotor

<table>
<thead>
<tr>
<th>RPM</th>
<th>Volts</th>
<th>Amps</th>
<th>Load Volts</th>
<th>RPM</th>
<th>Volts</th>
<th>Amps</th>
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<td>5.61</td>
</tr>
</tbody>
</table>

Magnets: 10 Stator: 12 coils

Table 4. Results of tests using Fiberglass Stator and 16 magnet rotor

<table>
<thead>
<tr>
<th>RPM</th>
<th>Volts</th>
<th>Amps</th>
<th>Load Volts</th>
<th>Volts</th>
<th>Amps</th>
<th>Load Volts</th>
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<td>7.93</td>
</tr>
</tbody>
</table>

Magnets: 16 Stator: 12 coils

All-In-One Stator
The two last stators built constituted an all-in-one stator combination. These stators had the steel lamination band and the coils attached to a three-eighth inch PVC plastic backing and sealed with resin. The second all-in-one stator was made to match the 12-magnets rotor. This stator had 10 coils with 150 turns and steel tubes in each coil. A photo of this stator is shown in Figure 15. The results of the first test are shown in table 5. The results show that more than 12 volt output was generated with steel band at the speed of 550 rpm.
Conclusion
The study described had a total material cost of only $650. I.e. this was a preliminary study that proves the concept of using steel tubes and steel band to improve the performance of a rotating flux generator. Both the process and application parameters in the study were aligned to the application of a small scale domestic wind turbine. Thus the goal of the study to investigate the feasibility of developing a single-rotor axial flux generation system has been successfully met.

Table 5. Results of tests using All-In-One Stator and 16 magnet rotor

<table>
<thead>
<tr>
<th>RPM</th>
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<th>Load Volts</th>
<th>Amps</th>
<th>Open Volts</th>
<th>Load Volts</th>
<th>Amps</th>
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<table>
<thead>
<tr>
<th>16 Magnets</th>
<th>12 Coils</th>
<th>110 Wires</th>
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<tbody>
<tr>
<td>2.88 Ohms</td>
<td>Light Bulb</td>
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References

Definition of key terms
• Alternator- A device that produces alternating current from the rotation of a shaft.
• Cogging- The cyclic physical resistance felt in some alternator designs from magnets passing the coils and gaps in the laminates.
• Eddy Currents- Currents induced due to magnetic induction. Laminates are used to reduce the occurrence of eddies.
• Magnet Wire- The kind of wire always used in making electromagnets, alternators, generators and motors. Uses very thin enamel insulation to minimize thickness and maximize resistance.
• Neodymium-Iron-Boron Magnet- Very strong permanent magnets. The materials are mined, processed, and sintered into shape. Then, they are subjected to an extremely strong magnetic field and become permanent magnets.
• Open-Circuit Voltage- The voltage that an alternator or generator produces when it is not connected to a Load.
• Closed load circuit Voltage- The voltage across a load in a circuit
Technologies Behind the 3D Movie “Avatar”

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Abstract
James Cameron’s 3D blockbuster movie ‘Avatar’ has been a phenomenal box office success. It is the most significant 3D movie ever produced. A number of revolutionary filmmaking techniques have been created during the production of Avatar. For its development of 3D viewing and stereoscopic filmmaking, cameras were specially designed for the film’s production. The facial expressions of the actors were captured and digitally transferred to the face of CGI (computer generated imagery) generated characters using a facial performance capture system. It’s our vision that the movie and the technologies bring great opportunities to higher education. Students are fascinated by these state of the art computer and multimedia technologies, and they will find plenty of career opportunities in the big budget and hi-tech movie industry.

Introduction
On January 27, 2010 ‘Avatar’ became the highest-grossing film of all time worldwide (Box Office Mojo), surpassing the previous record holder ‘Titanic’ (Both films were written and directed by James Cameron). The Avatar film is composed of 60% computer-generated elements and 40% live actions. Avatar represents a dramatic advance in movie-making technologies (Billington, 2008). The experience of Avatar in 3D explores the potential of film to bring viewers into a materialized onscreen world.

Prior to the film being shot with the live-action cinematography, the 3D Pandora environments were rendered in CGI (computer generated imagery). The virtual world of Pandora used over a petabyte ($10^{15}$) of data storage. The Fusion 3D camera system was developed to shoot stereoscopic HD video. CGI-generated environments could be viewed through virtual camera from any point and angle. Finally, Simulcam merged 3D camera and virtual camera in real time. Figure 1 shows an overview of the workflow of Avatar production.
This paper focuses on the production process of Avatar and studies a number of revolutionary techniques created for the movie production. In particular, the following techniques will be discussed:

- Fusion 3D camera system
- Facial performance capture system
- Virtual camera system
- Simulcam
- Data handling

Before discussing the technical details in Avatar production, we will first briefly introduce the background of 3D viewing.

**Binocular Stereo Vision**

When we observe a scene with both eyes, an image of the scene is formed on the retina of each eye. Since our eyes are horizontally displaced, the images formed in each eye are not identical. This stereo-pair of retinal images contain slight differences (binocular disparity) between the relative locations of local parts in the images, depending on how close these local parts in the scene are to the observer’s eyes (Cyganek & Siebert, 2009). The schematic of a human eye is illustrated in Figure 2.
When we take a traditional 2D picture, one dimension of information, the depth, is lost through the process of projection. The 2D imaging has satisfied us for hundreds of years and certainly will keep serving us in the future. However, in some particular circumstances such as robotic operations, or to enhance viewers’ experience, we need to capture three-dimensional visual information or to create an illusion of depth out of one or more images. Such techniques are called stereoscopy or 3D imaging.

A very common approach to achieve 3D imaging is binocular stereo vision, a way of getting depth information about a scene from two 2D views (images) of the scene. A number of techniques have been developed to generate binocular stereo vision. Based on if the viewing region is shared, these techniques can be classified into two categories: non-shared and shared.

The non-sharing scenario is also called side-by-side viewing – images are not overlapping. The main advantage of this type of viewing is its simplicity - little or no additional image processing is required. Techniques of this type include freeviewing (Erker), stereoscope, transparency viewers (Waldsmith, 2002), head-mounted displays (Melzer & Moffitt, 1996), and so on. Figure 3 shows eMagin Z800 3DVisor (eMagin), the world’s first head-worn display system.

The sharing scenario features two overlapping images. Viewers need to wear special 3D glasses to separate images to left and right eyes, respectively. There are two categories of 3D glasses: active and passive. Active glasses typically use shutters to block or pass light, which is also called alternate-frame sequencing. Figure 4 shows Samsung SSG-2100AB Active 3D Glasses (Samsung). There are several types of passive glasses, and the most popular type is polarized glasses, which are commonly used in 3D cinemas.
Figure 4: Samsung SSG-2100AB Active 3D Glasses.

From the next section, we will discuss the technical details in Avatar production. We will begin with the 3D camera system used to shoot stereoscopic real world pictures.

**Fusion 3D Camera System**

One crucial reason for the success of Avatar 3D is the eye strain when watching the movie was significantly reduced, whereas eye strain is a common problem associated with viewing previous 3D productions. The 3D live actions in Avatar were created through the extensive use of the Fusion Camera System. The system was developed by Cameron and Vince Pace, director of photography for the film. Originally called the Reality Camera, it was first deployed on Cameron’s underwater documentaries “Ghosts of the Abyss” (2003) and “Aliens of the Deep” (2005). The camera system combines two Sony HDC-F950 HD cameras (over $230,000 just for the cameras) with lenses that can dynamically adjust the angle of their convergence to match the depth of objects in Z-space. The eye strain is reduced for the following two features of the camera system:

- First, the two Sony cameras are 2½ inches apart to mimic the stereoscopic separation of human eyes.
- Second, an innovative “Constant Divergence Algorithm” is used to adjust the S3D (Stereoscopic 3D) settings, so that the stereo will match from shot to shot. Human eyes become less tired when the focus doesn’t change too quickly and dramatically (near and far). It’s similar to audio volume. When people listen to music, the audio level shouldn’t be jumping all over the place.

Figure 5 shows the Fusion Camera System (PACE) (Wordpress.com). Cameron et al. filed a patent application called “Platform for Stereoscopic Image Acquisition” in 2009, and the system design is shown in Figure 6. The basic idea is to adjust the distance and angle between the two camera-mounting plates.

Figure 5: Fusion Camera System
Facial Performance Capture System

To ensure that the characters looked realistic, Cameron developed a new “image-based facial performance capture” system. The system uses a head-rig camera to accurately record facial expressions with unprecedented clarity and precision. Traditionally, facial expression is captured using the motion capture technique, which places reflective markers on actors’ faces. In the production of Avatar, the actors wore special headgear, like a pilot helmet, to which a tiny camera was attached. The rig faced towards the actors’ faces, and the camera recorded facial expressions and muscle movements to a degree that was not possible before.

Figure 7 shows the facial performance capture system worn by the actors. The green dots on their faces are used by a software algorithm to track their facial expressions (Bearers, 2010). Figure 8 shows the facial expression of the actress and that of her CGI counterpart.
Virtual Camera System

As its name indicates, the virtual camera system operates as if a camera that can be placed at any location and angle with any focal setting in the virtual CGI world. It is a new way of motion-capture filmmaking. The system places the actors’ virtual counterparts into their digital surroundings, and displays the view from the virtual camera on a LCD monitor in real time. The director can adjust and direct scenes just like shooting live actions.

To create a precise performance for the CGI sequences, actors first perform scenes in a warehouse. The director views the action through the virtual camera, similar to looking at the viewfinder of a camcorder. But the screen displays the virtual world, such as 10-foot-tall aliens living in Pandora’s rich and lush forest. This system allows the director to position performers and to direct actions based on a real-time preview of the finished movie.

After the performances are captured, the footage can be accessed at any time. According to Cameron, “long after the actors have gone home, I’m still out there with the virtual camera, shooting coverage on the scene. I just have to play the take back. I can do the close up, the wide shot. ... I can even move them around on a limited basis. We relight it. We do all kinds of things.” (Giardina, 2008)

Figure 9 shows that the virtual camera was being used during the filming. The live action occurred in a warehouse, but the virtual camera displayed the CGI scene in real time.
Figure 9: Virtual camera system.

Figure 10: Using the virtual camera to choreograph camera moves.

Figure 10 shows that the virtual camera could be moved, and the view of CGI virtual world would move accordingly. Again, it happens in real time - directors don’t have to wait for computer rendering process. The cross with white beads at the front of the camera marks the position of the virtual camera in CGI world.

Simulcam - Merger of Live Action and CGI Environment
The Simulcam is closely related to the virtual camera explained in the previous section. The purpose of virtual camera is to place a camera at an arbitrary position in the CGI world and get the view, while the Simulcam is responsible for integrating the 3-D fusion camera and the virtual camera system in real time. When filming live actions with the Simulcam, the live action images were superimposed over the CGI images, captured by the virtual camera or designed from scratch, and the merged image was shown on the monitor. This integration makes it possible for the director to inform the actors how to relate to the virtual materials while shooting a scene.
Essentially, Simulcam treats a real camera like a virtual camera, and the merging (of Fusion camera and virtual camera) helps remove the guesswork. Cameron said, “We turned the set on the soundstage into a capture volume and turned the physical camera into a capture virtual camera, so we were able to integrate CG characters and environments into our live action.” (Giardina, 2008)

Figure 11 shows how the Simulcam works. The dragon view was shot by the virtual camera, and the character motion was shot by the Fusion camera. The Simulcam merged the two views and generated a view in the movie and displayed it on the monitor.

Figure 11: Simulcam merges live action and CGI environment.

Figure 12 gives another example. The flying scene on the left was from the live action camera (Fusion), and the Simulcam added the CGI scene and generated the scene as in the movie. This process works in real time, a key in Avatar production.

Figure 12: (Left) Live action. (Right) Merged with CGI in Simulcam.

A similar system called Previzion is commercially available at LightCraft (Lightcraft Technology). Previzion offers an integrated real time pipeline that allows users to transition seamlessly from live stage to the virtual stage (Figure 13).
Supercomputer Server Farm

It takes a lot of data center processing power to create the visual effects behind blockbuster animation movies. The data handling of Avatar was done at the New Zealand-based Weta data center (Figure 14), where a 10,000-square-foot server farm manages thousands of work orders and a serious amount of data. The Weta data center uses more than 4,000 HP BL2×220c blades, 10 Gigabit Ethernet networking gear from Foundry, and storage from BluArc and NetApp. Now this system occupies spots 193 through 197 in the top 500 list of the most powerful supercomputers (Data Center Knowledge, 2009).

The computing core consists of thirty-four racks, on which 32 machines are mounted. The core has 35,000 processors and 104 terabytes of memory. For the last a few months of the production of Avatar, those processors were handling 7 or 8 gigabytes of data per second, running 24 hours a day. A final copy of Avatar lasts 166 minutes, and each minute uses 17.28 gigabytes of storage (Data Center Knowledge, 2009).

Conclusion

The innovations created to film the Avatar movie has significantly influenced film productions, because they prompt a shift in thinking about 3D and inspire filmmakers to create the most engaging and immersive movies possible. According to Jon Landau, producer of Avatar, “It’s about philosophy. It’s more about a window into a world than a world coming out of a window.” (FilmContact.com, 2009)
The innovations in Avatar production not only change movie industry, but also bring great opportunities for higher education. Students are fascinated by these state of the art computer and multimedia technologies, such as computer animation, 3D modeling, motion management, computer graphics, image processing, and data storage and communication. The big-budget hi-tech movie industry opens lots of career opportunities for students who are interested and well-prepared in this area.

References
Unmanned Aerial Vehicle Automation and Control Systems: Potential Applications for Industrial Use

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Abstract
The purpose of this paper is to demystify the electronic systems on board a contemporary civilian unmanned aerial vehicle (UAV.) Often one industrial sector may develop control systems which can advance the technology and be deployed successfully in other industrial applications. Disseminating and sharing knowledge of like technologies is the first step in achieving this outcome. The research team gives a brief perspective of unmanned aerial vehicle automation and control systems; then, the new state of the art technologies used in the unmanned field follows with its integration between man and machine. Included are the degree of autonomy and use of the technologies in aviation and the relationship and applicability to industry. UAV automation and control systems may be used to minimize operator workload, prevent operator-induced errors, and protect against exceeding limitations. These principles and technologies can be leveraged to include industrial applications as well.

Introduction
Unmanned automation and control systems have steadily evolved over the last several years. Traditionally, it has been the military establishment which has led the way in emerging unmanned technologies. While the military remains on the forefront and continues to be one of the biggest users of unmanned technologies, non-military applications are gaining in popularity and usage. Academia, government and private industry are continuing to utilize many different applications for unmanned systems. Some of the many applications are found in agriculture, scientific research, meteorology, surveillance, mapping, surveying, security, marketing, and by emergency first responders and rescue. Unmanned control systems can be navigated either manually by an operator on the ground or by an autonomous mode. Essentially, both modes provide for the same outcome. The basic challenge for any mode is to accurately and effectively receive control inputs and properly respond to those inputs. Inputs may include directional commands to move the flight controls of a vehicle or to commands to initiate payloads such as weapons release, direct photography or activate sensors.

This paper highlights the different levels of automation associated with unmanned aerial vehicles (UAV’s), or more recently known as unmanned aerial systems (UAS). It also clarifies the basic fundamentals of the control systems associated with unmanned vehicles to include software components, communications protocols and systems integration.
Unmanned Systems Automation

There are different levels of automation which can be utilized in unmanned systems operations. Generally speaking, the higher the level of automation in the system, the higher will be the level of complexity and cost. While tremendous strides have been made in the area of unmanned automation, it does have its advantages and disadvantages. The advantages of automation are numerous. Among other things, it has been shown to reduce workload, decrease fatigue, increase situational awareness, and allows for minimum staffing levels.

A study conducted by Dixon, Wickens and Chiang in 2003 identified some of the pitfalls of imperfect automation in unmanned aerial vehicles. Some additional disadvantages are that the automation function and logic may be poorly designed, automation may use different control strategies than a pilot and automation can sometimes be very complex. Additionally, automation can lead to operator complacency (Ternham, 1978). In fact, the military has experienced a much higher accident/incident rate for unmanned systems than it has for manned aircraft systems (Williams, 2004).

“Current UAV systems differ dramatically in the degree to which flight control is automated. In some cases the aircraft is guided manually using stick and rudder controls, with the operator receiving visual imagery from a forward looking camera mounted on the vehicle. In other cases control is partially automated, such that the operator selects the desired parameters through an interface in the ground control station. In other cases still control is fully automated, such that an autopilot maintains flight control using preprogrammed fly-to coordinates” (McCarley & Wickens, 2005).

Even though there might be obvious shortcomings with automation systems, one must conclude that automation is a key component of an unmanned system. By the very nature of declaring a system to be unmanned, there must be an essential level of automation by which the system safely and properly operates.

Fundamentals of the Control Systems Architecture for Unmanned Aerial Vehicles

The control systems found on unmanned aerial vehicles range from simple to complex; and can best be described by illustrating various systems along a continuum with the simple or manual control system on the left and the most complex autonomous systems on the right (see Figure 1).
Basic Remote Controlled RC Aircraft

Each control system in the continuum will need a minimum of two processors, one for a remote transmitter and one for an onboard receiver. A simple design commonly found on basic remote controlled RC hobby type aircraft would include a PIC (Programmable Interface Controller) processor in a remote handheld transmitter that would receive inputs from one or more Joysticks, and a PIC on the aircraft sending information to one or more servo motors. The control process begins with the movement of a joystick, which is a potentiometer. This will generate an analog signal to be read by an ADC (analog to digital converter) portion of the PIC (see Figure 2). From there the signal is sent to an encoder and then to an RF (radio frequency) transmitter and antenna to be broadcast.

The signal is next picked up by an RF receiver and antenna on board the remote aircraft. Next, the signal is passes though an onboard decoder, the PIC decodes the information and sends the information to the onboard servo motors.

![Figure 2: Basic RC Control Process](image)

A recent research project by Aye, Tun, Naing, and Myint (2008) set out to build a basic unmanned aerial vehicle using two PIC controllers. Two PIC 16F877 (Microchip technology, Inc.) 8-bit microcontrollers were chosen to obtain the analog data from the joysticks in the transmitter and control the motors on the UAV (Aye, et al., 2008). This microcontroller has a 25 MHz processor, 33 input/output (I/O) pins, (8k*14words) of Enhanced Flash program memory, (386*8bytes) of RAM and (256*8bytes) of data EEPROM. Another feature which make this a good choice of microcontroller is that it simplifies the interfacing of motors with a 10-bit analog to digital converter, 14 interrupts, 3 timers, and 2 capture/compare/pulse width modulation (CCP) channels (Microchip Technology, 2001).

Unlike a personal computer, a PIC microcontroller does not have an operating system in its memory. A program must be written then stored in its memory and become ready to interrogate information once it is turned on.

The Aye group selected a matching pair of transmitter/receiver, the TWS-434A and RWS-434. These are used to send and receive data between the ground transmitter and the aerial vehicle. These units operate at 433.92 MHz, with an operational voltage of 4.5-5.5 VDC. No addressing is required and they are easily serial interfaced (Reynolds Electronics, 2010). For encoding and decoding, a matched pair of R-8PE/R-8PD IC’s were used. These IC’s are a low cost solution with a simple design in which the DOUT pin transmits encoded serial information to the RF transmitter, and the DIN pin is able to receive serial data from the RF receiver (Reynolds Electronics, 2006). To complete the hardware, the Aye group selected another off-the-shelf component for the servo motors: a Futaba Servo Motor (F-S148). This is a very common motor having relatively high torque at all speeds and is able to hold a static position, to reverse direction, to accelerate and decelerate, and to reach a desired position quickly. Weighing in at only 1.5 ounces, the servo motor develops 42 Oz/in torque in .22 seconds, on 4.8 to 6 VDC (HVW Technologies, 2010).

Software

The program is written in PIC C language. By using a simple C complier developed by CCS, Inc., called PCWH, the Aye group was able to write a program in C code to interface the PIC with the other hardware components selected. The PCWH compiler has built in libraries for working with serial I/O and digital I/O, and has easy to use timers and A/D conversions functions (Custom Computer Services, 2010).
Because servo motors are controlled via the management of PWM (Pulse, Width, Modulation) a statement must be written to the register in the form of Capture/Compare/Pulse Width Modulation values. CCS’s PCWH compiler can translate the values that the Futaba FP-S148 is optimized for: 1250us in neutral pulse, 2200us full ccw pulse, and 220us full cw pulse.

Communications protocols
In the Aye group’s project, the data begins in series with an RS-232 connection. Once the data is transmitted, a constant stream of ASCII packets is broadcast consisting of 5 pieces of information separated by underscores. These are: manual control status, propeller speed, rudder angle, elevator angle, and a check sum. The manual control status is either a value of 1 for enabled or a single packet containing five zeros if the manual control is disabled. The propeller speed value is set between -300 or +300 representing the direction of rotation and an rpm value. The rudder and elevator values range from -4500 and +4500, which represent a range between -45 degrees and +45 degrees. The checksum is calculated by adding absolute values of each variable and then checking against the check sum stated in the packet. If the check sum values differ, then that packet is ignored.

Systems Integration
Figure 3 and Figure 4 represent how the program written for the PIC performs and controls the system in both the transmit cycle and receiving cycle.

Semi-Autonomous Control System Architecture
In general, the categorical difference between a manually controlled unmanned aerial vehicle and a semi-autonomous unmanned aerial vehicle is the improved performance ability of the system’s processors to tune the vehicle’s flying characteristics without additional inputs from a manual joystick configuration. This would mean that the system must have at least one continuous control loop processor plus additional onboard sensors to provide a constant stream of real time data from which a known value can be compared to a desired value for continuous improvement. For an example of a semi-autonomous unmanned aerial vehicle, the Draganflyer X6 from Draganfly Innovations Inc. will be examined.

PID Controller
The processor on the aircraft is a PID (Proportional Integral Derivative) controller. A PID controller calculates an “error” value as the difference between a measured process variable and a desired set point. The controller attempts to minimize the error by adjusting the process control inputs. To improve on the input adjustments, an algorithm is used to tune the input calculations. The PID controller algorithm involves three separate parameters;
the proportional, the integral, and the derivative values, noted P, I, and D. The proportional value determines the reaction to the current error, the integral value determines the reaction based on the sum of recent errors, and the derivative value determines the reaction based on the rate at which the error has been changed (Araki, 2009). The sum of these actions, as depicted in Figure 5, is used to adjust the necessary motor speeds or control surfaces to lessen the error and begin reaching the desired set point. In terms of flying, a value of one of several flight parameters (such as altitude, speed, attitude, etc) may be the desired set point at any given time.

**Figure 5: PID Controller Process**

In addition to having a PID controller, the Draganflyer X6 has the following onboard sensors which provide a constant stream of data from which to make adjustments toward the desired positions and flight characteristics (Draganfly, 2010):

- 3 Solid State MEMS (Micro-Electro-Mechanical Systems) Gyros
- 3 Solid State MEMS Accelerometers
- 3 Magnetometers
- 1 Barometric Pressure Sensor
- 1 GPS Receiver

The purpose of the gyroscopes is to establish a known constant value in each axis from which an error or deviation can be measured. The accelerometers provide a translated voltage value from the known value of the gyroscopes. The gyros and accelerometers together provide improved flight stabilization and maintain a level attitude when needed. The magnetometers are used to measure the strength and/or direction of the earth’s magnetic field and provide error or deviation values from a desired value. The barometric pressure sensor provides altitude information as well as the error or deviation from the set point. The BP sensor is also used for determining and controlling altitude, which becomes increasingly important when flying in environments that do not permit a GPS lock. It also sends data for determining maximum dive or climb rates and for helping to control for failsafe landings. The GPS receiver’s primary function is to aid in flight, and it is used for holding a specific position. It provides a constant stream of latitude, longitude, altitude (ASL) and velocity information. With the on board GPS receiver and a PID loop processor, the Draganflyer would be capable of GPS waypoint navigation, but it is not currently packaged with any ground control software to allow this function. The Draganflyer may also be purchased with several camera options for several commercial applications and may possibly provide a live video feed from the vehicle which can help in navigation.

**Autonomous Unmanned Aerial Vehicle Control System**

The continuum of control systems architecture for unmanned aerial vehicles moving from a manual RC system to a semi-autonomous system has been attributed to the improved performance ability of the system’s processor to tune the vehicle’s flying characteristics without additional inputs from a manual joystick configuration. This has
been achieved by using a PID controller with control loop and tuning capabilities and by adding multiple onboard sensors to provide a continuous data stream to the controller. To move a system such as the Draganflyer into the autonomous category would not necessarily require more processing power but more software programming to achieve waypoint navigation, and possibly an autopilot circuit for as an additional way of maintaining course variables.

**Predator**

The Predator UAV is a medium-altitude; long-range aircraft that operates much like any other small plane. The Predator uses run-of-the-mill mechanical systems, such as a Rotax 914, four-cylinder, four-stroke, 101-horsepower engine, this engine type, the same commonly used on light aircraft or snowmobiles turns the main drive shaft. The drive shaft rotates the Predator’s two-blade, variable-pitch pusher propeller. The rear-mounted propeller provides both drive and lift. A remote pilot can alter the pitch of the blades to increase or decrease the altitude of the plane and can cause it to reach speeds of up to 135 mph (120 kts) (HowStuffWorks, 2010). The simple and lightweight design of the Predator’s fuselage allows it to carry a payload of up to 450 pounds in addition to the weight of its 100-gallon fuel tank. This large fuel tank and the nice gas mileage afforded by the Predator’s light weight are great assets for a reconnaissance aircraft. The Predator can stay in the air monitoring for up to 24 hours fully loaded. In some regards the predator is more like an RC manual controlled UAV and of the RF capabilities and because the motors which move the control surfaces are servo type which are moved or positioned via PWM information. What is different, and what makes the Predator a fully autonomous UAV is more processing power with two onboard control modules, full functioning GPS receiver and navigation, and extended line of sight control by utilizing a satellite data link.

**DIY Autonomous UAV Control System**

Recent efforts by amateur UAV hobbyists, such as Chris Anderson have proven that an autonomous UAV can be built with off-the-shelf RC and electronic components for less than $2000 (Deyle, 2010). Chris’s system uses a combination of autopilot, waypoint navigation, wireless telemetry, and GPS costing less than $300 and so leaving more than $1600 for purchase of an RC plane or helicopter as the primary vehicle. Chris is even able to fly in a near perfect circle of 100m diameter by linking with Google Earth as part of his program.

The research team of Saripalli, Montgomery, and Sukhatme (2003) at USC developed a similar UAV control system called AVATAR (Autonomous Vehicle Tracking and Reconnaissance) using an off-the-shelf RC helicopter, an onboard PID loop controller, and GPS navigation. What was unique about their research project was the addition of an onboard machine vision stem to send an input data stream to be processed as a method of achieving autonomous hands off landings.

**Summary**

This paper has briefly examined the components by which unmanned systems operate. The different levels of automation and the complexity associated with those levels determine the capabilities of a particular unmanned system. The separation between the pilot/operator and the unmanned system inherently produces unique obstacles which must be overcome in order to safely accomplish the desired tasks. By exploring the unmanned aerial vehicle control system continuum, one can identify the range of complexity from the manual remote control mode through the purely autonomous mode. These modes range from the basic remote controlled RC aircraft utilizing a Programmable Interface Controller (PIC) to the autonomous systems using data link as a primary method of navigation and control. Further research is necessary to determine which levels of automation and control are optimal for any given unmanned system.
References


Graphics
Computer-Integrated Design Concentration: Implementing a Product Design and Development Course in the Industrial Technology Curriculum

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Abstract
Through this paper the audience will understand the curriculum development model used at California State University, Los Angeles to deliver a Product Design and Development course as part of a concentration in Computer-Integrated Design. The Product Design and Development course (TECH 313) is open to junior-level students in the Industrial Technology program and the content was based upon a course from MIT’s Open Courseware website. The structure of the course, availability of instructor resources and experiences from offerings in 2009 and 2010 are discussed along with proposed enhancements for 2011.

Background
A new modified version of the B.S. Industrial Technology program became effective the fall quarter 2008. (See Figure 1) The program modification provided separate Foundation Program pathways, one for first-time freshmen who complete their lower division courses at Cal State Los Angeles and a second transfer program pathway whereby students complete their lower division coursework at a community college. Both pathways then lead students into a common Required Core followed by two Tracks (Industry or Technology Education for teachers) and finally a choice of five possible Concentrations to choose from. As a component of the Industrial Technology program modification, it was decided to create five concentration areas:

- Computer-Integrated Design (CID)
- Internetworking
- Graphic Communications
- Manufacturing Processes and Automation
- Power, Energy, and Transportation
Why Computer-Integrated Design?

Back in 2000 the author became involved with the CATIA Operators Exchange (COE.org) which is an industry-driven user group that sponsored annual conferences. The annual conference was focused on the needs of computer-aided design (CAD) specialists that used CATIA V4 on Unix-based workstations to create 2D and 3D geometry. Dassault Systemes (www.3ds.com) who developed CATIA V4 redirected their efforts by incorporating a totally new version of their software (V5) to run on the Windows operating system and began to look at how to incorporate the use of web browsers to manage design information and processes. A whole new business concept evolved called Product Lifecycle Management (PLM). PLM “is the process of managing the entire lifecycle of a product from its conception, through design and manufacture, to service and disposal” (Sudarsan, 2005).

A component of PLM is Product Data Management (PDM). PDM can be defined as “an information system used to manage the data for a product as it passes from engineering to manufacturing. The data includes plans, geometric models, CAD drawings, images, NC programs as well as all related project data, notes and documents. A PDM also manages the interrelationships between the data so that when changes are made to one database, the effects are highlighted in the others. PDMs are developed for workgroups as well as the entire enterprise” (PC Mag.com). The use of PDM as an information system has implications for today’s product design and development processes and how they are controlled.

Hartman and Miller (2006, p. 19) interviewed ten company representatives regarding how they implemented
PDM and PLM. One of the implications of PDM they point out for today’s educators’ states “With the advent of Windows workstations and powerful, relatively inexpensive graphics processors, CAD tools have become a staple in most engineering and technology programs. It is the use of PDM tools and other higher-order technologies that will enable students to develop new paradigms of thought about the design process. It will also require faculty to develop more creative instructional opportunities and to change their focus from a production mindset to one of technological integration. While the creation of geometry will always be important, a secondary focus of engineering design graphics education is now developing - a view towards leveraging a 3D database within the larger context of the design environment. To facilitate that process, literacy in the use of PDM tools as a communication and dissemination backbone will be required.”

Vision, Mission and Learning Outcomes Development
In 1999, the faculty of the Department of Technology went through an extensive process prior to an upcoming program review to develop a vision and mission statement and program learning outcomes for various majors including the Industrial Technology program. The educational objectives and learning outcomes that were developed are listed in Figure 2 under three categories of knowledge, skills and attitudes.

<table>
<thead>
<tr>
<th>Knowledge</th>
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<tr>
<td>Educational objective: Industrial Technology graduates will demonstrate a balance of technical and managerial knowledge.</td>
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<tr>
<td>In demonstrating this educational objective, graduates will exhibit the following outcomes:</td>
</tr>
<tr>
<td>1. They will have knowledge of science, math and technical management.</td>
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<td>2. They will understand the role of technical management in the public and private sector.</td>
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<tr>
<td>3. They will have knowledge of systems and the integration of technologies.</td>
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<td>4. They will have knowledge of information technology including its use in a digital enterprise.</td>
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<td>5. They will have knowledge of contemporary technology/management issues.</td>
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<tr>
<th>Skills</th>
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<tr>
<td>Educational objective: Industrial Technology graduates will demonstrate the skills needed to apply business practices, information technology, and other technical skills necessary to collaborate with, organize, and lead inter-disciplinary teams.</td>
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<tr>
<td>In demonstrating this educational objective, graduates will exhibit the following outcomes:</td>
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<tr>
<td>1. They will be able to apply theories and principles to solve technical and management problems.</td>
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<tr>
<td>2. They will be able to design, test and analyze a system or process to meet desired needs.</td>
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<tr>
<td>3. They will have good written and oral communication and presentation skills.</td>
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<td>4. They will be able to exhibit supervisory and team leadership skills.</td>
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<td>5. They will be able to collect, analyze and interpret data.</td>
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<td>6. They will be able to collaborate within a digital enterprise with a multi-disciplinary project team.</td>
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<td>7. They will be able to select and use computer applications software associated with desired needs.</td>
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<th>Attitudes</th>
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<td>Educational objective: Industrial Technology graduates will demonstrate a cooperative and inquisitive spirit that supports the desire to pursue lifelong learning enables them to adapt to contemporary issues in the workplace, and helps advance the goals of their organization.</td>
</tr>
<tr>
<td>In demonstrating this educational objective, graduates will exhibit the following outcomes:</td>
</tr>
<tr>
<td>1. They will have an understanding ethical responsibility.</td>
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<td>2. They will exhibit professionalism in their area of expertise.</td>
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<td>3. They will recognize of the need for, and an ability to engage in life-long learning.</td>
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<td>4. They will stay current on issues.</td>
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<td>5. They will achieve a balance of workplace and personal goals.</td>
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<tr>
<td>6. They will exhibit the desire to adopt emerging technologies to improve their area of expertise.</td>
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<tr>
<td>7. They will support and promote the goals of their organization.</td>
</tr>
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</table>
The reasons for evolving the Computer-Integrated Design concentration as part of the Industrial Technology program modification in 2008 can be traced to the fourth and fifth Knowledge outcomes and the sixth Skills outcome:
1. They will have knowledge of information technology including its use in a digital enterprise
2. They will have knowledge of contemporary technology/management issues
3. They will be able to collaborate within a digital enterprise with a multi-disciplinary project team.

With the program outcomes and the author’s knowledge of Product Lifecycle Management and Product Data Management trends, five course proposals were developed, one for the Required Core (TECH 310 - The Design Process) and four courses for the concentration.

**Computer-Integrated Design (CID) Concentration**
The four courses in the computer-integrated design concentration at our university address Product Design and Development (TECH 313), Project Design and Document Control (TECH 315), Tool Design (TECH 411), and Digital Manufacturing (TECH 462).

One of the courses in the core taken by all Industrial Technology majors is TECH 310 - The Design Process. TECH 310 which covers the engineering design process serves as a prerequisite to TECH 313, the first course for those students who intend to complete the concentration in Computer-Integrated Design.

**Structure of the Course**
TECH 313 – Product Design and Development is the three-unit lecture/lab course focusing on an “in-depth examination of the process of designing products for manufacture. Analysis and application of the methods, models organizations, standards and practices used in industry” CSULA, 2009, p. 703). Student learning outcomes for the course are as follows:
- Design products that are matched to user needs.
- Use design skills using both traditional and rapid visualization tools.
- Establish the design requirements, design criteria and deliverables for a product concept.
- Use tools and methods to develop a conceptual design.
- Identify the processes used for detail design.
- Prepare documentation necessary for the final design of a product including selecting components, engineering drawings, and cost estimates.
- Identify manufacturing processes to be used that are appropriate and cost effective.
- Make oral presentations as a member of a team during the product design and development process

The product design and development course builds upon what is covered in a class in a required core class called The Design Process. The focus of TECH 310 is to prepare students to understand the processes engineers use to do design, how they define client design problems, indentify functions, develop requirements, create and evaluate design alternatives and how to communicate the design outcome through models, engineering drawings and oral presentations. This course provides a very good overview of the design process used by engineers.

The primary challenge of the product design and development course (TECH 313) involves guiding collaborative student product design teams to understand and apply concepts such as product planning, identifying customer needs, developing product specification etc. while developing their products within a ten week period. To support the learning and concepts involved in this course, a textbook had to be found and adopted.

**Textbook and related educational materials**
The textbook that has been adopted for the course is the fourth edition of Product Design and Development by Karl T. Ulrich and Steven D. Eppinger from McGraw-Hill. Around the country and around the world, this text has been used to support both undergraduate and graduate level courses related to product design and development.

Additional related educational materials are available at several different websites. The first resource is the authors' textbook site www.ulrich-eppinger.net. (Figure 3)
Figure 3. Textbook website www./ulrich-eppinger.net

The website provides a link to an instructor site where teachers can request a password and I.D. from the authors. The instructor’s site (Table 1) provides sixteen chapter session outlines, solutions, PowerPoint files containing images in the textbook and instruction slides, and spreadsheets and related videos that can be downloaded to support instruction.
Table 1. Instructor Site teaching resources available

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Teaching Resources Available</th>
<th>Book Illustrations</th>
<th>Instruction Slides</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td></td>
</tr>
<tr>
<td>2. Development Processes &amp; Organizations</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td></td>
</tr>
<tr>
<td>3. Product Planning</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides Video</td>
</tr>
<tr>
<td>4. Identifying Customer Needs</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides</td>
</tr>
<tr>
<td>5. Product Specifications</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides</td>
</tr>
<tr>
<td>6. Concept Generation</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides</td>
</tr>
<tr>
<td>7. Concept Selection</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides Spreadsheet</td>
</tr>
<tr>
<td>8. Concept Testing</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides Survey Video</td>
</tr>
<tr>
<td>9. Product Architecture</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides</td>
</tr>
<tr>
<td>10. Industrial Design</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td></td>
</tr>
<tr>
<td>11. Design for Manufacturing</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides</td>
</tr>
<tr>
<td>12. Prototyping</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides</td>
</tr>
<tr>
<td>13. Robust Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Patents and Intellectual Property</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Product Development Economics</td>
<td>Session Outline Solutions</td>
<td>PPT</td>
<td>Slides Spreadsheet</td>
</tr>
<tr>
<td>16. Managing Projects</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The authors have divided the product design and development process into six different phases. The six different phases are Planning, Concept Development, System-Level Design, Detail Design, Testing and Refinement and Production Ramp-up. Figure 4 provides an overview of how the sixteen chapters are divided among the six phases (Ulrich, Eppinger, 2008, pg. 9).
A second resource site related to the textbook is MIT’s Open Courseware (OCW) website (Figure 5). The home page for the site can be found at: http://ocw.mit.edu. The OCW site
states that “it is open and available to the world and is a permanent MIT activity” (MIT Open Courseware, 2010). The OCW site for Product Design and Development allows free access to individual resources such as a syllabus, readings, lecture notes, assignments and projects. There is an additional link which allows a download of all course materials from MIT for this particular course. The course was developed in 2006.

Use of case studies
Each of the textbook chapters are supported with actual case studies from a variety of different sized companies with product examples such as ball point pens, power tools (DeWalt), cell phones (Motorola) and copy machines (Xerox). Although some case studies may focus on older versions of products, additional updated information can easily be supplemented by searching company websites for product updates. The case studies provide an overview of the concepts stressed in a chapter. For example, in Chapter Four: Identifying Customer Needs the case study revolves around DeWalt’s decision to develop cordless screwdrivers and the problems encountered. Students are introduced to a method of identifying customer needs with the case study that can be used later when collecting customer needs information via a survey and apply what they have learned for their team activity later in the quarter. The five-step process students need to understand in order to identify customer needs includes:
• Gathering raw data from customers
• Interpreting raw data in terms of customer needs
• Organizing the needs into a hierarchy
• Establishing the relative importance of the needs
• Reflecting on the results and the process
Experiences
After offering the course the past two years here are my thoughts regarding the results achieved so far, both good and bad.

Course delivery issues related to the quarter system
As mentioned earlier in this paper, TECH 313 is a three-unit lecture/lab based course meeting two times per week for a total of five contact hours. It is difficult to teach a course on a 10-week quarter system schedule, especially with a textbook having sixteen chapters, quizzes, case studies, team selection, team product development activities and field trips. I have chosen the following chapter readings to fit the limited timeframe for the course.

The chapters I have covered are:
- Introduction
- Development Processes and Organizations
- Product Planning
- Identifying Customer Needs
- Product Specifications
- Concept Selection
- Industrial Design

CAD systems used
Students in the course who took the prerequisite of TECH 310 - The Design Process were required to use CATIA V5 for their team project which involved learning the sketcher, part, assembly, and drawing workbenches. Student teams in TECH 313 over the past two years were able to select which CAD package(s) to use on their product they were developing. With the instructor's emphasis on embedding the processes used in the six stages to design and develop a product, many teams used one more CAD software package depending on the knowledge and comfort level certain team members had with a CAD package. Some students used AutoCAD 2010, SolidWorks 2010 or CATIA V5. There was no instructor requirement for a certain CAD product, however, in the near future we will standardize on SolidWorks to expose all students to a minimum of two parametric-based CAD software packages (SolidWorks 2010 and CATIA V5) prior to their graduating from the Industrial Technology program. This is important as we have many aerospace companies in Southern California who use CATIA V5 and many other small to medium-sized companies who standardize on SolidWorks.

Sample student products
During the winter quarter of 2009, there were five product development teams and four products developed. Two of the five teams pursued the same product idea which was a cell phone case/bottle opener. To highlight two of the four products, one was a clip on LED light attachment for a pair of glasses (Figure 6) and the second was a cigarette dispenser case (Figure 7) designed to light the cigarette automatically and dispense it from the case.

Collaborative team-based learning
The course lends itself well to individual and team-oriented project-based learning activities. One example of an activity that coincides with Chapter 3 Product Planning involved learning how to identify product development opportunities. The activity conducted during the development of products required each team to craft opportunity statements first individually and then draft a final opportunity statement. Examples of opportunity statements used by both teams appear below.

Identify Opportunities
Exercise 1 – Opportunity Statement
Based on your knowledge of your Product Realization Project, craft an opportunity statement for your product.
- Aidan – Create a light-weight LED lighting attachment for any kind of glasses suitable for different usage
- David – Create a better light-glasses combination product than what currently exists
- Mario – Create an eye glass attachment that incorporates lighting using LED technology for reading, writing, and walking around dark environments.
- Abraham – Create LED glasses that will help people look in the dark and improve visibility
Final Opportunity Statement
Create an LED eyeglass attachment device that will facilitate and improve the visibility in the dark.

Figure 6. LED Clip On for Glasses

Final Opportunity Statement

Figure 7. Automatic Cigarette Dispenser Case

Evaluation
After teaching the class two times, the student feedback received was positive. Written comments on the course evaluation conducted at the end of winter quarter 2009 included these statements:

• Great overall class - I learned to have better time management skills
• Very good class
• This class was a good learning experience to be in groups. Learned a lot of what the design process is like. Wish there was more time.
• I think this course is very helpful for the program. I like the quizzes and homework
• Course should move faster so we can make prototypes, maybe on a rapid prototyping machine
• I wanted more use of the CAD system

As far as meeting course level student learning outcomes shown below, most were achieved by students through various means including team product development activities, chapter readings and quizzes, case study team activities, student presentations and product team websites.

• Design products that are matched to user needs.
• Use design skills using both traditional and rapid visualization tools.
• Establish the design requirements, design criteria and deliverables for a product concept.
• Use tools and methods to develop a conceptual design.
• Identify the processes used for detail design.
• Prepare documentation necessary for the final design of a product including selecting components, engineering drawings, and cost estimates.
• Identify manufacturing processes to be used that are appropriate and cost effective.
• Make oral presentations as a member of a team during the product design and development process

Some of the areas that need improvement include more emphasis on generating engineering drawings, broader use of CAD visualization tools and identifying manufacturing processes to be used that are appropriate and cost effective. Motivating some student teams to work quicker and to not procrastinate on tasks will help overcome the limits of the 10-week quarter system.

Enhancements
Plans for enhancing the course currently underway include the integration of course documents, content and activities using the Moodle learning management system. Moodle will allow for better management of group activities, administration and grading of chapter quizzes, collection of assignments and keep all students notified of upcoming activities, assignments and due dates. In addition to Moodle, the campus has smart classrooms with Media Site recording that will be used to record individual and team presentations which will be archived. Presentations and lectures not recorded in the classroom will be recorded using CAMTASIA Studio 7 with a web cam and save as .wmv files. These lectures in .wmv format will be loaded on the Media Site server for streaming. Finally, ENOVIA Smarteam which is a Product Data Management (PDM) software will be integrated with the CAD software packages so students can have a place to store, share and revise all of their team’s documentation and better understand how high tech companies manage the product design and development process.

References
COE.org. CATIA Operators Exchange
Factors Affecting Electrical Conductivity of Blood Glucose Test Strips

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Introduction
As the global diabetic population expands, the need for diabetic blood monitoring equipment is naturally growing rapidly. According to the International Diabetes Federation (IDF) there are more than 250 million people worldwide who suffer from diabetes. Regular blood glucose monitoring in diabetic patients is very important, but trips to the hospital for blood glucose testing requires many complex processes, consuming much manpower and time resources, and results provided by detection through their large laboratory instruments are not immediately available, so personal home blood glucose detector provides a simple, rapid and accurate testing method so that patients during the course of their regular life activities can monitor their disease status through blood glucose detection.

The Blood glucose tester is a form of biosensor. Bio-sensors are used in the identification of biological molecules, such as: enzymes, and antibodies, to capture the materials under examination, and then convert their presence into electronic signals through the sensor processes as illustrated step by step in Figure 1. This study focuses on home blood glucose monitoring in relation to the screen printing process variables for the blood glucose test strip pieces which are most often purchased with high consumption rates, and a flowchart of this study’s investigational processes for these blood glucose test strips is shown in Figure 2.

Figure 1. Flowchart of Biosensor operational principles

<table>
<thead>
<tr>
<th>Target investigational Biomaterial awaiting detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular recognition</td>
</tr>
<tr>
<td>Bioactive</td>
</tr>
<tr>
<td>Enzyme, Antibody, Nucleic acid or Cell</td>
</tr>
<tr>
<td>Physical or chemical changes</td>
</tr>
<tr>
<td>Conversion medium</td>
</tr>
<tr>
<td>Electro-active Substance, PH, Heat, Light or Quality</td>
</tr>
<tr>
<td>Signal conversion</td>
</tr>
<tr>
<td>Detection reading</td>
</tr>
<tr>
<td>Electrode, PH Electrode, Thermal Components, Light Components or Voltage Component</td>
</tr>
<tr>
<td>Detected signal</td>
</tr>
</tbody>
</table>
In this study, a $2^3$ factorial experiment was conducted (a total of three factors, each factor was set to two factorial levels) to explore the major factors which impact resistance in blood glucose test strips.

The primary considerations of choosing a factorial design for this experiment include: (1) it was more efficient than one-factor-at-a-time experiments; (2) it was necessary because the factor interactions may be present; and (3) it allowed the effects of a factor to be estimated at two levels of the other factors, yielding conclusions that would be valid over a broad range of experimental conditions. (Montgomery, 1998, Ch.6-8-9)

**Research Objectives**

This study conducted experiments on blood glucose test via screen printing processes, to explore the relationships between conductive ink film thickness and screen mesh counts, measuring conductivity through the resistance of target blood glucose test strips, then using SPSS17.0 and Minitab14 .0 statistical software to calculate and analyze the experimental data, and identify a set of appropriate factors for a screen printing glucose test strip predictive model. The purposes of this study are as follows:

- Explore the significant factors influencing blood glucose test strip resistance values, including the relative size of the impacts and the means by which they exert their influence.
- Explore how to obtain factorial combinations to achieve the smallest blood glucose test strip resistance, and identify the optimal combination for conductivity with minimal resistance.
- Establish a regression model of factors for prediction of screen printed blood glucose test strip resistance.

**Research Framework**

This study employs the screen printing process, using 75μm PET printing substrate to examine the three major factors affecting test strip resistance, silver ink screen mesh counts, conductive silver (Ag) ink film thickness, and conductive carbon (Carbon) ink film thickness, applying multi-factor impact testing to identify significant factors in the blood glucose test strips and their respective effects and magnitude, to ascertain the optimal combination of conductivity and minimal resistance for process stability and yielding a prediction model, pursuant to the study flowchart as illustrated below (Figure 3).
Research Hypotheses

Under the same standardized processes, there exist significant effects on blood glucose test strip resistance from silver ink screen mesh counts, and from different thicknesses of the conductive silver (Ag) ink and conductive carbon (Carbon) ink. Namely:

\[ Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_1X_2 + \beta_5X_1X_3 + \beta_6X_2X_3 + \beta_7X_1X_2X_3 + E \]

Ha : \( \beta_i \neq 0 \quad i = 1, 2, 3, 4, \ldots, 7 \) (\( \beta_i \neq 0 \))

Ho : \( \beta_i = 0 \quad i = 1, 2, 3, 4, \ldots, 7 \)

(\( \alpha, \beta \) as coefficients, \( Y \) is resistance, \( X_1 \) for silver ink screen mesh counts, \( X_2 \) for conductive silver (Ag) ink variable film thickness, \( X_3 \) for conductive carbon (Carbon) ink variable film thickness, and \( E \) is a random error term.)

Methods

Research Flowchart

This study is a true experiment in nature, using 2^{3} factorial experimental design, which aims to investigate the influential factors affecting screen printing blood glucose test strips, to ascertain the optimal process combination of the three factors of silver ink screen mesh count number, conductive silver (Ag) ink film thickness and conductive carbon (Carbon) ink film thickness. The research process flowchart is illustrated in Figure 4.
Experimental Design

Experimental design relies on a $2^3$ factorial design (a total of three factors, with each factor having two levels). Three factors are: (1) Silver ink screen mesh counts ($X_1$), (2) conductive silver (Ag) ink film thickness ($X_2$), (3) conductive carbon (Carbon) ink film thickness ($X_3$). For details of the $2^3$ factorial designs, see Table 1. Each factor was divided into high and low levels ($+,-$). The experimental design provided for a total of eight different combinations, with each of the eight combinations conducted in random order as determined by the experiment processes, and each combination had a printing run of 150 samples, numbered sequentially from 1 to 150, from which we then used Systematically Random Sampling to select 50 investigational samples. Therefore, our results come from 400 measured samples.

<table>
<thead>
<tr>
<th>Combination number</th>
<th>factors</th>
<th>Run order</th>
<th>Total samples</th>
<th>Randomly selected investigational samples</th>
<th>Total investigational samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$X_1$ $X_2$ $X_3$</td>
<td>6</td>
<td>150 prints</td>
<td>50 prints</td>
<td>400 prints</td>
</tr>
<tr>
<td>2</td>
<td>$+$ $-$ $-$</td>
<td>3</td>
<td>150 prints</td>
<td>50 prints</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$-$ $+$ $-$</td>
<td>1</td>
<td>150 prints</td>
<td>50 prints</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$+$ $+$ $-$</td>
<td>7</td>
<td>150 prints</td>
<td>50 prints</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$-$ $-$ $+$</td>
<td>2</td>
<td>150 prints</td>
<td>50 prints</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>$+$ $-$ $+$</td>
<td>8</td>
<td>150 prints</td>
<td>50 prints</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>$-$ $+$ $+$</td>
<td>5</td>
<td>150 prints</td>
<td>50 prints</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>$+$ $+$ $+$</td>
<td>4</td>
<td>150 prints</td>
<td>50 prints</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor levels ($+, -$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$: variable silver ink screen mesh net mesh</td>
<td>250 lines/inch, 300 lines/inch</td>
</tr>
<tr>
<td>$X_2$: conductive silver (Ag) ink variable film thickness</td>
<td>8μm, 12μm</td>
</tr>
<tr>
<td>$X_3$: conductive carbon (Carbon) ink variable film thickness</td>
<td>12μm, 14μm</td>
</tr>
</tbody>
</table>
Experimental procedure
The experimental procedure consists of three phases: first, digital test forms are prepared for film output and plate making; second, the blood glucose test strips are screen printed, and the third stage with analyses and measurement of resistance. (As illustrated in Figure 5)

**Figure 5. Experimental steps**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The first stage (prepress)</td>
<td>Digital test form preparation, film output, screen-printing plate making</td>
</tr>
<tr>
<td>b. The second stage (printing, post-production)</td>
<td>Screen printing</td>
</tr>
<tr>
<td>c. The third phase (analysis / measurement)</td>
<td>Resistance measurement and analyses</td>
</tr>
</tbody>
</table>

- First phase (pre-press)

The first step for the prepress stage involves preparation of the digital test forms, of which there are two designed respectively for 1) the Conductive silver ink digital test form; and 2) the conductive carbon ink digital test form (see Figure 6). To design good digital test form for the conductive silver ink and conductive carbon ink, we must consider the screen printing process and provide for the variable parameter settings for the output film, and then engage in the screen preparation and plate-making processes.

**Figure 6. Digital test form designs for the conductive carbon and conductive silver inks**

- The second phase (printing, post-production)

The second stage is screen printing of the blood glucose test strips, with the blood glucose test strips structure illustrated in Figure 7. Table 2 shows the parameter setting of control variables for the printing process according to our experimental steps.

**Figure 7. Structure of the blood glucose test strips**
Table 2. Screen printing process steps

<table>
<thead>
<tr>
<th>Printing process step</th>
<th>Material</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PET substrate</td>
<td>Thickness of 0.75μm</td>
</tr>
<tr>
<td>1 Print run I</td>
<td>Conductive silver (Ag) ink</td>
<td>Drying at 120º for 15 minutes</td>
</tr>
<tr>
<td>2 Print run II</td>
<td>Conductive carbon ink</td>
<td>Drying at 120º for 5 minutes</td>
</tr>
<tr>
<td>3 Print run III</td>
<td>Conductive carbon ink</td>
<td>Drying at 120º for 5 minutes</td>
</tr>
</tbody>
</table>

• Third phase (measurement/analyses)

400 printed samples were systematically random selected and measured, using the DH-303 indicators to measure the blood glucose test strip resistance. Resistance measurement was made in a zone 0.5cm from the working electrode ends of blood glucose test strips. The data collected was analyzed using the SPSS17.0 and Minitab14.0 statistical software packages.

In this study, Factor Analysis was employed to test the construct validity of the experimental instrument through Principal Component analysis, with Eigen values set to 1. R-Square value explains the percentage of the total variance in the blood glucose test resistance contributed by the instrument. R-Square in this study was 99.11% (see Table 3), meaning all the measured values taken by the experimental instrument can collectively explain 99.11% of the total resistance variance. The results indicated that the construct validity is quite high for the DH-303 measurement instruments.

Table 3. R-Square values

<table>
<thead>
<tr>
<th>S</th>
<th>R-Sq</th>
<th>R-Sq(adj)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0247</td>
<td>99.11%</td>
<td>99.10%</td>
</tr>
</tbody>
</table>

Results

Descriptive statistics

Average measurement was taken for the 8 treatment combinations, on each of 50 samples, for averages from a total of 400 measured values. As can be seen from Table 4 the average value of the 400 samples was 7.9960: with a maximum of 9.1; and a minimum of 6.1; and a standard deviation of 0.6578; Skewness was 0.07628, with the 0.07628 lying between positive and negative 1;this means the data distribution was approximately normal. In addition, the peak state coefficient of -1.38123, being less than 3 evincing a flat broad peak, indicating that this data is effectively responsive for the overall sample.

Table 4. Typical Descriptive Statistics

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Kurtosis</th>
<th>Skewness</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance value</td>
<td>8</td>
<td>6.9</td>
<td>9.1</td>
<td>7.9960</td>
<td>-1.38123</td>
<td>0.07628</td>
<td>0.6578</td>
</tr>
</tbody>
</table>

Hypothesis testing

Using the Minitab statistical software Fit Faction Model to perform hypothesis testing, with a significant level at an α value of 0.05, we can see from Table 5, that P = 0.000 <α (significance level) = 0.05, so we reject Ho, and accept Ha, that is at least one factor has a significant impact on the test strip resistance.

Table 5. Significance levels for effects on Blood Glucose Test Strip resistivity

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Effects</td>
<td>7</td>
<td>171.124</td>
<td>24.4463</td>
<td>6265.00</td>
<td>0.000</td>
</tr>
<tr>
<td>Pure Error</td>
<td>392</td>
<td>1.530</td>
<td>0.0039</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>399</td>
<td>172.654</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Discussion

Main effects on resistivity in the blood glucose test strips

Figure 8 illustrates a plot of the main effects on the resistance of the blood glucose test strips, with the greater the slope rate representing a stronger significant effect on the blood glucose test strip resistance. The chart shows that the Silver ink screen mesh counts ($X_1$) had the maximum slope rate, yielding the greatest impact on the blood glucose test strips resistance value ($Y$).

![Main Effects Plot (data means) for Resist](image)

Table 6 provides a multi-factor analysis of resistance for the blood glucose test strips from the Effect value to determine the size of the absolute value of the factor on resistance. The silver ink screen mesh counts ($X_1$) had the greatest resistance impact (Effect value = 1.154), and the impact was positive. The table shows that each of the eight independent variables has significant effects on the resistance of blood glucose test strips.

Table 6. Factorial analysis of the blood glucose test strips’ resistance

<table>
<thead>
<tr>
<th>Term</th>
<th>Effect</th>
<th>Coef</th>
<th>SE Coef</th>
<th>T-value</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>7.9960</td>
<td>0.003123</td>
<td>2560.10</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>$X_1$ (Meshcount)</td>
<td>1.1540</td>
<td>0.5770</td>
<td>0.003123</td>
<td>184.74</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_2$ (Agft)</td>
<td>-0.5220</td>
<td>-0.2610</td>
<td>0.003123</td>
<td>-83.57</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_3$ (Cbnft)</td>
<td>0.3080</td>
<td>0.1540</td>
<td>0.003123</td>
<td>49.31</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_1X_2$ (Meshcount*Agft)</td>
<td>-0.0360</td>
<td>-0.0180</td>
<td>0.003123</td>
<td>-5.76</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_1X_3$ (Meshcount*Cbnft)</td>
<td>0.0400</td>
<td>0.0200</td>
<td>0.003123</td>
<td>6.40</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_2X_3$ (Agft*Cbnft)</td>
<td>0.0640</td>
<td>0.3200</td>
<td>0.003123</td>
<td>10.25</td>
<td>0.000</td>
</tr>
<tr>
<td>$X_1X_2X_3$ (Meshcount<em>Agft</em>Cbnft)</td>
<td>0.0720</td>
<td>0.0360</td>
<td>0.003123</td>
<td>11.53</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The most optimal combination for maximal conductivity (minimal resistance)

Figure 9 provides a cube plot for the blood glucose test strips resistance. The cube plot presents the average values of test strip resistance for the eight different combinations. The average values are labeled at each corner of the Cube. As shown in Figure 9, when the combination of (-1, 1, -1) is used, that is the silver ink Screen mesh counts ($X_1$) value of 250; conductive silver (Ag) ink film thickness ($X_2$) of 12μm; and conductive carbon (Carbon) ink film thickness ($X_3$) of 12μm, then the blood glucose test strip resistance ($Y$) is at the minimum value of 7.046.
Figure 9. Cube plot of the blood glucose test strip resistance

Forecasting model
Using Stepwise Regression analyses, this study obtains regression analysis of the blood glucose test strip resistance values. From the Coef(Coefficient) value in Table 6 we can derive a prediction model for the blood glucose test strips resistance values, as:

\[ Y = 7.996 + 0.557X_1 - 0.261X_2 + 0.154X_3 - 0.018X_1X_2 + 0.02X_1X_3 + 0.32X_2X_3 + 0.036X_1X_2X_3 \]

Therefore when the combination yielding the minimum resistance value is deployed \((-1, 1, -1)\), namely with the silver ink screen mesh counts \((X_1)\) of 250; conductive silver (Ag) ink film thickness\((X_2)\) of 12μm; conductive carbon (Carbon) ink film thickness\((X_3)\) of 12μm, the prediction model estimates a blood sugar test strip resistance value \((Y)\) of 6.788.

Conclusions
The overall results of Factorial and Regression analyses of the study, as shown in Table 7, indicate that all the eight factors, main effects and interaction effects, had significant influence on blood sugar test strip resistance (conductivity). The most optimal combination of the three factors to achieve the minimal resistance (or the maximum conductivity) is when screen mesh counts \((X_1)\) of 250, conductive silver (Ag) ink film thickness\((X_2)\) of 12μm, and conductive carbon (Carbon) ink film thickness\((X_3)\) of 12μm. In addition, the optimal prediction model of all the factors, with a high R-square value of 99.11%, is “\[ Y = 7.996 + 0.557X_1 - 0.261X_2 + 0.154X_3 - 0.018X_1X_2 + 0.02X_1X_3 + 0.32X_2X_3 + 0.036X_1X_2X_3 \]”, with a minimal estimated resistance value at 6.788

<table>
<thead>
<tr>
<th>Table 7. Overall results and findings of the study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant effects</td>
</tr>
<tr>
<td>Optimal combination for obtaining minimal resistance</td>
</tr>
<tr>
<td>Prediction model</td>
</tr>
<tr>
<td>R²(R Square)</td>
</tr>
<tr>
<td>Estimated minimal resistance value of blood sugar test strip</td>
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Acknowledgements
We wish to express our profound appreciation and gratitude for the support of the National Science Council for funding this study (Research Grant: NSC 98—2815—C—144—001-H).

References
Manufacturing
Have Technology Programs Succeeded Where Engineering Programs Have Failed?

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Abstract
Manufacturing engineering and technology was the topic of a 1969 Society of Manufacturing Engineering (SME) Forum on Manufacturing Engineering Education. The organizers were aware of the gap between design and manufacture. However, following this very little happened in academia, alas. Between 1994 and 1997, the National Science Foundation (NSF) invested $26M on major projects related directly to product realization and manufacturing in the ME curriculum. The executive summary of the American Society of Mechanical Engineers (ASME) report describing this activity stated: “Weakness in design and manufacturing capabilities is often cited as a crucial factor in the decline of this nation’s international competition.” This paper examines the thrust of contemporary Mechanical Engineering (ME) programs in relation to those of technology, as each attempts to cater for the needs of industry. A gap still exists between what ME students are taught and what manufacturing industry requires which is currently filled by technology programs. However, no opportunity is being offered for Engineering and Technology students to work together as they will be required to do on joining manufacturing industry. The paper concludes with recommendations for collaboration between Engineering and Technology programs. This paper is an updated version of a presentation made at the southeast section of the American Society of Engineering education (ASEE).

Introduction
In November 1969 The Society of Manufacturing Engineers (SME) held a Forum on Manufacturing Education, (Society of Manufacturing Engineers, 1969), at the General Motors Institute (GMI), (now Kettering University), in Flint Michigan. It specifically addressed academic programs and industry’s needs.

The important need for ‘formally trained manufacturing engineers’ had been revealed in an SME sponsored study conducted by Arthur D. Little, Inc. (Arthur D. Little Inc., 1970). The meeting convened by SME, involved six (6) distinguished speakers from industry, including such organizations as Ford Motor Co, IBM, Whirlpool, Diebold, Caterpillar, and Western Electric, and six (6) speakers from academia (Boston University, The University of Illinois at Chicago Circle, The University of Bridgeport, CT, Utah State University, and The University of Vermont). Each of these institutions possessed curricula designated Manufacturing Engineering. At that time (1969) they were the only universities in the US with curricula so designated. The second author was a member of the organizing committee of the SME meeting.

The academicians recognized several important dimensions of such programs, for example, materials, processing, computer control, management, and product development.

An important results was that many of the institutions represented there indicated that their path towards the accreditation of their programs would be best served by becoming associated with the National Association of Industrial Technology (NAIT), whereas others, (mainly drawn from Colleges of Engineering) would seek accreditation through the Accreditation Board for Engineering and Technology (ABET).

Interestingly the former NAIT has in the last year morphed into the Association for Technology, Management, and
Applied Engineering (ATMAE). Since 1969 not much has changed. Manufacturing engineering oriented programs became absorbed into Mechanical or Industrial Engineering programs as modest funding became available for research and educational development in this area, especially manufacturing systems. Otherwise the issue was forgotten.

As mentioned, one of the topics highlighted at the 1969 Forum was ‘Product Development’. In 1995 the American Society of Mechanical Engineers (ASME) published the report cited in the abstract of this paper entitled ‘Integrating the Product Realization Process (PRP) in the Undergraduate Curriculum’ (ASME, 1995), reporting on major projects related to ‘product realization and manufacture across the curriculum’. The National Science Foundation (NSF) had invested some $26m on these projects which involved collaboration amongst 35 universities and colleges, many of them major research institutions. This paper looks at what has transpired since the publication of this 1995 report by ASME, and summarizes the present situation in Mechanical Engineering as well as Technology programs.

The ‘Gap’ That Has Re-Established Itself
During the late fifties and early sixties, many manufacturers recognized the serious gap that existed between design and manufacture. The majority of manufacturing enterprises in the US declared that the “gap” was a virtually impenetrable “wall”. Quoting a prominent industrialist: “Those designers just throw the specifications of the product over the wall to us guys in manufacturing and expect us to work out the details of how to make it.” Another manufacturing-based individual referred to such designs as ‘mechanical onions’. They could not be readily manufactured but perhaps could be grown!

Indeed, the ASME report in its Executive Summary stated: “Weakness in design and manufacturing capabilities is often cited as a crucial factor in the decline of this nation’s international competition.” (ASME, 1995).

Reading the ASME report it seems that ‘model curricula’ addressing this weakness were being formulated and in some cases implemented.

It is interesting to examine what has happened since regarding these aspects of curriculum development in Mechanical Engineering, especially in the area of product design and development. Although XYZ University was proud to claim that product design was ‘alive and well’ in their (1995) ME Department, examination of their current curriculum lists no specific courses in this area, nor in the areas of materials or manufacturing processes. It is difficult to see how such topics can be bundled into a design course rather than be part of a planned design sequence.

Admittedly there have been serious external pressures on engineering educators since this time (1995). These are likely to include:

i. The ‘120’ hour syndrome
ii. The manufacturing image problem (‘Dumb, Dirty, Dangerous, and Disappearing’ (R. Shaunak personal communication, November 2009))
iii. The change taking place in the profile of the young engineering educator

Looking at each of these pressures, the curricula described in the 1969 SME Forum occupied anything between 139 and 144 credit hours. Current state legislatures, aware of the 5½ years of study accumulated by the average engineering student, have exerted external pressures to reduce such curricula to 120 hours, bringing things into line with programs in liberal arts. No doubt these political pressures were partly motivated by the concerns of their constituents whose offspring were following the engineering path.

The image problem has been with manufacturing since at least the time of the Industrial Revolution in England, exemplified by Blake’s “Satanic Mills” (Blake c. 1804-c.1811). It is perhaps partly perpetrated today by the notion ‘Let the Chinese make it, we can sell it at bargain prices!’ Those responsible for the Industrial Revolution in England were not university educated ‘gentlemen’ for the most part but more technologists than engineering scientists. Perhaps Isambard Kingdom Brunel was the last true engineer - or was he the first true engineering technologist? On the other hand, as a result of the Industrial Revolution flowering later in continental Europe
(Teich & Porter, 1996), the engineering culture involved more scientifically trained as well as widely respected individuals.

This image problem is reflected in the changing of NAIT into ATMAE to represent that technologists are not blue collar workers and that manufacturing industry is not “dumb, dirty, dangerous, nor disappearing”.

This respect has undoubtedly survived more in the minds of the public in Germany, for example it has had an effect on recruitment to engineering centered universities, which has in turn contributed to that country’s prestige across the engineering profession.

It is thus tempting to draw a parallel with a nation where engineering training is taken especially seriously and where the young engineer graduates with a broad appreciation of the science of manufacture. This approach, taken in Germany, Scandinavia, and to some degree in the Far East, involves exposure to the highly multidisciplinary aspects of that science such as the mechanical and thermal behavior of materials in processing, the analysis and design of machine tools, the associated fundamentals of metrology and tribology, topics largely ignored in many Mechanical Engineering curricula.

If one examines the overall economics of Germany and other industrial nations it is not difficult to perceive why such rigorous training has contributed to a trade balance of $278.7 billion while the US has slumped into a deficit of $815.3 billion, (The Economist, 2009). This is approximately a $1.1 trillion difference! For a breakdown of the figures for the past decade see Table 1.

Admittedly much of the US deficit is deeply related to oil imports. However, neither Germany nor Japan are blessed with such natural resources and have skillfully maintained a positive balance of trade through the export of manufactured goods ranging from machine tools to passenger vehicles. Many of the potential consequences of neglect of the above topics in the training of engineers in the US has been pointed out by a distinguished academician who has been at the cutting edge of manufacturing related research for the last forty years, (Gaynor, 1991, Altan 1992, Augustine 2009, Jarosz & Busch-Vishniac 2006, Berry, Altan, & Wyatt 2010).

The last of the three ‘pressures’ demands special attention. The necessity of the young assistant professor eager to teach advanced theoretical and computational graduate courses, to gain research support and obtain academic tenure has, over the current ‘generation’, brought into academia many who have little or no industrial experience, and indeed many with no concept of ‘how things are made’.

If one examines current research funding trends, one is tempted to question do all engineering educators need to become an expert in nanosciences, or as of now in biomedical sciences? As a result of this funding driven drift, are engineering students being short-changed? Are they going to become aware, for example, that selecting a highly automated, low cost method of producing a component by one of today’s modern casting processes is perhaps more appropriate than a forged or sintered processing route? Could a student see that the machining process they are using can drastically affect the surface finish, not just in roughness but its functionality, which is its suitability to perform the task for which it was designed? We are now going down a route that allows us to simulate everything, but unless clever experiments are undertaken to validate such simulations some of the knowledge will be drowned in a sea of algorithms.

It may be countered that the teaching of sound engineering fundamentals alone is the best preparation for today’s industry - leaving the familiarization with how to develop and economically manufacture a product to industry itself. This in turn, would be countered by industry saying that current international competition does not allow them to undertake this additional training luxury.

It would appear that the ‘gap’ or ‘wall’ between the designer/innovator and the manufacturer has been re-established! Except, perhaps, in the current case the ‘gap’ or ‘wall’ is often represented (in the US at least) by the Pacific: ‘The Chinese will work out how it’s to be made.’
The Rise of the Manufacturing Technologist

The ‘split’ that was initiated at the 1969 SME Forum between engineering and technology educators led to the technologists listening more carefully to the needs of sustainable industry. This has resulted in the growth and maturation of curricula in Industrial or Manufacturing Technology. This response has varied greatly in quality. The desertion of many Industrial and Mechanical Engineering departments of their responsibilities in the area of manufacturing, plus the apparent trend of these departments to educate engineering scientists, rather than engineers, has contributed significantly to the growth of technology programs. Furthermore this is emphasized by industry’s acceptance of individuals trained in certain of these alternative programs.

Not only are the technology students concerned fully accepted and indeed highly welcomed by industry, many such graduates often find themselves managing a group made up of engineering school trained individuals! Many Industrial Technology graduates go into industry in Industrial Engineering positions as they have a combination of the theoretical training, hands-on training, combined with management courses which make them ideal candidates for manufacturing management positions.

Finally, with respect to the better technology programs, they produce graduates who truly possess the necessary skills for manufacturing industry. However, to further improve student quality these technology programs need to align and ally themselves with their engineering counterparts. This is to ensure that the wall between design and manufacture is permanently demolished. This will lead to a cross-fertilization of ideas and curricula to produce both high quality technologists with a science background and to provide engineering students with a glimpse of manufacturing. Furthermore, this will permit them to work in “real world” teams on class and term projects. Interestingly enough the authors tried to undertake an experiment of this type where the students (both ME and Industrial Technology) had to design and build a small tilt-pour casting rig. Unfortunately, in the end the technology students went ahead and built the device, while the engineering students just drew the design that the technologists had built. It is clear that we still have a long way to go to have a truly concurrent engineering philosophy instilled in both Industrial Technology and ME departments.

However, all is not wine and roses with Technology programs. Indeed, a number of meaningful improvements must be brought about:

1. Students of Technology need to be made more appreciative of the physics underlying the many suites of process simulating software now available, without becoming expert in the writing of such code. The same is true in terms of their understanding of the analytical and computational limitations of such software.
2. They also need to be afforded the opportunity of working alongside engineering students, implementing a truly concurrent engineering approach, just as they are to work on joining industry.
3. Where possible, such programs should be housed in Engineering Colleges rather than in Colleges of Education and/or Business. Where this is not possible internships, which would allow them to meet and work with engineers in industry, would be highly desirable.
4. It is inappropriate to regard technology programs as second class. They need to be completely rid of the ‘high school’ shop image.

Conclusions

1. Mechanical Engineers have become scientists who frequently regard computer tools as the principal means of solution of manufacturing related problems. However, successful simulation requires careful validation prior to implementation. This stage at present is frequently left to the technologists as they alone possess the necessary skill sets to bring about this final highly essential implementation stage.
2. Mechanical Engineering programs appear to have handed the manufacturing tasks to technology programs as a result of the way new engineering educators are trained. For their part Mechanical Engineering professors have largely ignored manufacturing science, as has been pointed out earlier. These topics are highly multidisciplinary and require knowledge of the real practical world. Young PhD’s without any knowledge of the real world would of course rather focus on theory and on the solving of often neat but hypothetical problems that do not emulate reality. As a result, for example, the US machine tool and die making industries have seriously declined. Consequently, the best machine tools are now imported from Japan or German.
3. The image of the technologist as a second class citizen in the eyes of engineers needs to be addressed. Their role is vital if any industrialized nation is to prosper. This can only happen through a nation’s capability to
innovate, design and actually manufacture such products as machine tools for example. While the US still leads some areas such as software, biotechnology, communications, our lead in producing goods for export has eroded as a result. While among industrial countries, Germany, for example, has a trade balance of $278.7 billion while the US has slumped into a deficit of $815.3 billion, (The Economist, 2009). Germany and Japan has been able to protect living standards due their manufacturing capabilities. The US on the other hand is on the verge on lowering its living standard. Meanwhile, it has been pointed out that academics write papers and worry about increasing the ranking of their institution (Berry, Altan, & Wyatt 2010). Consequently, it seems that the world is passing us by. If the manufacturing core of an industrialized nation dies then that nation will become a third world country with simulation based engineering, some modest technology, and whole lot of people in the service industries.

4. The manufacturing profession is now firmly established in the technology camp. However, there must be an effective integration of the two disciplines by bringing together their respective students during their training. Engineering needs to learn how to communicate successfully with the manufacturing technologist. In this way the ‘wall’ between design and manufacture would eventually be demolished.

5. Finally, the quality of many technology programs must change! They must shake off the “trade school” image and become truly applied engineers.

Table 1. Balance of trade data for years 2000 and 2009 for selected industrialized nations (The Economist 2001 & 2009). Note Figures in red indicate a loss.

<table>
<thead>
<tr>
<th>Country</th>
<th>Trade Balance 2000 ($, bn)</th>
<th>Trade Balance 2009 ($, bn)</th>
<th>Difference ($, bn)</th>
<th>Average Difference per Year ($, bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>-245.00</td>
<td>-815.30</td>
<td>-570.30</td>
<td>-63.37</td>
</tr>
<tr>
<td>Germany</td>
<td>79.00</td>
<td>278.70</td>
<td>199.70</td>
<td>22.19</td>
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<tr>
<td>United Kingdom</td>
<td>-34.00</td>
<td>-178.70</td>
<td>-144.70</td>
<td>-16.08</td>
</tr>
<tr>
<td>Japan</td>
<td>122.40</td>
<td>104.80</td>
<td>-17.60</td>
<td>-1.96</td>
</tr>
<tr>
<td>France</td>
<td>26.20</td>
<td>-54.90</td>
<td>-81.10</td>
<td>-9.01</td>
</tr>
<tr>
<td>China</td>
<td>46.60</td>
<td>315.40</td>
<td>268.80</td>
<td>29.87</td>
</tr>
</tbody>
</table>

References
Altan, T. (1992, October 31). Scarce dollars should go to most profitable research”, [Letter to the editor]. The Columbus Dispatch.
Berry, J.T., Altan, T. & Wyatt J.E. (April 2010). Whatever happened to product realization? Will technology programs succeed where engineering programs have failed? American Society for Engineering Education Southeastern Section Annual Conference. April 18-20, Virginia Polytechnic Institute and State University, VA.
Measuring the Effect of Lean Implementation at a Low-Volume, High-Variety Manufacturer: A Case Study

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Introduction

Competition and increased competitive awareness of customers has forced manufacturers to continuously improve their operations. These improvements have taken several forms during the past decades including TQM, MRP, JIT, TOC, ISO 9000, Cellular Manufacturing, World Class Manufacturing and Six Sigma. The end mission of each of these programs has been relatively the same: To improve the operation and, in turn, enhance the manufacturer’s profitability.

The most recent improvement mechanism that has gained prominence is lean manufacturing. Lean manufacturing focuses on reducing unnecessary steps and simplifying the movement of materials and information, to reduce waste within the manufacturing system (Bodek 2004; Womack et al. 1990). This reduction of waste improves operational efficiency, which can provide increased opportunities for profitability and an enhanced position among the competition.

There is a widespread belief that lean implementation is beneficial. However, publications documenting these successful implementations have been focused on large-scale, mass production manufacturers (Bozzone 2002; Conner 2001); there is limited detailed documentation available to support the value of lean implementation in small-scale operations, especially in high-mix, low-volume job shop environment.

Background

Starting in the late 20th Century, the U.S. fabricated metal product manufacturers began experiencing a crisis. According to the Bureau of Labor Statistics website, fabricated metal product industry in the U.S. experienced an employment drop of 12% between 1997 and 2008. This was in spite of the fact that the domestic market for products produced by fabricated metal manufacturers was growing. Imports into the United States during the same period increased 45%, and the trade imbalance within the industry (the difference between United States exports and imports) increased by more than 500%; the trade balance in 2003 was a negative $10 billion, according to the Office of Trade and Industry Information website. The decreasing trend in employment and the increasing dollar volume of goods imported has created a driving need for change within the industry.

MECM Engineering (acronym chosen to protect the anonymity of the company), a process-oriented metal fabricator located in Minneapolis, Minnesota, was a manufacturer experiencing this crisis impacting the US. MECM Engineering understood that in order to improve their operational performance, they needed to make changes throughout their manufacturing environment.

Measurement System for Lean Manufacturing

In order to determine the impact a change process has had in an organization, a measurement system needs to be established. Lean principles are gauged by crucial measures such as faster throughput time, smaller batch sizes, reduced inventories, shorter set-up times, greater schedule stability, workforce utilization, and lower quality costs (Jina et al. 1997). The book *Lean Manufacturing: Tools, Techniques and How to Use Them* describes a lean measurement systems including space in terms of square feet utilized, work-in-process inventory, output per person, efficiency and lead time, and staff levels (Feld 2001). Measuring manufacturing productivity can be
a complex subject; however, all one needs is a set of indexes to indicate which direction productivity is moving. Simple measures, such as units produced per person, revenue generated per employee and equipment utilization, will usually suffice (Kaydos 1999).

Utilizing the information from the referenced sources and the insight of the management team at MECM Engineering, eight manufacturing metrics, categorized into three divisions, were established to gauge the impact of lean manufacturing in this study: Financial (gross profit and value added per square foot of manufacturing floor space), operational (material scrap rate, value added per employee, and running hours as a percentage of staffed hours), and material management (inventory turnover rate, on-time delivery, and set-up hours as a percentage of staffed hours). This study then quantified results by comparing three months of performance data prior to lean implementation with three months of data following the implementation; all measures collected for this study have been normalized to the beginning month of the research by utilizing the Producer Price Index (PPI).

**Gross profit.** This metric is defined as a company’s sales less their cost of goods sold. It has been expressed as a percentage of sales (Sánchez and Pérez 2001). An increase in gross profit would indicate improvement, that the company had reduced their cost of goods (Shah and Ward 2003), thus increasing the gross profit.

**Inventory turnover rate.** This is expressed as the cost of goods sold divided by the total inventory level during the time period being investigated (Arnold and Chapman 2001). An increase in the inventory turnover rate reflects improved efficiency of inventory management, which results in a cost reduction of inventory and increased profitability (Sánchez and Pérez 2001).

**Material scrap rate.** The labor, material and overhead consumed by a defective product, which cannot be economically repaired, is referred to as material scrap rate (Gryna 2001; Sánchez and Pérez 2001). This rate is expressed as a percent and determined by dividing the cost of scrapped material by the cost of goods sold. A reduction in the material scrap rate results in decreased costs, which should lead to higher profitability (Shah and Ward 2003).

**Value-added per employee.** The value each full time equivalent employee has produced is called value-added per employee. This is determined by dividing the gross profit at the end of a given month by the number of full time equivalent employees during a specific period of time. An improvement in this measure would result from each full time equivalent employee producing an increased amount of value.

**Value-added per square foot of manufacturing floor space.** The value produced within each square foot of plant space is called value-added per square foot of manufacturing floor space. This was determined by dividing the gross profit by square footage of manufacturing space utilized during a specific period of time. An improvement in this measure would result from improved utilization of the manufacturing plant.

**On-time delivery.** The measurement of on-time delivery determines how often customers are served within the time frame promised. This metric is calculated by dividing the number of orders shipped on the date promised by the total number of orders processed within a given period. An increase in on-time delivery indicates that customers are being better served and that the business is more focused on market requirements.

**Set-up hours.** Set-up hours refer to the amount of time required to change a process or machine from the production of one item to the production of another item (Sánchez and Pérez 2001). This may include the changing of tools, position, paint color or material (Womack and Jones 1996). Set-up hours are measured as a percentage of staffed hours. Improving this measure is the result of reducing the time required to changeover a process, with the ultimate objective to eliminate set-up hours completely. To normalize the set-up measures, the set-up hours have been measured per employee and per number of orders processed.

**Running hours.** Running hours are the amount of time the equipment was processing in comparison to the amount of paid labor during that same period. Running hours are calculated by dividing machine running hours by paid personnel hours during a specific period of time. Increasing running hours reflects effective use of corporate resources by having the processing equipment operating efficiently.
Internal validity of the measurements has been accounted for by assuring that MECM Engineering has not undergone any other process improvement programs, management changes, key employee loss, or additional new technology implemented into the business during the time frame of this research.

Data Collection and Normalization
The data for this research was collected directly from the MECM Engineering accounting database. The metrics used to calculate the eight operational measurements were taken from MECM Engineering’s database and entered into a spreadsheet developed for this research (Table 1). The information for this study was collected from three months prior to lean transformation to three months following the completion of lean training and process improvements.

<table>
<thead>
<tr>
<th>Titles/Dates</th>
<th>3 months before lean</th>
<th>2 months before lean</th>
<th>1 month before lean</th>
<th>1 month after lean</th>
<th>2 months after lean</th>
<th>3 months after lean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Good Sold</td>
<td>$309,054</td>
<td>$278,431</td>
<td>$249,315</td>
<td>$265,281</td>
<td>$233,544</td>
<td>$211,614</td>
</tr>
<tr>
<td>Total Inventory</td>
<td>$477,182</td>
<td>$401,713</td>
<td>$367,359</td>
<td>$448,049</td>
<td>$448,089</td>
<td>$492,466</td>
</tr>
<tr>
<td>Cost of Scrapped Material</td>
<td>$2,214</td>
<td>$2,354</td>
<td>$3,020</td>
<td>$5,631</td>
<td>$4,807</td>
<td>$5,071</td>
</tr>
<tr>
<td>Orders Shipped on Time</td>
<td>298</td>
<td>260</td>
<td>213</td>
<td>214</td>
<td>232</td>
<td>204</td>
</tr>
<tr>
<td>Total Number of Orders</td>
<td>318</td>
<td>271</td>
<td>249</td>
<td>239</td>
<td>261</td>
<td>236</td>
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<tr>
<td>Hours Spent on Set-up</td>
<td>346</td>
<td>324</td>
<td>282</td>
<td>344</td>
<td>209</td>
<td>455</td>
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<tr>
<td>Personnel Hours</td>
<td>3732</td>
<td>3529</td>
<td>3556</td>
<td>3677</td>
<td>3869</td>
<td>3853</td>
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<td>Machine Hours</td>
<td>4649</td>
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<td>5035</td>
<td>5373</td>
<td>5342</td>
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<td>Number of Employees</td>
<td>23</td>
<td>25</td>
<td>27</td>
<td>27</td>
<td>26</td>
<td>26</td>
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<tr>
<td>Sales Dollars</td>
<td>$325,570</td>
<td>$342,768</td>
<td>$301,272</td>
<td>$399,040</td>
<td>$313,515</td>
<td>$269,473</td>
</tr>
<tr>
<td>Plant Square Footage</td>
<td>30720</td>
<td>30720</td>
<td>30720</td>
<td>27620</td>
<td>27620</td>
<td>27620</td>
</tr>
<tr>
<td>Producers Price Index</td>
<td>133.1</td>
<td>133.3</td>
<td>133.7</td>
<td>148.2</td>
<td>148.6</td>
<td>149.1</td>
</tr>
<tr>
<td>Producers Price Index for Commodities</td>
<td>130.2</td>
<td>131.4</td>
<td>133.1</td>
<td>160.5</td>
<td>160.4</td>
<td>161.1</td>
</tr>
</tbody>
</table>

The data collected from MECM Engineering spanned 21 months. Due to changes in economic conditions during this time, the financial data collected needed to be normalized in order to allow for direct comparison and further analysis. The eight measures were each calculated and normalized in the data analysis sheet (Table 2).
### Table 2. Calculations of the Operational Metrics Prior To and Following Lean Implementation

<table>
<thead>
<tr>
<th>Titles/Dates</th>
<th>3 months before lean</th>
<th>2 months before lean</th>
<th>1 month before lean</th>
<th>1 month after lean</th>
<th>2 months after lean</th>
<th>3 months after lean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Profit</td>
<td>$16,516</td>
<td>$64,240</td>
<td>$51,724</td>
<td>$120,130</td>
<td>$71,629</td>
<td>$51,650</td>
</tr>
<tr>
<td>Gross Profit as a Percentage of Sales</td>
<td>5.07%</td>
<td>18.77%</td>
<td>17.25%</td>
<td>33.52%</td>
<td>25.51%</td>
<td>21.47%</td>
</tr>
<tr>
<td>Inventory Turnover Rate</td>
<td>.69</td>
<td>.70</td>
<td>.69</td>
<td>.66</td>
<td>.58</td>
<td>.47</td>
</tr>
<tr>
<td>Scrap Rate</td>
<td>.007</td>
<td>.008</td>
<td>.012</td>
<td>.024</td>
<td>.023</td>
<td>.027</td>
</tr>
<tr>
<td>Value Added per Employee</td>
<td>$718</td>
<td>$2,570</td>
<td>$1,916</td>
<td>$4,449</td>
<td>$2,755</td>
<td>$1,987</td>
</tr>
<tr>
<td>Value Added per Square Foot</td>
<td>$0.54</td>
<td>$2.09</td>
<td>$1.68</td>
<td>$4.35</td>
<td>$2.59</td>
<td>$1.87</td>
</tr>
<tr>
<td>On-time Delivery</td>
<td>94%</td>
<td>96%</td>
<td>86%</td>
<td>90%</td>
<td>89%</td>
<td>86%</td>
</tr>
<tr>
<td>Set-up Hours as a Percentage of Personnel Hours by Number of Orders</td>
<td>.029%</td>
<td>.034%</td>
<td>.032%</td>
<td>.039%</td>
<td>.041%</td>
<td>.050%</td>
</tr>
<tr>
<td>Set-up Percentage by Total Number of Orders by Number of Employees</td>
<td>.0013%</td>
<td>.0014%</td>
<td>.0012%</td>
<td>.0014%</td>
<td>.0016%</td>
<td>.0019%</td>
</tr>
<tr>
<td>Running Hours as a Percentage of Personnel Hours</td>
<td>124.57%</td>
<td>132.81%</td>
<td>121.43%</td>
<td>136.93%</td>
<td>138.87%</td>
<td>138.65%</td>
</tr>
</tbody>
</table>

### Discussion

The eight operational metrics that were measured indicated improvement in some areas and a decrease in performance in others. Although all the results were not positive within the time frame of this study, the positive results received this quickly were encouraging. Lean manufacturing is not a quick fix program and companies can often see some surface set-backs prior to improvements (Womack and Jones 1996; Lane 2007). The fact that Toyota has been developing and refining the Toyota Production System, the basis for lean manufacturing, since World War II indicates that the conversion to lean manufacturing is a continual process requiring long-term vision (Liker and Hoseus 2008). MECM Engineering has just begun this journey.

**Financial measures.** Two of the measures are financially driven (gross profit and value added per square foot of manufacturing floor space). The expectation is that lean implementation would improve the financial measures of the organization, increasing gross profit and providing improvement in the value-added per square foot of manufacturing floor space; the results supported this.

Financial improvements were recognized due to the reduction in the cost of goods sold. This measure decreased due to a reduction in the manufacturing costs at MECM Engineering. The cost of goods sold as a percentage of sales dollars prior to lean manufacturing averaged 86%, and following the implementation, the average cost of goods sold as a percentage of sales reduced to 73%. The reduction in manufacturing costs is a result of improved work methods and equipment utilization that was realized through the development of work cells. Improvement in the value-added per square foot of manufacturing floor space was due in part to the improvement in gross profit. This measure also benefited from the reduction in plant square footage requirements. The plant required 3,100 fewer square feet following lean implementation, a reduction of 10%. This reduction is due to the implementation of improved work flow, the development of work cells, and the implementation of 5-S workplace organization.

**Operational measures.** Three measures are categorized as operational (scrap rate, value-added per employee, and running hours) because they are heavily influenced by the day-to-day operational management decisions. Out of these operational measures, value-added per employee and running hours showed improvement, while scrap rate experienced a decrease in performance.
The increased scrap rate was due to an improvement in the quality of product passed on to MECM's customers, a key point in lean implementation. In the case of MECM Engineering, they invested in quality education, training employees on customer expectations. The result was that more defective parts were identified within their operation, driving up the scrap rate. Customer quality may have increased, moving defective parts from external identification to internal identification, which would be a desired improvement.

Value-added per employee and running hours each yielded expected results. The improvement in running hours following the lean implementation is a result of work cell development, which allowed production personnel to operate machines simultaneously while spending less time transporting material between machines.

**Material management measures.** The material management category includes inventory turnover rate, on-time delivery and set-up hours as a percentage of staffed hours. Each of these measures is influenced by scheduling and material flow into and out of the business, which falls under the control of material management. The expected results were that the inventory turnover rates would improve, the time spent on set-up would be reduced, and on-time delivery would increase following the implementation of lean manufacturing. However, each of these performance measures moved in the opposite direction predicted.

Inventory turnover was measured by dividing the cost of goods sold by the inventory level during a given period. The average inventory during the course of this research did decrease. During the three periods prior to the implementation, the average level of inventory was $401,527, and for the three periods following, the average was $375,065 (all values normalized to three months prior to lean implementation), a decrease of 6.6%. However, as discussed previously, the cost of goods sold decreased as well. Also, the productivity in terms of running hours increased, resulting in employees producing more products per scheduled hour following the implementation. The reduction of average inventory was not great enough to offset the impact of these other two measures; the increase in productivity and the decrease in cost of goods sold caused the inventory turnover rate to decrease.

The percentage of orders shipped on time decreased 4% following the implementation countering expectations of an increase. In this case, the production capability increased, which should have allowed for additional orders to be processed in a timely fashion. Along with this, newly developed work cells provided an improved flow of material through the production area. Both of these should have resulted in decreased time required to manufacture a product and thus improve on-time delivery, yet that was not the result. A possible cause of the decrease in on-time performance is the number of priorities placed on MECM Engineering's support staff. This small group of people has been responsible for the continued operation of the plant, while at the same time re-engineering the operation to reflect lean manufacturing practices. These multiple priorities may have been beyond the capacity of the small number of staff.

The amount of time spent on set-up activities, increased following lean manufacturing implementation. This study did not measure specific set-up times at various machines within the operation, but rather the total time spent on set-up. Ironically, the resulting increase in total set-up time was due to the decrease in individual set-up times of the processing equipment. The implementation of the work cells, dedicating specific equipment to process particular components, and work on tool organization through 5-S, did have a positive impact on reducing the individual process set-up time. The lower set-up times provided the economical ability for set-ups to be done more frequently. Doing set-ups more often benefits MECM Engineering by allowing smaller volume orders to be processed, and orders to be processed more often. Ideally, both set-up times of individual processing equipment and the total time spent on set-up would indicate reduction; however, this has not yet been achieved.

**Implications**

The results of this research have both theoretical and practical implications. With the findings in this study, there is a definite indication that research on lean manufacturing is a continued need in multiple types of manufacturing settings. The positive findings indicate that lean manufacturing is definitely worth exploring further in low production, low volume companies, yet the mixed results indicate that these types of companies have different concerns which need to be explored further. One of these concerns noted earlier that is specific to smaller organizations was that of limited personnel performing multiple functions and how it may affect long-term success. Smaller firms may also have more of a personal relationship with their clients which may result in
more improved customer value, reducing internal value findings at first. Thus, this study has noted that there are
definite benefits for lean manufacturing in a different type of setting, yet when and how these benefits occur is
an open avenue for researchers to explore further.

Other practical implications are the labor capacity considerations that lower volume producers need to take
into consideration when putting lean production into place. Liker and Hoseus (2008) has pointed out that a
strong “human system” is the key ingredient to long-term competitiveness, which is the ultimate goal of lean
implementation. If individuals are responsible for a variety of tasks, in addition to taking on responsibility for
lean implementation, management may need to consider reassigning some of these tasks. This would allow a
more concentrated effort for lean implementation to occur. The overall implication of this study is of course that
lean manufacturing can definitely be successful, but that this success can take effect in different forms than in
the larger manufacturing firms, and different implementation concerns need to be taken into consideration.

References
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Company.
Understanding the Need for Lean Training for Students in Technology-Based Undergraduate Programs

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Background of Lean Manufacturing
Manufacturers have been forced, through competition and the increased competitive awareness of their customers, to continuously improve their operations. These improvements have taken different forms during the past twenty years. Manufacturing Resource Planning, Just-in-Time Manufacturing, Total Quality Management, Theory of Constraints, ISO 9000, Cellular Manufacturing, World Class Manufacturing and Six Sigma are some of the more popular implementation strategies companies have adopted. However, the end mission of each of these programs has been relatively the same: to improve the operation and in turn to enhance the manufacturer’s profitability.

Lean manufacturing is a current manufacturing strategy that has gained prominence and has been shown to deliver results. Lean is a war against waste of both manufacturing inefficiencies and underutilization of people (Bodek, 2004).

Lean manufacturing, as it is generally understood today, was developed and implemented in Japan during the 1950s with the development of the Toyota Production System (Ohno, 1988). Although some aspects of lean had been reported by some authors such as Hall (1983) and Schonberger (1982), it was brought to light in the United States with the book *The Machine That Changed the World*, which popularized the terms “lean production” and “lean manufacturing” (Womack, Jones & Roos, 1990). During the past two decades, many manufacturers have implemented lean manufacturing as their primary source of process improvement.

Lean manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste (Likert, 1997; Lee & Allwood, 2003). Lean is focused on meeting customer requirements -- it starts and ends with customer service (Bodek, 2004). The objective is to increase the value-added work by eliminating waste and reducing unnecessary tasks.

Definition of Lean Manufacturing
Womack et al. (1990) define lean in terms of a manufacturing operation to represent a system that utilizes fewer inputs to create the same or more outputs than those created by a traditional mass production system, while increasing the range and type of goods offered to customers. The benefits of lean manufacturing are generally lower costs, higher quality, and shorter lead times (Likert, 1997). Lean is a process, implementing change and continuous improvement to develop leaner operations. Hines, Holweg & Rich (2004) indicate that lean is one of the most influential paradigms in manufacturing, providing improvement beyond the original focus, which was on heavy industrial shop floors, to improving the entire business operation.

The objective of lean is to improve manufacturing operations, increase productivity, reduce lead time to customers, and reduce costs and improve quality (Sanchez & Perez, 2001). These improvements are achieved by improving product flow, eliminating non-value-added activities, shortening manufacturing lead times, and establishing a process of continuous improvement (Labow, 1999). Simply put, lean manufacturing is about doing more, adding more value to products, improving customer satisfaction and generating additional income while utilizing fewer resources.
Origins of Lean Manufacturing

Henry Ford, of the Ford Motor Company, and Alfred Sloan, of General Motors, moved manufacturing from a craft industry to a model of mass production in the early part of the twentieth century. In the mid-twentieth century, the Japanese manufacturer Toyota developed an improved production technique known as the Toyota Production System that has now come to be known as lean manufacturing (Womack & Jones, 1996). Henry Ford developed the auto industry during its infancy. His focus was on manufacturing excellence, which led to the development of mass production as a cost reduction strategy. The mass production model that was popularized in the automobile industry during the 1920s was quickly adapted in nearly every industrial sector in North America and Europe (Womack et al., 1990). Mass production was developed as a result of Henry Ford’s effort to create true efficiency, developing and using the best methods possible, leading to the assembly line model of manufacturing (Ford, 1926).

Following World War II, the Japanese industrial base needed to redevelop itself. It had been decimated by the war efforts and its productivity was far behind the United States. Toyota identified their mission to catch up with American productivity within three years. At that time, American manufacturers were nine times more productive than their Japanese counterparts (Ohno, 1988). Taiichi Ohno is credited with developing the Toyota Production System, which focused on waste reduction and was the genesis of lean manufacturing. Using waste reduction as the tool to lessen the productivity gap between Japan and the United States, Toyota developed many of the techniques that are now associated with lean manufacturing.

Toyota did not have the resources or market share that Ford enjoyed, so they needed to develop tools to provide them with a competitive advantage. The techniques and tools Toyota developed have become synonymous with lean manufacturing: kanban, methods for pull scheduling, mistake proofing, just-in-time inventory delivery, asking why five times for problem solving, and kaizen for process improvement. Each of these focuses on waste elimination and represents an alternative model to capital-intensive mass production (Hines et al., 2004). In the period between World War II and the 1970s, these new changes allowed Toyota and other Japanese manufacturers to make great strides in their manufacturing productivity. Soon, the United States was facing tough competition from Asian manufacturers (Hall, 1987). Productivity increased in Japan at a rate 400 percent higher than the United States over the postwar years (Ouchi, 1981).

In 1986, Toyota, working in conjunction with General Motors, re-opened an assembly plant in Fremont, California utilizing the Toyota lean principles. The Fremont plant immediately showed the auto industry the difference Toyota techniques could deliver, such as improved productivity, reduction of defective production and reduced inventory (Womack et al., 1990). Ten years following the Japanese publication date, Toyota Production System was translated and republished in the United States, popularizing the Toyota management tools with United States manufacturers. Following this, The Machine That Changed the World was published in 1990, introducing the term “lean”:

"Lean production (a term coined by IMVP researcher John Krafcik) is “lean” because it uses less of everything compared with mass production -- half the human effort in the factory and half the engineering hours to develop a new product in half the time. Also it requires keeping far less than half the needed inventory on site, results in many fewer defects and produces a greater and ever growing variety of products. (p. 13)"

Need for Lean Training

Lean manufacturing is implemented in an attempt to reduce unnecessary steps and simplify the movement of materials and information, expecting to reduce waste within the manufacturing system. This reduction of waste improves operational efficiency, which converts into increased opportunities for profitability and an enhanced position among the competition.

A survey conducted in July 2003 by DemandStream, a leading supplier of enterprise automation software, indicated American corporations are rapidly adopting lean manufacturing principles in order to insure global success. The study involved approximately 280 manufacturers and indicated that 40% of U.S. manufacturers described lean manufacturing as their primary business strategy. Additionally, the survey stated that 60% have
adopted or have taken steps to adopt “continuous flow production” practices in their factories, where machines and operators handle uninterrupted flow of material at a given rate (Society of Manufacturing Engineering, n.d.).

Graduates in engineering and technology disciplines will in most cases be employed by manufacturing companies that utilize lean techniques to improve their operations. Providing a course that is dedicated to exploring and practicing lean tools will provide students with a unique set of skills to offer future employers.

The graduates of University of Wisconsin Stout in business, engineering and technology disciplines were recently surveyed to identify their primary operational strategy. The results indicated that the majority of them were using lean as their principal strategy to improve their operations and thus reduce operational costs. Employers are in a mode of cost management, hiring reduction and are experiencing increased competition. This has lead employers to be all the more selective in their hiring practices. Understanding which operational tools potential employers are using provides an opportunity for higher educational programs to tailor their curriculum to best meet employers’ needs. This will provide students with a competitive advantage as they enter the job market.

Development of the Lean Enterprise Course

The Manufacturing Extension Partnership (MEP) is a nationwide network of not-for-profit centers whose purpose is to provide small and medium sized manufacturers with access to technology for improved productivity. The National Institute of Standards and Technology (NIST) created MEP to serve as regional centers for technology transfer of manufacturing knowledge, with the objective of enhancing manufacturing productivity and technological performance in the United States (Manufacturing Extension Partnership, n.d.).

The Manufacturing Extension Partnership offers a variety of services to manufacturers that allow them to evaluate and implement manufacturing improvement processes. The primary services offered are: environmental friendly manufacturing, growth planning, lean manufacturing, measurement systems, nanotechnology, radio frequency identification, strategic management and quality systems management. The lean manufacturing services offered through MEP focus on producing more with existing resources by elimination of non-value-added activities and creating flow throughout the entire company (Manufacturing Extension Partnership, n.d.).

The Northwest Wisconsin Manufacturing Outreach Center (NWMOC), which is the MEP office serving northwestern Wisconsin, has recently developed a successful lean program to provide the training and consultation required for companies to begin their lean transformation. This training program and the associated lean-flow certification program NWMOC offers is the genesis for the lean enterprise course developed for students in the Technology and Engineering fields at UW-Stout. The outline of the NWMOC program is as follows:

1. Established a lean manufacturing implementation team
2. Trained the team members in the principles of lean manufacturing
3. Defined product families for process grouping and work center development
4. Chose a project within the manufacturing process to begin the lean implementation
5. Established goals and benchmarked present metrics

Furthermore, the course development has made use of the five primary elements of lean manufacturing: specifying value, identifying the value stream, flow, pull, and perfection (Womack & Jones, 1996). Specifying value refers to knowing what the customer values in the products they purchase. Value is a product related measure. Value is defined as the activities the customer pays for willingly, because it is truly necessary to solve the problem or required to produce the product (Womack & Jones, 2005). How the product performs, what the product costs, how the product is delivered and how the product is serviced are a few points that may define the value of a product. The value stream is defined by Womack and Jones (1996) as the set of actions required to bring a product through the physical transformations from materials into a salable product. In other words, the value stream is the series of activities or processes supporting the daily production needs of the organization.

The crucial element of lean manufacturing is value. Value is defined by the customer. It is expressed in terms of a product that meets the customer’s needs at a specific price and a specific time (Womack & Jones, 1996). Manufacturing has two types of operations, those that add value and those that do not. In the past, using traditional thinking, manufacturers have focused on improving the value-added operations, while allowing the
non-value-added operations to continue to exist (Conner, 2001). Lean manufacturing turns this traditional thinking around and focuses on the elimination of wasteful non-value-added operations, resulting in improved value for customers (Sahin, 2000). Non-value-added operations are waste. Waste can be found in excess motion or transportation, excess production, production of defective parts, and underutilization of abilities. Waste includes items the customer neither wants nor expects to pay for (Bodek, 2002).

**Lean Enterprise Course Objectives**

The objective of this new course is to provide students the ability to function as a leader with in a lean environment through the understanding and practice of the philosophy, process, people and problem solving systems utilized within a lean enterprise. Upon completion students will be able to:

- investigate the systematic differences between mass production and lean techniques
- develop a value stream
- analyze 5s systems for work place organization
- develop quick changeover and set-up reduction techniques
- determine lean strategy and justify specific projects
- organize project teams
- apply leadership and communication skills to lean management
- develop Kaizen activities
- identify and calculate Takt time
- analyze the benefits of flow processes
- develop pull systems for replenishment

**Summary**

Due to the need to support operations objectives to reduce costs and improve value to customer’s experience companies are implementing lean tools at an increasing rate. To provide relevant and timely education related to the principles and use of these lean tools undergraduate as well as graduate students need to be exposed to lean training prior to leaving campus. This training will likely provide these students with a competitive advantage as they enter the increasingly competitive job market.

**References**


Safety
Bridging the Gulf with Hearing Protection: A Classroom Study on the Effectiveness of Alternatives to Commercial Hearing Protection

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Introduction
Most people wear hearing protection improperly, if it is worn at all. What can be done if hearing protection is not available? How effective is a simple wad of tissue? What about holding your fingers in your ears or cupping your hands over your ears? The purpose of this study is to experimentally compare sound attenuation using foam earplugs, a wad of tissue, a finger, and a cupped hand for hearing protection. The various frequencies used to measure the attenuation will all be at 95 decibels (dB).

Terminology
• Attenuation: The reduction of energy, e.g., sound (Martin & Clark, 2003, p. 428).
• Frequency (Hz): The rate of a sound wave’s periodic fluctuations which occur per unit of time, usually specified as one second. The unit is called Hertz, abbreviated Hz.
• Decibel (dB): A unit of measurement used in measuring the relative intensity of sound (Turkington, 2000, p. 65), or a unit expressing the ratio between two sound pressures (Martin & Clark, 2003, p. 430).
• Hearing Protection Device (HPD): A device used to reduce noise exposure in individuals.
• Noise Reduction Rating (NRR): measurement, in decibels, of how well a hearing protector reduces noise as specified by the Environmental Protection Agency (Cooper n.d.).
• Sound Pressure Level (SPL): The sound intensity measured in a logarithmic decibel scale (Rabinowitz, 2000).

Review of Literature
There are two main methods for reducing hearing loss from noise. The first and most desirable way is to avoid loud noises. This can be accomplished by staying in quiet areas, which is not always possible, or by making noisy areas quieter through the engineering of quieter equipment and work areas which is often impractical or too expensive (Sataloff, & Sataloff, 1993). Wearing hearing protection is the other option to prevent hearing loss.

Hearing protection devices (HPD) come in two main types, the insert type such as earplugs, and the type that fit over the ear such as earmuffs (Newby & Popelka, 1985, p. 340). To be effective HPDs need to be worn properly. Insert HPDs must have an airtight seal in the ear canal, and external HPDs must have an airtight seal around the ear. Air leaks can typically reduce attenuation by five to fifteen dB (Berger, 1996). Extensive testing has been done on the effectiveness of HPDs, but except for the mention of using dry cotton (1985) as a protective device which “is almost useless” (p. 343), no literature was found on studies that tested or gave the effectiveness of using a wad of tissue, a finger, or a cupped hand, which are alternatives if other HPDs are not available. The attenuation rating or noise reduction rating (NRR) required by The Occupational Safety and Health Administration (OSHA) of most HPDs, are done in controlled laboratory settings. When tested in real world settings the attenuation value is considerably lower (Hager, 2003; Toppila, 1998).
Human hearing is limited to a certain frequency range. This range varies from person to person. The average audible frequency range for a normal young adult is between 20 to 20,000 Hertz (Hz). The most sensitive frequencies are between 500 and 8000 Hz. Frequencies above 8000 Hz and below 500 Hz require more intensity to be perceived (Newby & Popelka, 1985, p. 10). Noise induced hearing loss begins at higher frequencies, generally around 3000 Hz to 6000 Hz (Rabinowitz, 2000).

Hearing loss is affected by exposure time and sound intensity measured in decibels (dB). OSHA has established criteria for the mandatory wearing of hearing protection. These limits are based on an average exposure during a 24-hour period. Eight hours at 90 dB, six hours at 92 dB, 4 hours at 95 dB, 3 hours at 97 dB, 2 hours at 100 dB, 1 ½ hours at 102 dB, ½ hour at 110 dB, and ¼ hour at 115 dB (U.S. Department of Labor, n.d.). Exposure to impulsive or impact noises, such as gunfire or fireworks, should not exceed 140 dB without some form of HPD. Brief periods of unprotected time can have serious implications on hearing, so wearing HPD at all times is essential for the prevention of hearing loss (Hager, 2003).

Sound is created when some force vibrates an object and that vibration causes the molecules in the surrounding medium to move in a wave pattern. When the sound waves reach the human ear, sound is heard. Sound waves can be affected by the medium of transfer, for example, sound travels slower through air than water or some solids like steel. Sound loses energy and becomes weaker as it travels further from the source. Waves can reach the ear through air conduction or bone conduction in the head. Sound can also be reflected from hard, nonconductive surfaces to cause an echo. Certain materials like foam rubber can absorb sound. Sound can be refracted or bent. This is usually observed when there is a temperature change in the medium the sound is traveling in, for example, sound travels faster in warmer air than cooler air. Sound can also be diffracted, meaning it can move around corners. Low frequencies will diffract more than higher frequencies (Newby & Popelka, 1985, pp. 5-30).

A frequency generator was used to produce the sound frequencies in this experiment so that various frequencies could be used. Then the frequencies were amplified and converted to sound energy through a speaker. The speaker is placed close to the ear to prevent loss of power and to avoid reflection.

Purpose Statement
The purposes of this study were to: 1) Select hearing protection for comparison on their meeting any sound attenuation, 2) Devise a method to test the hearing protection devices (HPD), 3) Select a decibel (dB) level to be used for each frequency measured, and 4) Select the various frequencies to measure the attenuation.

Pilot Study
A preliminary study was performed to test the equipment and the test mannequin. The test mannequin was assembled using seven pieces of half inch Baltic birch plywood cut at sizes and angles to make the rough shape and size of a normal human head. (See Illustration 1)
Measuring some adult heads with calipers and averaging the measurements determined head measurement. A model silicon ear (See illustration 2) was obtained from an audiologist and mounted in the side of the mannequin head in the position of a normal ear.

Illustration 2

A signal generator was used to produce the desired frequencies. This was connected to an amplifier with a speaker to produce the sound pressure level (SPL) at 95 dB.

A sound level meter was set on a block of wood inside the mannequin with the microphone level with the ear hole. It was set back 7/8 of an inch from the ear canal opening, replicating the average distance of the eardrum from the ear canal opening. The speaker was set on the outside of the ear a total of six inches from the meter microphone. The equipment was turned on and the SPL was set at 95 dB which is the control variable for each measured frequency. A clear cover was placed over the top of the mannequin to provide an easy view of the meter.

As the various hearing protection methods were tested at each frequency, it was observed that there was little or no attenuation for each HPD. It was determined that too much sound was reaching the meter through the air and the wood support under the meter. To eliminate this problem, pieces of two-inch thick foam rubber were cut to fit inside the mannequin to support the meter. Other pieces were placed around the meter so only a small area representing the ear canal would be present. The back end of the meter was left exposed so the meter could be read. This change provided the meter with the isolation needed to show a difference in attenuation for each measurement.

Variables and Control
Control variable: The sound frequencies generated were set at 95 dB when measured through the ear with no protection.

Dependant variables: The sound attenuation measured from 95dB at various frequencies using the various hearing protection methods.

Independent variables:
- Aearo EAR Classic foam earplug (NRR 29 dB).
- Aearo EAR Classic foam earplug with cupped hand.
- Two-inch square tissue paper rolled in a wad.
- Two-inch square tissue paper rolled in a wad with cupped hand.
- Index finger
- Cupped hand
- Frequencies generated for each round of tests: 50 Hz, 100 Hz, 200 Hz, 400 Hz, 600 Hz, 800 Hz, 1000 Hz, 1200 Hz, 1400 Hz, 1800 Hz, 2000 Hz, 4000 Hz, 6000 Hz, 8000 Hz, 10000 Hz, and 12000 Hz.
Methodology
This experiment was conducted in the steps as follows:
1. Gather the equipment and materials
   a. Frequency generator, amplifier with speaker, and sound level meter.
   b. Foam earplugs and tissue torn in two-inch squares and waded up.
   c. Plywood mannequin with silicon ear.
2. Equipment set up.
   a. The sound level meter was set on the foam rubber, with the microphone 7/8 of an inch from the opening of the ear canal inside the mannequin. The meter was turned on and covered with a layer of foam.
   b. The speaker/amplifier was set six inches from the microphone on the outside of the mannequin. The speaker was set on pieces of foam to help prevent any sound conduction through the table.
   c. The position of the amplifier and mannequin was marked, so as the mannequin was moved each time one HPD was removed and another inserted, they would be in exactly the same position.
   d. The frequency generator was connected to the amplifier.
3. The experiment.
   a. The frequency was set at 50 Hz.
   b. The amplifier was adjusted to produce a SPL of 95 dB reading on the sound level meter in the mannequin without a HPD.
   c. A foam HPD (FP) was inserted into the ear.
   d. The decibel reading was taken from the meter and recorded.
   e. A cupped hand was held over the ear with slight pressure to the mannequin.
   f. The decibel reading was taken from the meter and recorded.
   g. The foam HPD (FP) was removed from the ear.
   h. A wad of tissue was inserted into the ear.
   i. The decibel reading was taken from the meter and recorded.
   j. A cupped hand was held over the ear with slight pressure to the mannequin.
   k. The decibel reading was taken from the meter and recorded.
   l. The wad of tissue was removed from the ear.
   m. A finger was inserted into the ear.
   n. The decibel reading was taken from the meter and recorded.
   o. The finger was removed from the ear.
   p. A cupped hand was placed over the ear.
   q. The decibel reading was taken from the meter and recorded.
   r. Set the frequency at 100 Hz.
   s. Repeat steps b. through q.
   t. Continue test through the rest of the frequencies: 200 Hz, 400 Hz, 600 Hz, 800 Hz, 1000 Hz, 1200 Hz, 1400 Hz, 1800 Hz, 2000 Hz, 4000 Hz, 6000 Hz, 8000 Hz, 10000 Hz, and 12000 Hz.
   u. Repeat tests once more to verify results.

Findings
The results of the testing showed attenuation patterns were similar for all methods except for the frequencies of 600 Hz, 1200 Hz, 1800 Hz, 2000 Hz, and 8000 Hz (See Table 1 and Figure 1)
- At 50 Hz there was no change for any HPD.
- At 600 Hz the readings were erratic, between three and four dB, so an average was taken to plot the graph.
- At 1200 Hz, and 2000 Hz the cupped hand, alone, had the greatest attenuation.
- At 800 Hz the dB readings for all methods were recorded at or above 95 dB.
- The increase of dB readings for frequencies above 4000 Hz was significant for all methods of protection.
<table>
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Figure 1

Attenuation Comparison, First Try

Attenuation Comparison, Second Try
Conclusions
The difference in sound attenuation for each hearing protection device varied with the frequency used for the test. The foam earplug showed better attenuation only in the test with 1800 Hz. All the methods tested showed some attenuation except in the 800 Hz, 1800 Hz, and 2000 Hz range. In these ranges, the tests resulted in an increase in decibels for some of the protection devices.

Recommendations
The following recommendations were made as a result of this study:
1. Tests should be repeated more times to check the validity of the frequencies that varied in the first two tests.
2. Conduct tests using more frequencies between 3000 Hz and 8000 Hz, the frequencies that can cause the most hearing damage.
3. The distance of the speaker from the ear should be changed to two or three feet from the ear to be a “real world” or arms length distance.
4. Other commercial HPD should be tested and compared.
5. If you are in a noisy environment for a short time and do not have an HPD, plug your ears with your fingers.

References
Collegiate Development of Crisis Leaders: A Strategic Step toward Establishing Disaster Preparedness/Emergency Response Capabilities for Homeland Security

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Abstract
Whether man-made or natural, disasters require crisis leaders who think on a large scale and operate across the breadth of homeland security. Simultaneously, crisis leaders must bring their expertise to the local community for increased safety through effective disaster preparedness and emergency response. Today, few such individuals exist even though organizations worldwide have already shown a growing demand for them. As the global community reacted to the catastrophic natural disaster in Haiti, the need for crisis leadership to support local or regional emergency response once again come to the forefront. An increasing need exists for education and training in homeland security and crisis leadership; and, universities may play an important role. The authors explain how the educational system in the United States has only begun to provide the knowledge base and training capabilities needed to improve our safety. In addition, they explain how universities may create Centers of Excellence in Homeland Security to meet the demands for the desired homeland security professional in the local private and public sectors. Lastly, they discuss one example used to establish a disaster preparedness and emergency response component of a collegiate homeland security and crisis leadership center.

Background
In December of 2006, the Center for the Study of the Presidency and Congress hosted a seminar entitled Crisis Leadership: Securing Societies, Protecting Homelands to explore the future needs of creating effective crisis leaders to improve the safety of the US populace. A paper entitled “Building Capacity for Enhanced Societal Security through Crisis Management Training,” was presented at the seminar by Jesper Gronvall (2006), Senior Analyst for Homeland Security at the Swedish Institute of International Affairs, and Bengt Sundelius, Chief Scientist for the Swedish Emergency Management Agency. The authors presented a compelling case of the need to train leaders who are able to manage and direct in times of preparation for, analysis of, and response to crisis events (Gronvall & Sundelius, 2006).

Man-made and naturally occurring threats and hazards are continuously being presented on local, regional, and national scales according to Robert B. Stephan, Assistant Secretary of Infrastructure Protection, National Protection and Programs Directorate, Department of Homeland Security. The wide range of types also presents a wide range of challenges to survivors and responders (Stephan, 2008). Many crises have occurred in recent years where decision-makers had to make critical decisions to protect human lives and to sustain political, economic and social structures (Gronvall & Sundelius, 2006; Department of Homeland Security [DHS], 2008). Events such as the attack of September 11, Hurricane Katrina, Hurricane Rita, the Indian Ocean tsunami, the earthquake of
Haiti, and unusual flooding in the US and Europe are just a few that highlight the complex issues facing leaders responsible for response and recovery from extreme crises. Therefore, communities of varying sizes require strategies that include effective crisis leaders who are able to direct and manage the prevention, protection, and preparedness activities required to mitigate risks to the people (Stephan, 2008).

Homeland Security is a composite of many different fields that individually have some bearing on the man-made and naturally occurring threats and on the techniques to combat these hazards and vulnerabilities. Each individual field is supported by the knowledge and expertise of an established community of individuals with the interdisciplinary breadth needed to manage that field of homeland security comprehensively and effectively (Kamien, 2006). The public watchfulness generated from notoriety of disasters has resulted in mounting pressures to reduce the risks associated with the safety of individuals and communities at large (Petrowski, 1994). In the 21st Century, only effective crisis leaders with genuine interdisciplinary knowledge and experience will be able to understand the complexity of any particular homeland security challenge, devise an efficient and viable strategy for dealing with the problem, and implement the strategy effectively; however, the current educational system produces too few (Kamien, 2006).

The Criticality of Crisis Leaders
Dr. John Harrald, Director of the Institute for Crisis, Disaster, and Risk Management at George Washington University, says that leadership alone may not be sufficient to overcome extreme events in crisis. Emergency managers now must operate within a Homeland Security context that drastically expands the domains of required expertise (Harrald, 2003). The vulnerabilities these managers will face are amplified by globalization, interconnected technological systems, and an ever faster pace of innovation and evolution of science and technology (Gronvall & Sundelius, 2006).

After a full review of Hurricanes Rita and Katrina, a General Accounting Office (GAO) report to Congress in September 2006 stated the three basic elements in preparing for, responding to and recovering from any catastrophic disaster are (1) leadership; (2) capabilities; and (3) accountability. Leadership in the form of legal authorities, roles and responsibilities, and lines of authority at all levels of government must be clearly defined, effectively communicated, and well understood in order to facilitate rapid and effective decision making. A March 2006 GAO report provided preliminary observations and noted that the key issues were in many ways very reminiscent of the issues identified in the wake of Hurricane Andrew in 1992. Again, these fell into three broad, interrelated categories (General Accounting Office [GAO], 2006); and further, one of the major factors as “The experience of Hurricane Katrina showed the need to improve leadership at all levels of government in order to better respond to a catastrophic disaster” (GAO, 2006).

The Commission on 9/11 stated leadership as the single most important factor in meeting the needs and challenges of the future (GAO, 2004). The GAO report of 2007 Homeland Security Observations stated the number one requirement to prepare for and respond to major disasters was clearly defined and understood leadership roles and responsibilities.

Threats, Consequences, and Vulnerabilities
The first and primary task of any crisis leader is to understand possible threats and hazards that may present themselves to the public and private sectors (Stephan, 2008). During a subcommittee report to Congress, Assistant Secretary Stephan stated the threats and hazards to our safety are constantly changing and include: terrorism, hazardous material spills, cyber attacks, industrial accidents, hurricanes, earthquakes, floods, power outages, pandemics, and many other challenging events (Stephan, 2008). For anyone in charge of disaster preparedness planning, significant effort is required and tasks must be identified to meet the crises most likely to occur (DHS, 2007b). To assist in this effort, the National Preparedness Guidelines (DHS, 2007a) provides a list of a wide range of threat and hazard scenarios that serve as a basis for crisis preparation (see Table 1).
Table 1: National Planning Scenarios

<table>
<thead>
<tr>
<th>Improvised Nuclear Device</th>
<th>Toxic Industrial Chemicals</th>
<th>Radiological Dispersal Device</th>
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</thead>
<tbody>
<tr>
<td>Aerosol Anthrax</td>
<td>Nerve Agent</td>
<td>Improvised Explosive Device</td>
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<tr>
<td>Pandemic Influenza</td>
<td>Chlorine Tank Explosion</td>
<td>Food Contamination</td>
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<tr>
<td>Plague</td>
<td>Major Earthquake</td>
<td>Foreign Animal Disease</td>
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<tr>
<td>Blister Agent</td>
<td>Major Hurricane</td>
<td>Cyber Attack</td>
</tr>
</tbody>
</table>

Every disaster, man-made or natural, results in specific consequences to people, property, animals, society, or economics. Crisis leaders may make certain assumptions about those events during planning and response concerning their consequences. The National Preparedness Guidelines Target Capabilities List (DHS, 2007b) lists a set of general assumptions about major events (see Table 2).

Table 2: Assumptions for Major Events

<table>
<thead>
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<th>Assumptions</th>
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<tbody>
<tr>
<td>May occur at anytime with little or no warning</td>
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<tr>
<td>Require significant information-sharing at the unclassified and classified levels across multiple jurisdictions and between the public and private sectors</td>
</tr>
<tr>
<td>Involve single or multiple geographic areas</td>
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<tr>
<td>May have significant international impact and/or require significant international information sharing, resource coordination, and/or assistance</td>
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<tr>
<td>Can span the spectrum of incident management to include prevention, protection, response, and recovery</td>
</tr>
<tr>
<td>Involve multiple, highly varied hazards or threats</td>
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<tr>
<td>May result in numerous casualties; fatalities; displaced people; property loss; disruption of normal life support systems, essential public services, and basic infrastructure; and significant damage to the environment</td>
</tr>
<tr>
<td>Impact critical infrastructures across sectors</td>
</tr>
<tr>
<td>Overwhelm capabilities of State, local, and Tribal governments, and private-sector infrastructure owners and operators</td>
</tr>
<tr>
<td>Attract an influx of spontaneous volunteers and supplies</td>
</tr>
<tr>
<td>May require short-notice asset coordination and response</td>
</tr>
<tr>
<td>May require prolonged, sustained incident management activities</td>
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The National Preparedness Guidelines Target Capabilities List (DHS, 2007b) and the Universal Task List (DHS, 2007c) provide lists of scenarios with the defined tasks and capabilities necessary to prevent, protect against, respond to, and recover from them. Effective crisis leaders are familiar with these documents and include them in their risk planning. The determination of risk includes identification and characterization of threats, their consequences, and our vulnerabilities. While each is important for capabilities-based planning and national preparedness, determinations of vulnerability are important since they include exposure and sensitivity (DHS, 2007b). Effective crisis leaders attempt to eliminate consequences and minimize the vulnerabilities by mapping corresponding capabilities and resources to anticipated threats.

Responding and Reacting to Threats And Disasters
Preparedness is achieved and maintained through a continuous cycle of planning, organizing, training, equipping, exercising, evaluating, and taking corrective action. Ongoing preparedness and response activities ensure coordination during times of crisis. Moreover, preparedness facilitates efficient and effective crisis management and response activities (DHS, 2008).

The National Preparedness Guidelines (DHS, 2007a) and the Target Capabilities List (DHS, 2007b) provide the framework defined as the Preparedness Cycle. As illustrated below, the cycle takes the user through a series of preparedness activities from conducting risk and capabilities assessments, strategy development, planning,
identification and filling of resources gaps, training, exercises, and implementation of corrective actions.

**Figure 1: National Preparedness Guidelines - Preparedness Cycle**

The National Preparedness Cycle shows the activities for ongoing preparedness and response. However, it does not highlight the critical common element used to plan, create strategies, exercise, assess, and implement corrective actions: problem solving (Krause, 2003).

Leadership involves the art of problem solving (Yukl, 1998). Leaders who find themselves thrust into crisis situations, whether in war or peace, on the battlefield or in the corporate world, must be able to do two things to be effective in the art of leadership: analyze problems and develop solutions for response (Koestenbaum, 1991; Mintzberg, 1973). Once the crisis occurs, the leader initially must understand the problem (crisis), through critical analysis, and then to use the collective thinking skills of the team to find a response.

Problem solving is essential to crisis leadership and preparedness for three reasons. First, problem solving analysis allows the logical and objective examination of what and how the crisis event is progressing (Koestenbaum, 1991). The crisis leader must evaluate the present response to determine if what is being done is productive and on the right track towards stopping the effects and moving into recovery. Secondly, analysis encourages the team to communicate ideas and alternative solutions. They use the analysis to compare past exercise performance to the current event to possibly find a better way (Yukl, 1998) to address the event. Thirdly, the crisis leader uses encouragement and policy to establish critical analysis as an essential habit pattern in the team’s response plan (Yukl, 1998). It infuses the organization and gives it life during the crisis (Mintzberg, 1979).

An incident may have a mix of political, economic, social, environmental, public safety, public health, and financial implications with potentially serious long-term effects. Frequently, incidents require the crisis leader to create a coordinated response (across agencies, jurisdictions, and/or the private sector), during which elected and appointed officials must make difficult decisions under crisis conditions (DHS, 2008).
A Proposal for Developing Crisis Leaders

The tragedy of 9/11 and the natural disaster of Haiti have exposed a tremendous need and opportunity for universities to play a lead role in the civilian homeland security assessment and training efforts. It is important for universities to share information and become part of a new network of shared knowledge. Equally important is to create programs for degreed and certificated education and training aimed at developing critical thinkers, able communicators, and effective leaders in the areas of disaster preparedness and emergency response.

One example of such a program is the Indiana State University (ISU) Center for Crisis Leadership and Homeland Security. ISU has established this center to meet the ever growing demand for effective crisis managers. The homeland security curriculum is not merely a vocational stepping stone to prepare students for a specific profession. Instead, the primary mission of homeland security education is to develop leaders with a public service ethos and citizens that embody civic virtues. ISU offers degreed education as well as certificated training. The focus for the future will be to develop the 21st century's Crisis Leader for the area of Homeland Security at Indiana State University (ISU).

The mission of the new Center for Crisis Leadership and Homeland Security is to prepare the crisis leaders of the 21st century for positions of responsibility in government or corporate entities. The basis will be an interdisciplinary approach to prevention, protection, and preparedness for man-made or natural crisis events. Graduates of the program will receive either a Master of Science degree or professional certification.

The Center’s view of Homeland Security encompasses a broad range of activities and occupations including:

- crisis prevention;
- emergency preparedness and response;
- border and transportation security;
- infrastructure protection;
- information analysis;
- homeland defense.

ISU has academic departments with expertise in the fields that will be involved in the future globalization of threats, technological systems demands, and ever faster pace of innovation and evolution of science and technology. Collectively, the Scotts College of Business, Bayh College of Education, College of Arts and Sciences, College of Nursing, Health, and Human Services, and College of Technology have the required knowledge and expertise to provide an outstanding multi-disciplined approach to Homeland Defense. The various Colleges of ISU provide a broad interdisciplinary basis to train leaders specializing in prevention, protection, and preparedness for man-made or natural crisis events. The Indiana State University Center for Crisis Leadership and Homeland Security can and will meet the ever growing demand for effective crisis leaders.

In addition to the education mission, an objective of the Center is to provide an avenue to deliver capabilities of assessment, training, and direct action. Assessment capabilities include the services of evaluating and auditing the status, needs, and abilities of organizational readiness in prevention, preparedness, response, and/or recovery. Training spans the breadth of studies needed from crisis leadership to individual homeland defense mission exercise. Direct action capabilities include planning, a speaker’s bureau, consulting and advising support to the community and government agencies, to name just a few.

The Center for Crisis Leadership and Homeland Security must enable our students and clients to address the same issues that face the Department of Homeland Security. The crisis leaders of the future must be able to address the short-term, immediate issues while planning for long-term sustainability. The Center must help them understand and determine how much of their resources should be devoted to terrorism, natural disasters, or other man-made episodes. The current wisdom professes an all-hazards approach to risk management; but, due to economic, climate, and social factors, that really may not work for local and regional communities. Difficult choices must be made; and, crisis leaders must stay ahead of evolving threats by understanding the vulnerabilities and resources to reduce risk.
In the current world of an interdependent global environment, there are no distinct lines separating the foreign from the domestic or the public from the private. National security and local security overlap. Federal agencies, state and local governments, and the private sector must all build stronger relationships with one another. The skilled crisis leader will be a critical asset in understanding the various agencies, who to contact, and what assets or resources each provides to assist in addressing the latest crisis, and how to deploy them to mitigate the threats. ISU has established one example of higher education approach to developing crisis leaders.

Summary
There is an increasing need for crisis leaders who can think and operate across the breadth of homeland security. They must understand the communications and interfacing needs with agencies of all types and contribute their expertise on a local, regional, or national level. There are only a few such individuals today even though governments worldwide have already created a growing demand for such individuals. However, the higher educational system in the United States has only begun to provide the knowledge base and training capabilities needed to meet the demands for the desired homeland security professional. To meet the growing demand for crisis leaders, universities may play a lead role by establishing Centers for Homeland Security with education and training focused appropriately on creating training to understand, direct, and control effective prevention, preparedness, response, and recovery efforts.

References
A Review of Fire Protection and Life Safety Arrangements Onboard a Deepwater Oil and Gas Drilling Rig in the Gulf of Mexico

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Abstract
The inherently hazardous nature of deepwater drilling, high population density of a drilling installation, and spatial, temporal and weather impediments to safe evacuation dictate a systematic and organized approach to the planning and management of fire and life safety risks. The foreseeable emergency scenarios include fire and explosion, blowout, marine/helicopter collision, loss of stability, structural damage, hydrocarbon and/or H₂S exposure, and severe weather. Those risks are formally evaluated and addressed through safe design, construction, installation, operation, maintenance, and management processes that conform to the Certifying Authority’s shipbuilding & classification rules and comply with offshore regulations.

The passive and active fire protection arrangements of a typical deepwater drilling rig include fire and blast-protected bulkheads and decks, hazardous area ventilation, automatic fire and gas detection systems, fire suppression systems, and portable fire extinguishers. The life safety arrangements include fire and gas-protected means of egress, areas of refuge, emergency lighting/power, alarm and communication systems, code-compliant interior finishing, fire drills, and an incident command system which oversees trained, tactical response teams. The fire and life safety inspection performed for this research assignment identified but a few areas of concern, for which recommendations were made to meet the Life Safety Code and US Coast Guard regulations.

NOTE: This investigation and article preparation were conducted prior to the April 20, 2010 Transocean Deepwater Horizon incident. The manuscript discusses fire, safety, and lifesaving arrangements designed to prevent and respond to onboard incidences, and does not address subsurface/well control arrangements.

Introduction
This paper summarizes an inspection of the fire prevention arrangements and application of the Life Safety Code (NFPA 101) on board typical deepwater a semi-submersible drilling rig that was engaged in a multi-well developmental program for a US oil company. A fire and life safety inspection of the rig was performed in June, 2009. The rig was located approximately 125 nautical miles (nM) from the coast of Galliano, Louisiana, at a water depth of 2,950 ft.

The discussion that follows draws upon American Petroleum Industry (API) recommended practices, American Bureau of Shipping (ABS) rules for classing mobile offshore drilling units, International Maritime Organization Mobile Offshore Drilling Unit Code, US Coast Guard regulations, NFPA standards, and work experience in offshore drilling.

Rig Description
The rig inspection was conducted on a 10,000 HP, ABS class, semi-submersible drill rig of the Noble EVA-4000™ design. It was built in 1981 by Ingalls Shipbuilding in Pascagoula, MS, and subsequently underwent a major refurbishment in 1998. The rig has a water depth rating of 6000 ft. and drilling depth rating of 30,000 ft. It has
an Occupant Load of 106 persons, based on the number of beds approved for the living quarters, and would be classified as a Water-Surrounded Structure, High Hazard Industrial Occupancy for the purpose of the NFPA 101, Life Safety Code. The helicopter deck is sized and load rated for a Sikorsky S-61 and serves as the primary point of personnel transportation. 4 x 63-person totally enclosed motor-propelled lifeboats and additional throw-over life rafts are provided for marine abandonment.

**Figure 1: Typical Semi-Submersible Drilling Rig**

![Noble Paul Romano](http://www.noblecorp.com/Fleet/RigDetail.asp?RigAbbrev_CH=NPR)

**Fire And Life Safety Hazard Analysis**

The emergency scenarios that have the potential to adversely impact life safety on the NPR include loss of well control/blowout, fire and explosion, H$_2$S exposure, helicopter crash on the installation, collision with attendant vessel or external traffic (drifting or under power), riser and pipeline accidents, structural collapse, foundation failure, and loss of stability or position. These scenarios are discussed below briefly.

A loss of well control would result with the well flowing to surface, whereupon large quantities of hydrocarbons would be released at significant pressures and become flammable upon mixing with the atmospheric air. The well fluids, however, may or may not ignite upon reaching surface. Rig fire suppression systems are not designed for, nor are intended to fight blowout fires; a typical life safety response would be to shut in the subsurface safety valves, activate the wellhead deluge system (not available on this particular rig), and/or abandon the rig.

Explosions on a drilling rig may be caused by overpressure and/or confinement, and they may occur as a result of: blowout ignition, within a flare stack or pressure vessel, accidental detonation of explosives used for well
perforation, pressure vessel failure, accumulation of explosive quantities of mists or dusts, and BLEVEs (Boiling Liquid Expanding Vapor Explosion) in well test separators or fuel storage tanks. According to the U.K. Health and Safety Executive (HSE) (nd.), there were 10 significant explosions (>0.2 bar) in the North Sea over the 25 year period from 1973-97.

The fire hazard areas on the typical rig include the paint storage locker, lube oil storage area, battery charging room, helicopter refueling system, accommodation (living, laundry and food preparation areas), boiler and machinery rooms (oil leaks on hot surfaces), welding workshop and welding gas storage area, mud additives store, and the drilling mud return circuit between the well and final degassing discharge. The possibility of a fire from H$_2$S is ruled out as the reservoir being developed does not contain H$_2$S in flammable concentrations.

Helicopters are the primary means of transportation for personnel traveling to the rig. According to accident data published by the International Association of Oil and Gas Producers (OGP, 2007) for the US Gulf of Mexico, there were 10 helicopter “flights into terrain or obstacle” during 1997-2004, and an incident rate of 2.38 per 100,000 flight hours during 2001-2005. The safety measures to respond to a helicopter crash and resulting fire on the rig were noted to be robust and are described further under Fire Protection Systems. There were trained fire teams, a helicopter crash rescue kit, and helideck firefighting arrangements for such eventualities.

Life safety emergencies resulting from collision with an attendant vessel or in-field traffic, loss of rig stability, riser or subsea pipeline failure, structural collapse, or foundation failure would inevitably result in the partial evacuation and/or total abandonment of the rig. The means of escape and egress conformed to the Life Safety Code, the Mobile Offshore Drilling Unit (MODU) Code, US Coast Guard regulations and ABS Rules for MODU Classification. The means of egress include watertight doors, escape ladders, fire, smoke and gas-protected lifeboats, and life rafts. These are illustrated in Figure 2.

Figures 2: Means of Egress

**Figure 2.1 Liferafts**

**Figure 2.2 Lifeboats**

Active Fire Protection Systems
The active fire protection systems on a typical rig include: a) an automatic fire detection and alarm system, b) a combustible gas and H$_2$S detection system, c) a carbon dioxide flooding system for the engine room, emergency generator room, paint locker and SCR (power control) room, d) a foam system for helideck firefighting, e) a Class III stand pipe system, f) a wet chemical fire suppression system for the galley range hood, and g) portable fire extinguishers. The equipment/systems cited above were inspected during the rig visit and are described below.

Automatic Fire Detection and Alarm System
A 17-zone automatic fire detection and alarm system with inputs from ionization type smoke and fixed-temperature heat detectors (200°F), and manual “pull stations” is installed on board. The system conforms to NFPA 72, *National Fire Alarm Code* The system is covered by the rig planned maintenance program and certified
Annually by a third party to comply with ABS rules and US Cost Guard Regulations. Weekly fire system tests are performed by the rig’s Electronic Technician and documented when completed. The manual fire alarm boxes are distributed throughout the rig and comply with the 200 feet horizontal travel distance, per 9.6.2.4 of the *Life Safety Code*. The control panel is located in the continuously manned rig Control Room. Combination audible/visual alarm units are distributed throughout the rig and those alarms are supplemented by announcements over the rig Public Address system. The automatic fire detection system is automatically connected to the rig’s emergency power supply in the event of main power failure. An emergency alarm initiates the Emergency Action Plan, for which duties are defined in the Rig Station Bill. The fire alarm panel and zone locations are illustrated in Figure 3.

*Figure 3: Fire Zone Control Panel*

**Fixed, Automatic Combustible Gas and Hydrogen Sulfide Detection System**

A multi-channel gas detection system is installed on board, with eight channels assigned to combustible gas/LEL detection and 3 channels to H₂S detection. The combustible gas sensors are of the catalytic bead type and have a 0-100% LEL sensitivity range, an accuracy of +/-3%, and response time of T-50 < 10 seconds and T-90 < 30 seconds. The high and low alarm levels were set at 20% LEL and 40% LEL respectively. The sensors were distributed as follows: mud pit/shale shaker (4 sensors), scalper, moon pool (area around blowout preventers), drill floor, and rotary table.

The H₂S sensors are of the electrochemical diffusion type and were located in the mud pit area (2 sensors) and H₂S scalper. The H₂S high and low alarms are set at 10 ppm and 20 ppm respectively; however, there was no evidence that this portion of the system is operational.
The gas detection system is covered in the rig planned maintenance program and calibrated weekly. The system is annually certified by a third party, in keeping with ABS rules and US Coast Guard regulations. The sensor assemblies are certified for use in classified hazardous locations and protected against water and dust ingress. The control panel is located in the rig Control Room and alarm devices are on the rig floor (near the driller’s console) and in those work areas where the sensors are located. A gas detection test kit is available and used for calibration of the system and the portable units on board.

Discrepancies were noted in the recording of sensor identification numbers in the weekly calibration log, which did not tally with the information posted on the control panel. It was also noted that the sensor and alarm strobe lights were covered with mud, which could reduce their performance and visibility. The H₂S detectors should be calibrated and made operational at the earliest. The system and its associated components are shown in Figure 4.

**Figure 4: Combustible and H₂S Gas Detection Systems**

**Carbon Dioxide Flooding System**
A UL-listed CO₂ flooding system complying with NFPA 12 *Standard on Carbon Dioxide Extinguishing Systems* is installed on board for fire protection of the engine room, SCR (Silicon Controlled Rectifier or power control center) room, paint locker, and emergency generator room. The CO₂ bank is comprised of 17 x 300 lb., 3000 psi cylinders which are allotted to each protected space based on the volume of the area. A manual bypass provision allows for the entire battery to be routed (i.e. dumped) to a single space, if required. The system has pre-discharge alarms to warn the occupants (e.g. first responders) to evacuate the space before CO₂ flooding commences and it can be activated from outside the protected space or the main control station in the CO₂ room. The CO₂ flooding system is covered under the rig’s planned maintenance program and is annually inspected and certified by a third party. The system was noted to be in excellent state of repair. The system and its various components are shown in Figure 5.
Figure 5: Carbon Dioxide Extinguishing System

Foam Firefighting System
A 3% AFFF (Aqueous Film Forming Foam) foam system conforming to NFPA 11 Standard for Low, Medium and High Expansion Foam has been installed for protection of the helideck and helicopter fueling system. The system is comprised of a 150 gallon vertical bladder tank with an inline foam concentrate proportioner and booster pump rated at 132 gallons per minute (gpm). It supplies two foam monitors positioned in proximity to the helicopter landing deck and a foam hose reel located near the helicopter refueling skid. The foam system is covered under the rig’s planned maintenance program and is annually inspected and certified by a third party. The system is designed to discharge foam at the rate of 4.07 liters per minute for each square meter (0.1 gallon per minute for each square foot) of area covered for five minutes at a minimum, in compliance with US Coast Guard regulation 46 CFR 106.489 and the IMO MODU Code.

The helideck is designed to accommodate a Sikorsky S-61 helicopter and the area of coverage is the circle of diameter extending from the forward tip of the main rotor to the aft tip of the tail rotor. A foam sample is tested annually at a third party laboratory to determine its quality and fitness for continued use. It could not be established if a refractive index test was performed on the foam water solution since the system was installed, which would verify the accuracy of the foam proportioning equipment. The system bladder and foam concentrate was replaced prior to the last annual certification in February 2009.

Fire Main/Standpipe System
The fire main system is designed to NFPA 14 Standard for the Installation of Standpipe and Hose Systems; ABS Rules; IMO MODU Code, International Convention for the Safety of Life at Sea (SOLAS), US Coast Guard, and Flag State requirements. The system also conforms to the requirements of NFPA 101 Life Safety Code, Sections 9.7.3 and 9.7.4. The system is Class III-rated (incorporates features of a Class I and Class II system) and is supplied by two 100 HP, 700 gpm centrifugal pumps that draw water from the sea chest. The Fire Main System is interconnected and supplies the following:
- Fire water piping and 50 ft. hoses throughout rig with 45 hydrants, 1 ½” couplings
- The foam system, with 2 ½” couplings

The fire main system has a design pressure of 125 psi and is equipped with isolation valves to ensure the system remains operational in the event a section of the piping becomes damaged, e.g. from an explosion. Each hydrant station is equipped with a wrench, 50 ft hose, hose rack, and dual purpose nozzle (jet/stream). The fire water
pumps are covered by the rig emergency power supply and can be operated locally and from the Control Room. The fire main system is covered by the planned maintenance program and annually inspected and certified by a third party in accordance with NFPA 25, *Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems*. Documentation on design, procedures for maintenance, inspection and testing, and test and maintenance records were available on board for review (originals maintained on file at company head office in Sugarland, TX). The fire main system is tested, on main and emergency power, on a weekly basis during the fire drill.

**Wet Chemical Fire Suppression System**

An Ansul R-102™ wet chemical system is installed in the galley for protection of the range hood, duct, filters and plenum. The system is comprised of a 3 gallon, 110 psi wall-mounted stainless steel tank, expellant gas cartridge, regulated-release mechanism, piping, and discharge nozzles. The extinguishing agent is a mixture of organic salts designed for rapid flame knock-down and works by saponification upon contact with the cooking grease during a fire. The nozzles are fitted with metal blow-off caps to prevent the orifices from clogging with grease. The system meets the requirements of NFPA 96, *Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment* and NFPA 17A, *Standard on Wet Chemical Extinguishing Systems*. The system can be activated manually at point of installation, remotely, or automatically by fusible link detectors. The galley personnel have not been trained in operating the system and their training was recommended by the inspection. A schematic is given in Figure 6.

*Figure 6: Galley Wet Chemical Fire Suppression System*


**Portable Fire Extinguishers**

Portable fire extinguishers complying with NFPA 10, *Standard for Portable Fire Extinguishers* and 29 CFR 1910, Subpart L (Fire Protection) are installed throughout the rig, in accordance with the approved Fire Safety Plan. The majority of fire extinguishers are 20 lb dry powder type; 9 light foam extinguishers are provided in the engine room. The spacing of the extinguishers exceeds the minimum travel distance requirements of 75 ft for Class A and 50 ft for Class B extinguishers. The extinguishers are visually inspected and tagged on a monthly basis, and inspected annually. Hydrostatic testing of the steel cylinders is performed every 10 years if they are deemed suitable for continued service. All of the above inspections are documented and the records were reviewed during the inspection. Each extinguisher is securely mounted off the floor, marked with a unique identification number, and protected from the elements and physical damage, when mounted outdoors. The wall space behind
the extinguisher is marked to indicate the location and type of the extinguisher and the appropriate signage is posted. All extinguishers that were reviewed during this inspection were fully charged and in good condition. All rig personnel are provided initial and annual training in fire extinguisher operation. Fire blankets have been provided in the galley and the helicopter rescue kit.

It was noted that the 100 lb. and 50 lb. dry powder extinguishers for the helideck were positioned on the deck below and were not secured. A recommendation was made to document the procedure for how those extinguishers would be deployed in the event of a helicopter fire. Recommendations were also made to provide a Class B fire extinguisher for the grease storage locker, a 50 lb. extinguisher for the helicopter refueling skid (to comply with US Coast Guard regulation 46 CFR 108.489), and a Class D extinguisher for helicopter firefighting. Figure 7 depicts the various types of portable fire extinguishers on board the rig.

Figure 7: Rig Fire Safety Plan showing location of portable fire extinguishers, fire fighting systems, and other safety equipment

Conclusion
This paper discussed the emergency scenarios impacting life safety on an offshore drilling installation, the fire hazards, and the results of an inspection of the fire protection and life safety arrangements on board. It underscored the importance of fire safety design, equipment selection, personnel training, housekeeping, and planned maintenance. The recommendations of the inspection were made and accepted by the drilling contractor and the oil company.
References
Teaching Innovations
Humanizing the Digital Natives

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Abstract
This study sought to determine if the teaching methods employed in a new Sustainability in the Built Environment course were effective for the professor’s objectives to create a transformative and student centered learning experience. The integration of information and communications technologies (ICT’s) with the students’ personal experiences and research created a collaborative learning community. Mezirow’s theories on transformative learning, and Rogers’s person-centered approach were foundational for the construction of this course.

Introduction
The advent of the post-modern, information age is a time of profound change in our world. Future needs for knowledge workers are changing and the industrial age model of education is not keeping pace with industry requirements for future employees. For current students to be effective in the emerging global economy, they need to master current skill sets, as well as highly adaptive learning skills. Beyers (2009) indicated that, Graduates tend not to be adequately prepared for the demands of today’s more complex society which requires such competencies as creative thinking, group problem solving and decision making, as well as the capacity to learn more and more efficiently and effectively which is inherent in the 21st century skills. (p.222)

Oblinger (2008) stated, “today’s students must graduate able to deal with ambiguity and capable of higher-order analysis and complex communication” (p. 20). As the world changes and adapts to the explosion of unprecedented access to information, our students are changing as well.

This generation of students known as the “net generation” (Beyers, 2009, Oblinger, 2008) or the “digital natives” (Prensky, 2001) are bringing different learning styles and expectations to their university experience. Immediate access to information has made students eager to quickly access and process what they need and move on to the next interest area which creates a different set of multi-tasking skills and processing abilities than preceding generations possess. Prensky (2001b) argued that the culture a person develops within causes them to think differently than people from a different culture or era. “They develop hypertext minds. They leap around. It’s as though their cognitive structures were parallel not sequential” (Winn, as cited by Presnsky, 2001b, p. 3). This evolution in cognitive processing has created a different set of values than those held by the digital immigrant (Prensky, 2001a) generation that acquired, processed and retained information very differently in a pre-information technology driven world. This disconnect between many in the teaching generation and the current learning generation reveals some challenges for instruction. Both Oblinger (2008) and Prensky (2001b) stated that the attention spans of the net generation are not incapable of being maintained, but rather the learners are highly selective in what they choose to pay attention to. This creates some challenges and opportunities for educators as we strive to create relevant curriculum with transferability. McLoughlin & Lee (2007) expressed, “a need to expand our vision of pedagogy so that learners are active participants or co-producers rather than passive consumers of content, and so that learning is a participatory, social process supporting personal life goals and needs (p. 664).
There is potential to revolutionize the way students acquire knowledge in this new information age. Students have shown tremendous capacity to embrace social networking technologies and games of many types. Deliberate and thoughtful information and communication technologies (ICT’s) can extend the value of technology beyond entertainment and into the realm of high level collaboration, problem solving and knowledge development. Caution must be used to not assume all students are automatically tech savvy by virtue of their birth year. Authors (Oblinger, 2008, Vaidhyanathan, 2008) have warned that while fearless in approach to technology, students do not always have the skill set for high levels of integration into their learning. Assumptions should not be made that they know how to use technology for learning. Hence, the teacher or facilitator of knowledge must incorporate all that we know about our students, available technology and our own goals and objectives to design more effective instruction.

The research in this study focused on integration of learner-centered instruction and information and communication technologies (ICT’s) to create a transformative learning experience. Given a highly collaborative and student driven curriculum, would students take more intrinsic rewards from the experience?

**Method**

Students in two sections (n = 46) were invited to participate in a study that measured their satisfaction and transformation at the end of the course. One hundred percent of the students elected to respond to the optional end of course survey. A proxy-pre-test design (Trochim & Donnelly, 2008) was utilized. The survey asked students to gauge several factors in their sustainability experiences before and after taking the course. Institutional Review Board (IRB) approval was pending during instruction which prevented pre-course data collection. All student responses were gathered at the conclusion of the course.

Mezirow’s transformative learning theory guided the construction of the pre and post items within the survey. Mezirow’s theory has four main components: 1) inclusion of life experience, 2) critical reflection, 3) reflective discourse and 4) action. (Mezirow as cited by Merriam, Caffarella, & Baumgartner, 2007, p. 134) The survey was designed to gauge the students’ perceived efficacy to take action in regard to sustainability themes. Mezirow (1997) identified a three step process for social action: 1) becoming aware of a need to change, 2) having a sense of solidarity with others who are also committed to change and 3) knowledge of what actions are appropriate to implement change. Questions seven through nine were designed to assess students’ readiness for action.

Descriptive statistical methods were applied to demographic questions and satisfaction questions in the survey (Items 1-5, 10, 12, 13, and 14). Inferential statistics included a t-test for dependent means that measured the five pre and post questions (Items 6, 7, 8, 9, and 15). Effect size was also calculated for those four items to determine if the outcomes had practical significance. Items 11, 17, 18, and 19 were open ended responses that provided greater insight for students’ experience within the course.

E-portfolios included reflective conclusions drawn by the students that provided qualitative data that further explained the impact of the course on their learning and efficacy to understand sustainability issues.

**Course Design**

Sustainability in the Built Environment was a new course that had recently been approved as a general education course for the full university. Previously, it had been a program requirement with the Building Construction Management program. This required some redesign to insure that many perspectives were provided beyond the construction centered themes. This also presented an opportunity for the professor to incorporate some pedagogical techniques for learning to create a more student centered classroom. Rogers (1983, pp.188-189) developed a non-directive model for instruction that includes phases of learning community creation where the instructor serves as the facilitator rather than the sole dispenser of learning. These principles were incorporated into the design of this course.

*The leader of the course believed they could share the experience with the students. They trusted that the students had the capacity to think and learn for themselves.*
Statements were made to the students at the beginning of the course regarding the learner centered design. The themes of the course were presented (Land Use and Development, Food and Water, Energy, Global Warming, Green Construction and Transportation). Each student was informed of their responsibility to research and contribute to a warehouse of information for the class that would be maintained within a Wiki. The collective and collaborative process required everyone to research articles and current events, present their findings, contribute to active discourse, reflect on their learning and create an e-portfolio that demonstrated the depth and scope of their learning.

The facilitative teacher shared the responsibility for the learning process with the students.

Discussions were held prior to each new theme to determine what the pre-existing knowledge and experience of the group was with the topic. Then areas of interest were explored to provide the responsible researchers for that theme some direction that benefitted the class. A democratic method of self-governance was established at the beginning of the course as student expectations for participation were revealed through the syllabus.

The facilitator provided learning resources from them self and their experience, from books and materials and from the community. Learners were invited to add resources of knowledge or experience.

Extensive print resources were provided to the students in the syllabus, access to an online library Questia™ by subscription reinforced the paperless sustainability principle. The students utilized Questia™ to research their selected topics within the theme. Speakers from the community spoke on Energy and Land Development topics. Technology instructors provided technical instruction for development of e-portfolios. Rubrics were provided to guide the students’ development of the research they conducted for the shared library. The documentary An Inconvenient Truth was viewed in class, and modeling for effective discourse was made explicit for the students. The structured online library Questia™ was an important resource to help guide students in seeking high quality materials. Oblinger (2007) explained the problem of navigation through the information that exists on the internet, “Only 31 percent of information searches are successful. Just because students know how to open a Web browser, educators should not assume that everyone knows how to search for information” (p. 18). Teaching students the process of gathering information effectively was a skill set that was instructed early in the semester given the expectation that all students would conduct effective research.

The student developed their own program of learning, alone or in cooperation with others. The student made choices to their learning direction and maintained responsibility for their choices.

Within the context of the seven unifying themes of the course, students had the option to utilize the common library of research conducted by their peers, or they could seek out other information that provided meaningful learning for them on that topic. Given the extensive amount of information that was available, the students were allowed to customize their e-portfolio to their interests and areas of development that they found to be most engaging. Rubrics were provided to assist them in developing high quality products that demonstrated their proficiency in that theme, but ultimate decision making of content was left to their discretion.

A facilitative learning climate was provided. Initially, the modeling for respectful interaction was demonstrated by the facilitator, but as students became more comfortable, they engaged in self-guided discussion and reflection on shared experiences.

Explicit encouragement and modeling for effective listening and discourse skills was provided by the facilitator. This element took a long time to develop as the students did not have many experiences with highly collaborative learning communities. Both the freedom and responsibility to share experiences and research was a new experience for many of the students.

It was clear that the primary focus was about attaining the skills for the continual process of learning. The content was secondary to modeling the process of how students can become life-long learners and producers of critical thinking.
Students were taught research, conversation, reflection and presentational skills to provide them the tools they needed to complete the authentic assessment of an e-portfolio. It was made explicit throughout the course that these skills were going to be beneficial well beyond the expectations of this course and into their future career path.

_The discipline necessary to reach the student’s goals was self discipline. The student was intrinsically motivated to take responsibility for their own learning and outcomes of that effort._

This element was best explained by the students’ responses. These quotes were taken from the end of course survey question that asked, “This course required you to participate in a different manner than many of your other courses. Please indicate your level of comfort with these methods of student centered instruction both at the beginning of the course and now.”

“I had known this instructor previously and so trusted in his decision to run the class in this manner. I was slightly skeptical as this was the first class for me taught in this manner but the instructor really made the expectations clear and all skepticism was erased after the first week when the student presentations began.”

“I felt once we knew what was going on, we were able to discover more.”

“I know more about the subject and feel good enough to talk about it.”

_The evaluation of the student’s learning was made primarily by the learner, although the self-evaluation could be influenced by feedback from other members of the group and facilitator._

The use of advance rubrics to guide student development of research presentations, e-portfolio development, speaker evaluations, current events, and the film review put a great deal of responsibility and decision making power in the students’ control. While the professor graded the assignments to the rubrics that were provided in advance to the students, it was their self-assessment of what level of quality they expected from themselves that shaped the final products.

**Results and Discussion**

Outcomes of the survey and student products were confirming pieces of evidence that students transformed in both their knowledge and efficacy with the topic of sustainability as well as increasing their technical skills to convey complex concepts in a presentational medium that will be useful in their future career applications as experts in their fields.

The dependent `t`-test was conducted on five items that measured transformation in the students’ readiness for action in regard to sustainability issues as based on Mezirow’s fourth component of transformative learning. All five items asked students to consider their perspective both before and after participation in the course. Item 6 asked, “The following questions explore your interest in the class. What was your level of interest in sustainability issues?” The Likert type scale went from 1 = no interest, 2 = some interest, 3 = interested, 4 = high interest. The outcome revealed that students experienced a significant increase in their interest levels for sustainability. (`t`(45) = -6.741, _p_ < .05) with an large effect size of .71 (Field, 2005). The next question asked students to “Respond to these statements after thinking about your thoughts, impressions, and experiences before AND after taking this course. Sustainability issues require social action for positive change.” The Likert type scale went from 1 = no need for change, 2 = some awareness of need for change, 3 = change is possible, 4 = change is essential. Students showed a large gain in their belief that change is necessary in regard to sustainability practices. (`t`(44) = -6.904, _p_ < .05) a large effect size of .72 showed practical significance for this question. The students also demonstrated a gain in their awareness of “a committed people willing and able to create positive change in sustainability issues.” The Likert scale ranged from 1 = I don’t know any people, 2 = I know some people, 3 = I know people who have made some effort for change, 4 = I know highly committed people who work toward sustainability. (`t`(44) = -4.934, _p_ < .05) with another large effect size of .60 (Field, 2007). Regarding the students sense of efficacy that they know appropriate actions to take for change, again there was a significant increase when asked, “There are definite actions that can be taken to impact sustainability issues.” The Likert scale ranged from 1 = I have no idea
what to do, 2 = I have a couple of ideas, 3 = I have a strong understanding of actions to make changes, 4 = I feel able to make change, 5 = I can help advise others how to make changes. \( t(42) = -5.974, p < .05 \) with a large effect size of .68. The final \( t \)-test for dependent means regarded the students’ level of comfort with the learner centered format of the course. The Likert scale ran from 1 = extremely uncomfortable, 2 = quite uncomfortable, 3 = somewhat uncomfortable, 4 = comfortable, 5 = quite comfortable. There was a significant increase in comfort for the students with the format from the beginning of the course to the end of the course. \( t(43) = -4.904, p < .05 \) with a large effect size of .60 (Field, 2007). Overall, the students demonstrated significant gains in all areas of the goals set forth by the instructor for the format of the course as well as the transformational effect of feeling empowered to make a difference with regard to sustainability issues.

While the qualitative results were generally positive and elaborated upon the inferential statistics reflected here, some students still sought more lecture and indicated some discomfort with the responsibility of the learning being placed so directly upon them. This is not surprising given the abrupt change in design this course was for many of the students.

**Future Study**

While the results were consistently favorable both to the learner focused method of instruction as well as the strong comprehension and synthesis demonstrated in the e-portfolios, there is some indication that learning preference and experiential transformative learning models aren’t embraced by all students. Future study will include the use of the Kolb Learning Style Inventory (Kolb & Kolb, 2005) to explore correlations between students’ learning styles and the learner focused, experiential transformative models of instruction.

**References**


Modeling Instruction for the Net Generation: The Use Of New Media To Frame Classroom Conversation In A Graduate Seminar Course: Possibilities And Predicaments

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Introduction: Young People And The Media
The first decade of the new century has been marked by a steep rise in media use by children, teenagers, and young adults. Several studies in recent years have suggested a substantial increase in youth, and young adults’ media use (Rosen, 2010; Ucak, 2007; Palser, 2005). At the same time studies show continued disengagement and shorter attention spans of young learners (Leard, and Lashua, 2006; UNICEF, 2006). This paper demonstrates the use of new media activities in graduate classroom, to enhance the learning experience, and promote student interest and engagement. The paper discusses some innovatory instructional strategies to better address the young learners of today in the context of a graduate seminar class in a midwestern regional university. The Web 2.0 model of interactivity is supported in a multi-directional flow of information, instead of the conventional one-way lecture format in a traditional classroom.

Interactivity invites participation, where young people more than most like to voice their opinions, and join the conversation. The ubiquitous phenomenon of social networking for instance is a testament to the greatly increased media use by the young people today. It is also an indication of a shift in the way information is received, and processed (Kemenetz, 2010; Cope, and Kalantzis, 2009; Totter, 2008). The model encourages multi-dimensional pathways of communication rather than a ‘one to many’ classroom lecture format. Arguably a graduate classroom with adult student population is likely better suited for such multidirectional interactivity, where each student can bring his or her own extensive professional and experiential background to the classroom. There is considerable room for meaningful give and take within the context of the topic under discussion. Promoting such an exercise is also conducive to greater exploration and risk taking within the safe environment of the classroom and forms a proactive strategy to promote student engagement in the learning process.

Instructional Strategies In A Revised World
The extreme ‘media seeking’ and ‘media friendly’ behaviors seen in today’s young people lead one to speculate on new instructional strategies more in tune with such patterns. The ongoing research in the area of instructional best practices seems to suggest that faculty must be encouraged to think of themselves as learners rather than...
experts (Huston, 2009). Introducing topics in ways that are lively, interactive and more attuned to the youth audience, are all universally agreed upon ways of promoting student engagement.

The abundance of new media and technology seems to offer ways to achieve just this synergy between the learner and the instructor. However, the visual ‘text’ may be ambivalent and there are numerous pitfalls, in addition to the potential benefits of integrating visual pedagogies in instruction. Outside of a class on media itself, what may be some potential applications of such a strategy in a science, language, or a history classroom? The technology offers the means to publish the work created by students’ active engagement in research, synthesis, and application of concepts learnt in the classroom. The potential for dissemination of research and/or creativity may offer some answers as to the usefulness of this approach in diverse classroom settings.

The case illustrated below highlights such an application, where students were given the tools, and the know-how to create their own multimedia projects. The imagery created by the students for this project served to not only inform and illustrate, but also persuade, and argue their position with respect to the issue at hand in powerful ways. The projects were meant to enhance the learning experience, and encourage the students to delve further into the material in lateral and ‘un-textbook’ ways.

Global Technology Graduate Seminar Course: Case Illustration
Pedagogical use of new media in instruction is demonstrated by the case of “Global Technology”, a graduate seminar course in the department of Applied Engineering Technology in a regional university in the Midwest. The course outline in the university Academic Catalog describes it as “a study of global technology as affected by factors such as socio-cultural structures, economic conditions, governmental decision-making, and corporate-managerial strategies” (Graduate Catalog, 2009).

The course is designed to create an awareness of the global nature of technological innovations and to analyze their implications. The mutual impact of technology and social, cultural, economic, and political spheres is addressed. The instruction is intended to allow the development of a macro-perspective towards technology and society. Such a broad focus and outlook are especially relevant to the study of ethics/policy/politics and the third world in the context of global technology. The course also serves as a venue for developing analytical and argumentation skills, besides extensive writing and presentation.

In many ways curricular planning for the Global Technology course is a moving target. In order that the course content continues to remain relevant and meaningful for the graduate students in today’s rapidly evolving technology landscape, the following tripartite framework of content trajectories has been adopted for implementation.

- Technology innovation: To include technology life cycle, technology forecasting, barriers to new technology implementation, and technology adoption opportunities and risks in the context of a global enterprise
- Organizational culture: To entail management of diverse technology personnel. This will include but not be limited to diversity, cultural, ethical, and regulatory issues pertaining to today’s global organizations
- Technology and Society: To form the philosophical basis and guiding framework for this course, and include a contextual fabric of societal issues being impacted by, or impacting technology development

In accordance with the framework outlined above, the course is designed to accomplish the following set of learning objectives:

- Critically analyze the interrelationship of technology and society in the global context (Intersection of technology with ethics, energy, ecology, politics, economics, and culture, the transformational impact of emerging technologies on lifestyle choices).
- Evaluate the management of a globally diverse workforce, and/or globally diverse organization (Cultural, ethical, language, communication, spatial, temporal, diversity issues including but not limited to ethnicity, gender, and age; hierarchy, authority, leadership, regulatory and legal issues).
- Assess alternatives for managing innovation, and change (Emerging technologies, technology forecasting, barriers to new technology adoption, technology life-cycle, technology as a vehicle for paradigm shifts).
The Global Technology course is a core course in the Master of Science in Technology Graduate program at the university, and is designed in congruence with the overall program objectives. The alignment of the graduate program goals with the learning objectives of the Global Technology course is indicated in Table 1. The multimedia podcast project discussed in the following section is also located in the proposed pedagogical framework.

The course is intended to promote a discussion of new and emerging technologies as a piece of the larger societal fabric, in terms of its impacts, and implications. Although a textbook (Hjorth et al, 2008) has been prescribed, the extreme topical nature of the issues being discussed tends to render any textbook out of date. The class typically includes a large number of continuing education adult professionals/ students returning to school for various reasons. Retraining for new technologies, or enhancing their resume in a sluggish economy is only a part of what motivates this older population.

Table 1: Program Goals Alignment with Course Learning Objectives and Assessment Criteria

<table>
<thead>
<tr>
<th>Graduate Education Goals</th>
<th>Global Technology Learning Objectives</th>
<th>Multimedia Podcast Assessment goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. A depth of content knowledge</td>
<td>Analyze the transformational impact of new and emerging technologies in the context of global cultures</td>
<td>Students will develop understanding of the global impact of technology</td>
</tr>
<tr>
<td>b. Critical thinking and problem solving skills</td>
<td>Evaluate new technology adoption, opportunities and risks, barriers to implementation, and technology life cycle</td>
<td>Designed to facilitate students' learning and comprehension of the global impact of technology</td>
</tr>
<tr>
<td>c. Effective oral and written communication skills</td>
<td>Identify and analyze the human resource issues in global organizations including but not limited to communication, diversity, culture, ethics, and leadership</td>
<td>To apply the concepts and issues of living and working in a global technological society, improving their ability to act as responsible citizens in a technological world</td>
</tr>
<tr>
<td>d. Evidence of advanced scholarship through research and/or creative activity</td>
<td>Relate emerging technologies with their impacts, implications, costs, and benefits to global society</td>
<td>Initiating and maintaining a meaningful and spontaneous discussion with classmates on global technology impacts</td>
</tr>
</tbody>
</table>

Diversity inside the classroom is increased by a large number of international students who for financial reasons are more likely to gain admission in graduate school, due to paucity of funding in undergraduate education. The highly diverse student demographic makes the Global Technology classroom a challenge even without the rather fluid nature of the course content. The class as such defies any conventional course design, and calls for more innovative instructional strategies.

Course Design

The increasing use of new media by young people today, as discussed in the previous section, was used as a key component in redesigning the Global Technology course structure in a revised context of a tech savvy student body. Arguably instruction is best carried out by student engagement in the learning process. The use of multimedia to enhance student engagement, as well as generate independent inquiry was the focus of this experiment. The pedagogical strategy included the introduction of assignments framed and informed by the new media technologies.

During the course of the term the students were required to prepare three ‘podcasts’ to address the various technological issues being discussed in class at the time. They could work within any of the following three broad domains and focus on specific instances of the same:

- Emerging technologies
- Organizational Culture
- Impact of technology on society
The podcasts were made increasingly complex in terms of technological expertise and delivery formats. It was required that the podcasts be accompanied by a word transcript complete with references in the form of a quasi-paper. The three assignments are briefly described below.

- **Podcast-1: Audio Clip** Podcast-1 was assigned as a 5-8 minute audio recording of a written transcript, presented in the manner of an on-air broadcast. The audio file had to be accompanied by a word transcript, a 3-4 page text transliteration of the audio. The students were asked to select a specific technology, and discuss its implications for peoples/society. They were given step-by-step technical instructions for building their sound file. The learning edition of Audacity™ software was used for this project (Audacity, 2010). The deliverables for this assignment were 1) Audio file in mp3 format and 2) Transcript as MS Word document.

- **Podcast-2: Video Clip** Podcast-2 was assigned as a 5-8 minute video clip of a written transcript, presented in the manner of an Internet news clip. The assignment also required a transcript with references in the form of a quasi paper. The students were given detailed step-by-step directions for building their video file. The learning edition of PhotoStory 3™ software was used for this project. (MS PhotoStory 3, 2005). The deliverables for this assignment were 1) Video file in wmv format and 2) Transcript as MS Word document.

- **Podcast-3: Screencast** Podcast-3 was assigned as a 5-8 minute Screencast of a written transcript, presented as an Internet broadcast. The Screencast was expected to be a recording of students’ screen activity, accompanied by audio commentary explaining the work shown on the screen. Example clips were shown to explain the potential of such a format for rich content with a ‘live’ interactive feel that could not be achieved by mere static pictures. Students were encouraged to use relevant websites, graphs, charts, visual aids, and even short video clips in their work. The transcript remained a requirement as before, and had to include all references and web addresses used in the recording. The students were given detailed step-by-step technical instructions for building their Screencast. The learning edition of Camtasia™ software was used for this project (Camtasia, 2009). The deliverables for this assignment were 1) Screencast file as CamProject and 2) Transcript as MS Word document.

The assessment rubric used for grading the podcasts is shown in Table 2. As can be seen, the bulk of the assignment was geared towards analysis, and discussion of the issue at hand, however points awarded in the mechanics section acknowledged the increasing technical complexity of the students’ projects.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>Introduction, Setup, Contextual framework, Conclusion</td>
<td>5</td>
</tr>
<tr>
<td>Analysis</td>
<td>Tech Context, Internalization, Examples, Detail, Specificity</td>
<td>30</td>
</tr>
<tr>
<td>Mechanics</td>
<td>Language, Style, Grammar, Technically competent audio/video,</td>
<td>10</td>
</tr>
<tr>
<td>References</td>
<td>APA style formatting, Parenthetical references, Citation list</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

The subject treatment and content expectations were outlined in each assignment. The students were instructed to briefly outline the specific technology they had selected for discussion, and focus the bulk of their work on analysis, implications, and influences of technology on peoples, society, and/or cultures. They were encouraged to give specific examples, add their own viewpoint, and take a position relative to the particular technological dilemma being discussed. Crediting sources in the correct format was an essential part of the assignment.

**Student Work**

As an instructional strategy the Podcast assignment operated at many levels. It encouraged the students to translate the broad conceptual knowledge from class lectures, and apply it in specific concrete settings. For instance, one student built his podcast on “technologically enhanced toys” (Curry, 08), discussing the role of technology in teaching and learning for toddlers. Do the educational toys in fact enhance the act of learning? What is the role of parenting in the technology classroom/homeroom? Another student prepared her podcast on the pros and cons of Nitrogen fertilizer in Soybean production (Sadorus, 09). She effectively situated the problem in context and discussed the impact on participating communities in terms of cost, health, and profits.
Yet another student prepared an excellent project on Massive Multiplayer Online Games, exploring the impact of videogames on violent behavior of young adults (Jorge, 10).

Although some exemplary work was produced over the years, students expressed the need for more specific content directions. Accordingly the final podcast assignment in spring’10 included topic choices. The students were asked to work in groups of two, and could select any of the following as their canopy subject for this assignment:

- **Education**: Learning/ instruction / distance learning
- **Communication**: One to one/ one to many/ many to many/ synchronous - asynchronous/ social networking
- **News**: 24-hour news/ multiple channels/ Internet activism/ blogs
- **Entertainment**: Nature of entertainment - 3-D movies/ video games vs. active sports, implications for social interaction
- **Piracy and Intellectual Property**: Internet and access vs. ownership of information/ torrents/ copyright and plagiarism
- **Population**: People’s impact on technology - appropriate technology/ sustainability/ third world issues
- **Workforce**: Impacts on employment - outsourcing/ automation/ new job creation/ nature of new jobs/ new worker demographic
- **Politics**: Campaigns/ grassroots-’netroots’/ polling/ organizing / consensus building/ 24-hr channels/ talk radio/ participatory use of Internet
- **Ecosystem**: Deforestation/ urbanization/ species extinction/ habitat balance
- **Environment**: Global warming/ pollution/ oil-spills/ regulation/ national vs. international concerns
- **Surveillance**: Military/ scientific/ crime prevention vs. criminal activity/ pets, kids, stalkers/ biometrics/ privacy vs. security
- **Gender/ Diversity**: Technology impacts - technology for / by women/ feminist concerns/ and/or intersections of diversity with technology
- **Religion**: New media impact/ New technology to prop old rituals/ beliefs? Impact on awareness of/ education about religions /religious concerns

Topic threads provided a bearing point, which the teams could use as a launching pad to more specific cases. For instance the topic canopy ‘workforce’ could be developed into a podcast on labor market issues caused by the introduction of automation in industry. The impact of technology could be explored in the context of the macro-economic scenarios in labor markets, and industries, working within a financial and administrative framework. Such a topic would necessarily have to deal with a variety of global technology issues, where students could use an example case of their choice. One interpretation of this topic is illustrated in Figure 1 below:
Possibilities and Predicaments
The production of podcasts, it is fair to say, ranged from excellent, mediocre, to failing plagiarized material; however, the assignment did serve to substantially enhance student involvement and class participation. The projects were enjoyed by most students, as evidenced by high ratings for this assignment in their final teaching evaluations. Selected work was showcased in the classroom, where students could share their creations with the entire class. They enjoyed the hands-on technology-oriented nature of the assignment. Many confessed to learning new tools in the process of completing their work. The opportunity to tackle almost any topic in relation to technology, and explore it through visual means was universally liked. However, some problems were encountered in the student treatment of content.

First and foremost it was found that from the students’ perspective the notion of plagiarism seems to be exclusively reserved for textual material. They were not very careful or conscious of using visual and/or graphical material without adequate credits. Moreover the assignment inevitably involved work on technical multimedia issues in addition to the course content itself. This dichotomy presented its unique challenges. In a course on global technology, the multimedia activity in and of itself was not a relevant exercise. Some student evaluations commented on this lack of congruence between the subject matter and class activity. Moreover not all students seemed to grasp the intent of this project. Some focused on detailed recounting of technology processes, instead of discussing societal impacts. There were issues of style versus substance. Some students tended to work on media presentation almost exclusively, at the expense of any substantive contribution. Having said that though, introducing a multimedia project in this graduate course significantly contributed to enhancing student participation and involvement. A number of unique and spontaneous student-initiated discussions ensued, and the class as a whole gained in the process.

Conclusion: Media Use In The Classroom Of The Future
The podcast experiment outlined in this paper is arguably a useful pedagogical tool in certain learning contexts. It is one way to engage the highly diverse, short attention spanned, yet tech-savvy student demographic of today. It can create interest, and personalize issues that may not immediately relate to the class. When the students are encouraged to tinker with technology in their classroom, and offered a legitimate ‘techno’ venue for delivery, they may be more inclined to take interest. The podcast assignments do not and must not replace
writing, discussion, or oral presentations for this or any other course. However, the experiment suggests that these do offer a viable tool to generate greater interest and actively involve the students as creators of their own scholarship in the classroom.

References
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Spatial Visualization Skill Assessment in an Introductory CAD Course

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Abstract
The shift to digital technologies in engineering-related disciplines has required faculty to re-assess strategies for content related to spatial visualization development which is a critical skill for students entering design fields. This paper reports the outcomes a study in which a spatial visualization skill assessment tests was administered to students in an interdisciplinary introductory CAD class. Results of a pre-class test were used to investigate the extent to which performance on the spatial visualization test could be used to predict academic performance in the class, and a post-class test was used to investigate the extent to which course content impacted performance on the assessment instrument. Other factors such as prior course work were also considered. The study found a limited positive correlation between visualization skill performance and academic performance, but found no correlation between visualization skill performance and prior coursework and or between the pre-class and post-class tests. The results are discussed and recommendations are proposed for faculty teaching similar courses.

Introduction
The ability to conceptualize and visualize three-dimensional space and form is fundamental to development of design skills. Spatial visualization is central to the design process as it provides a bridge between design and design representation (Bertoline, Wiebe, Miller, & Nasman, 1995) and development or improvement of 3D spatial visualization skills is often cited as one of the major goals of engineering design graphics education. Spatial visualization is described as “the mental manipulation of spatial information to determine how a given spatial configuration would appear if portions of that configuration were to be rotated, folded, repositioned, or otherwise transformed” (Salthouse and Mitchell, 1990). Similarly, spatial visualization has also been defined as the ability to manipulate an object in an imaginary 3D space and create a representation of the object from a new viewpoint (Strong and Smith, 2002).

Academic programs in engineering, architecture, and other design fields have traditionally utilized manual drafting courses to develop fundamental design and visualization skills and to provide students with the technical skills needed for effective communication and documentation. The adoption of computer aided design (CAD) tools in professional and technical design fields has led educators to replace courses that traditionally used manual drafting and traditional drawing techniques with courses structured around CAD and related digital applications.

The role of CAD in the education of engineering and design professionals has become increasingly important. According to Contera et al (2009) “visual reasoning is to be considered, in terms of the learning outcomes and competences, as a capital aspect of future engineers’ education…. CAD tools, particularly the different “views” of CAD models used for engineering purposes cannot ... be considered a secondary learning ability” (p. 1). However, the adoption of these new technologies has not been without controversy. Clark and Scales (2000) identified concerns about software-based classes teaching technology-specific skills over content related to more traditional outcomes. They proposed that the clear trend towards teaching of constraint-based modeling and computer-aided manufacturing has raised concerns regarding the emphasis of software instruction over fundamental skills such as problem solving and that “software and technology will become the core of courses to the detriment of graphical and visual science concepts” (p. 33). While some educators have argued that the advances in 3D modeling has made teaching 2D and 3D visualization skills obsolete (Gow, 2007), while studies using a standardized spatial skills assessment, administered at the beginning and upon completion of 3D modeling CAD classes, found no significant improvements in spatial skill performance (Yue and Chen, 2001). Therefore, the effectiveness of digital technologies in meeting outcomes related to visualization skills should be further analyzed.
Spatial and Visualization Skills
Research first identified relationships between spatial skills and general intelligence in the early 20th century (Kelly, 1928). Esparragoza (2004) proposed that spatial visualization abilities are to a large extent analogous to any other human trait, stating that “there are some people who can run faster than others the same as there are some people who have the ability of processing visual information better than others” and that “engineers, designers and scientists should have visual abilities above average people to be creative and resourceful professionals (p. 77).”

Tartre (1990) proposed that there are two categories of spatial skill based on the mental processes involved in performing a visual task. The first, spatial visualization, involves mentally moving an object. The second, spatial orientation, involves mentally shifting the orientation from which a fixed object is moved. While standardized tests have been developed to assess spatial skills, they typically assess only one aspect of visual skill ability. According to Lieu and Sorby (2008), spatial intelligence is associated with multiple activities “just as developing linguistic intelligence requires you to speak, read, write, and listen (p. 3-5)”.

Research has found that performance among students with lower levels of spatial skill can be remediated with additional supplemental activities such as multi-view sketching and modeling exercises (Potter and Van der Merwe, 1993, 2004). Similarly, Esparragoza (2004) proposed that “training to help the students to develop and enhance their visualization skills can be done by means of problems and exercises in the orthographic projection and axonometric drawings topics (p. 78)”. He cited the role of two multi-media tutorials, the Visual Reasoning Tutorial (VRT) and the Orthographic Projection Tutor (OPT), in improving skills in a freshman engineering class. The VRT consists of fourteen missing view problems and the OPT consists of 32 sets of problems each of them with more than one exercise involving orthographic projection concepts. Other researchers have proposed the use of 3D virtual models to promote remedial spatial skill development (Martín-Gutiérrez, Luis Saorín, Contero, Alcañiz, Pérez-López, & Ortega, 2010). The positive impact of remedial spatial skill exercises has been found to be interdisciplinary. Research has also found that students in fields such as Computer Science and Biology who were enrolled in a remedial visualization course showed significant improvement in their spatial visualization ability (Sorby, Drummer, Hungwe, & Charlesworth, 2005).

Purpose of the Study
Based on the assumption that students with lower visualization and spatial skill ability could benefit from remedial exercises and coursework, it would be important for educators to identify students with lower levels of visualization skills early in order to provide an opportunity to supplement coursework with activities specifically designed to enhance spatial and visualization skills. Therefore, this study was developed to determine if a specific spatial visualization assessment instrument administered at the beginning of the course could be effectively used to predict academic performance, which could enable faculty to target students who may benefit from supplemental exercises. Additionally, using a post-class test, the study investigated the extent to which the content of course impacted performance on the test. This study utilized the Purdue Visualization of Rotations Test, which has been widely used in research related to multiple disciplines and is considered to be a spatial ability test for which results are least likely to be complicated by analytical processing (Bodner and Guay, 2009).

The study population was drawn from students from varied academic programs enrolled in two separate sections of an introductory CAD course, each of which were taught by different instructors. The study also investigated the relationship between prior coursework in manual drafting and computer aided drafting (CAD) and performance on the Purdue Visualization of Rotations Test.

Overview of the Purdue Visualization of Rotations Test
The Purdue Visualization of Rotations Test consists of three sections, each of which has 12 multiple-choice questions. The sections are referred to in this paper as “folding,” “views,” and “rotations.” At the beginning of each section, sample problems with an accompanying solution and explanation are provided. The tasks related to each section are as follows:
Folding (Figure 1):
- 12 images of 2D drawings representing unfolded 3D objects. The portion of the unfolded shape which is to form the base is cross-hatched;
- For each of the 12 drawings, five isometric views of 3D objects are provided. All are somewhat similar in geometry are provided, but only one of the five is the correct representation of the 2D drawing folded into its 3D form;
- Participants are to identify which of the five options corresponds to the unfolded surface.

![Figure 1. Folding Test Example](image)

Views (Figure 2):
- Each task has one 3D object shown positioned in the center of a wireframe cube;
- There are 12 unfolded 2D drawings. The portion which is to form the base is cross-hatched;
- The cube has a mark indicating a viewing direction;
- Participants are to identify which of five view option corresponds to the viewing direction.

![Figure 2. Views Test Example](image)

Rotations (Figure 3)
- Each task has an object pre-rotated and post-rotated;
- A second object is shown pre-rotated.
- Five isometric views of the second object are provided, each showing a different post-rotation. Participants are to identify the view showing a second object rotated the same way as the first.
Methodology
The research questions developed for the study were as follows:
1. Does prior coursework in manual drafting or computer aided drafting impact performance on the Visualizations of Rotations Test?
2. Is there a relationship between performance on the Visualizations of Rotations Test total score, the aggregate of the three sections, administered at the beginning of the course and academic performance?
3. Is there a relationship between performance on any of the individual sections of the Visualizations of Rotations pre-class test administered at the beginning of the course and academic performance?
4. Was there a significant difference in pre-class and post-class scores on the Visualizations of Rotations Test?

The Visualizations of Rotations Test pre-test was administered in the first week of the CAD class, along with an additional form that was used to collect demographic information and document the number of prior manual drafting courses and prior computer aided drafting courses taken at the secondary and post-secondary level. The post-class test was administered in the last week of the semester. Students were not told they would be re-taking the test at a later date. Participation was voluntary.

To document prior classes related to CAD and manual drafting, the respondents were asked to indicate the number of classes selecting from a list of none, one, two, three, or more than three. These responses were classified as ordinal data. The grades were structured as ordinal data using a five-point scale, with a value of 4 assigned to a letter grade of A, and a value of 0 assigned to a letter grade of F. These responses were also classified as ordinal data. The student’s final letter-grade was used as the basis for determining academic performance in the class.

For both the pre and post-class tests, scores were documented for each of the three Visualizations of Rotations Test sections and an aggregate score, the sum of the scores of the individual section, was calculated and classified as scalar data. The pre-class test aggregate score, termed the Total Score Test 1, was used to test for significant correlations with final letter grade in order to determine the extent to which the Visualizations of Rotations Tests predicted academic performance. The post-class test, termed Total Score Test 2, was analyzed in the same way as the pre-class test. The pre-class and post-class test scores were analyzed using Paired Samples t-tests to determine if performance on the Visualization of Rotations Test was influenced by course content. Research question four was based on the assumption that a statistically significant increase in performance on the assessment instrument would suggest an increase in spatial visualization skill resulting from course content. A confidence interval of .95 was used for all tests.
Results and Analysis

28 students in the two sections of the class initially agreed to participate in the study and completed the pre-class Visualizations of Rotations Test and the accompanying demographic form. Of these, two were engineering technology majors, 9 were architecture majors, 11 were construction majors, and 6 were from other fields including aviation, art, and electronics. 15 (53.6%) of the respondents indicated they had experience with prior manual drafting coursework and seven (25%) indicated they had prior CAD coursework. Of the 28 students completing the pre-class test, 18 (64%) completed the post-class test at the end of the semester.

In response to research question one, statistical analysis of the using crosstabs and bivariate correlations found no statistically significant relationship between the number of prior manual drafting courses or the number of prior CAD courses and final grade. Similarly, no statistically significant relationship was found between the number of prior CAD courses and final grade or performance on the Visualizations of Rotations Test.

The results for the analysis of data associated with research questions two and three were mixed. Analysis using crosstabs yielded a statistically significant relationship between the aggregate score for the pre-class test (Total Score Test 1) and final grade using both the spearman correlation ($\rho=.050$) and kendall’s tau-b ($\rho=.048$). When considering the individual sections, only the scores pre-class test folding section was found to be statistically significant in relation to the final grade (kendall tau-b correlation, $\rho=.040$). However, analysis using bivariate correlation tests yielded no significant relation between final grade and the pre-class Total Test Score, but it did yield a significant relation between final grade and the scores for the pre-class folding section. When considering the post-class test, no significant correlations were found with final grade and either the aggregate score or with any individual sections.

When considering research question four, comparisons between the pre-class and post-class tests produced did not prove conclusive. The mean of the pre-class test aggregate score was 20.18 (56.1%) and the mean of the post-class aggregate test score was 20.83 (57.9%), indicating an increase of only 1.8%. Similar results were found with the test sub-sections. The Folding score mean increased from 7.0 to 7.5 (4.2%) increase and the Views score mean increased from 6.68 to 7.28 (5.0%). However, the mean for the Rotations scores decreased from 6.50 to 6.06 (-3.7%). Analysis of the pre-class and post-class aggregate test scores, Total Score Test 2, and of the individual sections using paired samples t-test yielded no statistically significant change. These results are documented in table 1.

**Table 1. Paired Sample test results**

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td>-2.778</td>
<td>5.42115</td>
<td>1.27778</td>
<td>-2.9737 - 2.4181</td>
<td>-2.217</td>
<td>17</td>
<td>.05</td>
</tr>
<tr>
<td>Pair 2</td>
<td>-1.11</td>
<td>2.968</td>
<td>.700</td>
<td>-1.59 - 1.36</td>
<td>-1.159</td>
<td>17</td>
<td>.25</td>
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<tr>
<td>Pair 3</td>
<td>-.72</td>
<td>2.585</td>
<td>.609</td>
<td>-.80 - .62</td>
<td>-1.185</td>
<td>17</td>
<td>.25</td>
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<td>Pair 4</td>
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<td>2.812</td>
<td>.663</td>
<td>-.84 - 1.95</td>
<td>.838</td>
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<td>.10</td>
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</tbody>
</table>

Discussion and Conclusions

The purpose of the study was to determine if a specific spatial visualization assessment instrument could effectively predict academic performance, thus providing a mechanism for identifying students that may benefit from supplemental course activities to improve their performance in class. While the data did indicate that there was a significant relationship between grade and Total Score Test 1, indicating a relationship between test score and academic performance, the lack of similar findings on the individual test sections suggest that the relationship was not uniform and was primarily attributed to the performance on the Folding section. Therefore, these data indicate that the Visualization of Rotations Test demonstrated limited applicability in predicting academic performance in this class.
More importantly, the results of the analysis of the post-class test, along with the comparison of the pre-class and post-class test scores, indicate the class content did not influence performance on the visualization skill test, particularly since a slight increase in performance would be anticipated based on the participant’s prior experience with the pre-class test. While these results could be influenced by the limited sample size, as well as the reduced participation in the post-class test, the lack of correlation between Total Test Score 2 and academic performance suggest that the content of the class had minimal impact on the development of visualization skill as measured by this specific test.

The specific visualization skill assessment tool used in this study was one of several discussed in the literature. Investigation into the effectiveness of alternative instruments may yield different results. Therefore, further study using alternatives are warranted. As the study looked at performance in a computer-based class, these alternatives should include instruments that are administered via electronic mediums rather than paper form.

Wieb (1999) argued that “it is clear that traditional analytic graphical techniques help students to think ‘geometrically (p. 15)”’. The literature does suggest that visualization skill can be improved and enhanced, even among students with lower levels of ability in this area. However, the cited examples used both traditional and digital strategies. Therefore, faculty may want to consider the integration of traditional media exercises to parallel, and at least to some extent assist in, the development of spatial visualization abilities among our students.

Technological advances in the design professions require educators to incorporate digital applications into curriculums in order to adequately prepare graduates with the skill sets needed in practice. However, it was previously noted that Clark and Scales (2000) raised concerns that classes such as that used in this study emphasized software skill over problem solving. While in-depth analysis of the content and pedagogy of this specific CAD was beyond the scope of this study, these data suggest that faculty must be diligent in insuring that the integration of new digital tools does not dominate the development of fundamental skills, including visualization abilities. Tasks requiring students to utilize CAD tools such as dynamic section planes, and views generated with orthographic camera features, integrated with hand-sketching and physical model building could assist in the development of visualization skill in parallel with CAD skills.

References


2010 Graduate Student Research Presentation Competition Abstracts

“Bridging the Gulf”
Wednesday October 27 - Saturday October 30, 2010
Edgewater Beach Resort - Panama City Beach, Florida
Graduate Student Research Presentation Abstracts

The University Division of ATMAE sponsors an annual conference competition, the Graduate Student Research Presentation & Poster Competition, to allow selected graduates students an opportunity to showcase their work and hone their presentation skills. The presentations to be made at the conference are selected by peer-refereed review of submitted one-page abstracts by ATMAE members who are University faculty. Eight abstracts were submitted for the 2010 competition, and four were chosen for presentation, an acceptance rate of 50%.

Titles and Authors:

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Assessment of the Effect of Green Supply Chain Management Barriers to Its Implementation

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Abstract:
Since environmental issues have gained the public’s attention significantly in the last few years, organizations around the country have increased awareness of green concepts and attempted to be environmental friendly organizations. Green supply chain management (GSCM) is one of many areas influenced by this occurrence. GSCM integrates environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers, and end-of-life management of the product after its useful life. In the United States, many organizations adopt GSCM principles into their systems. Not only manufacturing, but GSCM is also applied in other business sectors such as government, education and services. Transportation companies change their trucks to be more environmental-friendly such as replacing old engines with hybrid engines. Retailers force suppliers to provide products that are from an environmental-friendly process. It can be said that environmental concepts are embraced in every industry and business.

Despite its extensive benefits and importance, few studies are concentrated on the barriers of the GSCM implementation. Most research is related to the GSCM benefits and its different applications. Although the GSCM has been adopted widely in various businesses, electronics industry is one industry getting effect from green the most from many reasons. The nature of the industry usually involves with heavy substances. Several processes require high amount of energy and they emit toxic waste at the same time. Moreover, there have been new regulations by several countries and regions all over the world for electronics industry such as European countries and China. Electronics companies in the United States who export their products to these countries will be required to follow the new regulations in order to continue their market.

This study identifies barriers to implementation of green supply chain management in the electronics industry. This study explores factors that prevent companies from implementing green, and identifies types of green that the electronics industry adopted in the United States. Data was gathered by interview and survey methods. A few selected participants were interviewed face-to-face and via phone. Interview participants were employees working in an electronic company. Interview questions were related to the company’s contribution to green implementation projects. Data from interview along with literature review was analyzed and used as an input for generating survey questions. An initial email was sent out to the electronics industry across the country. Participants represented different roles in the industry such as manufacturing, distribution, third party, and retailer. Survey questions identified the barriers of GSCM implementation, as well as the implementation level of electronics industry in GSCM. Data was analyzed by SPSS using the Factor Analysis method to verify results. Other aspects, such as the company size and location, were tested to see the difference in GSCM barriers and implementations. Also, some questions detailed collaboration with suppliers and customers, technology used, how they choose the supplier, and future trends.
Lean Six Sigma Implementation in a Newly Established Cable Manufacturing Company

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This paper describes an ongoing research project of Lean Six Sigma deployment in a newly established cable manufacturing company.

Introduction:
As Lean Six Sigma shows a great influence on bottom-line savings in many companies, it is becoming popular among large and small enterprises, which are seeking more benefits in order to survive from slow economy. Newly established companies need to have more effort in order to implement Lean Six Sigma methodology into their manufacturing process. Previous studies mostly addressed two types of deployment models. Newly established companies and companies, which have already been established and are currently producing goods or services. This project intends to show a need for an improved model for Lean Six Sigma deployment for newly established enterprises, which decide to deploy Lean Six Sigma into their process after a year or two from their establishment time. As a result of lacking sufficient and appropriate process documentation and substantial workload of management, the nature of Lean Six Sigma application should be improved in order to overcome some difficulties through studying, analyzing and implementing stages of the process improvement project. Substantial workload of the management in new companies will result in less support for the Lean team, which may contribute toward failure of the project. The substantial workload also applies to other ranks such as operators and mid managers, and makes it harder to have them involved into the project. Besides this problem, several types of resistances have been experienced through different stages of Lean Six Sigma implementation. These resistances have been addressed through different literature (Waring and Bishopa 2010), (Kwaka and Anbari 2006).

Purpose:
In this study Lean Six Sigma methodology, which is based on customer review of a product and emphasizes on waste reduction concept, is used as a mean of process improvement to a cable manufacturing company. As the company has been established since a year ago, there have been several challenges regarding efficiency of work flow and process management throughout its different production lines.

Methodology:
The Jacketing Line, which was identified as one of the most inefficient processes, has been selected as a pilot project for the first deployment step. As the first step, influential metrics were defined A production dashboard was developed using graphs and charts demonstrating the defined metrics measurements. Value Stream Mapping process was developed and the current status of the production line has been defined. To develop a baseline, the manufacturing activities were categorized into value added and non-value added and different types of waste in the list of processes were defined. Then other important parameters such as UnDesirable Effects (UDEs), used space, lead time, distance and systems velocity have been measured. The most significant part of this project was to embed some basic process control instruments for the production line into the Lean Six Sigma deployment model. Since this was a newly established company, no documented procedure for data collection and quality measurement for the production line existed. Designing of the basic structures, such as quality control process design, production flow chart for different processes, and production data collection structure were among the embedded instruments into our developed Lean Six Sigma deployment model.

Conclusion:
At the current stage of the project, some recommendations have been provided in order to implement basic techniques of Lean Six Sigma such as Kaizen and 5S in the line. By applying these recommendations, we expect a significant reduction in waste and considerable improvement in the flow of product to a smoother and faster pattern. After completion of the pilot stage, Lean Six Sigma is going to be implemented through the whole processes into the company from manufacturing level to administrative and managerial levels.

Reference:
Measurement and Analysis of Safety and Quality Decision-Making in the Workplace

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Human factors play an important, but often overlooked, role in the management of safety and quality in the work environment. One of these factors is trust. Little research has been done to explore the linkages between trust and safety or quality workplace outcomes. Safety and quality programs depend heavily on the decisions employees make on the job, therefore, an increased understanding of factors influencing their decision-making process is an important component of safety and quality educational intervention.

This research will address an important element of safety and quality-focused workplaces - personnel and their interpretation of the importance of tasks and procedures assigned to them by their supervisors and management. Safe workplaces benefit both workers and the organization. Additionally, quality management systems have been shown to increase revenue, improve inventory management, and allow increased compliance with legal regulations. None of these improvements can be realized if employees do not make positive safety and quality-oriented decisions on the job, therefore, an increased understanding of factors influencing their decision-making process is an important component of safety and quality educational intervention.

Data for this project will be gathered in two parts. Workers will be surveyed on three aspects of organizational climate: trust, safety, and quality. Each survey instrument will ask for their perceptions of two levels of administration: direct supervisors and corporate management. The second part of data collection will involve employees completing two computerized decision-making scenarios. The first will present a typical workplace scenario emphasizing safe decision-making and the second scenario will emphasize a typical quality-related decision. Each scenario will offer four decision alternatives and outcomes of each decision in a matrix format. The computer program will track the alternatives and outcomes visited by each employee, allowing measurement of both the final decision and the process used by each employee to make their decision.

Data collection will begin October 1, 2009 and will continue through February 2010. Using inferential statistical tools such as regression and factor analysis, the goal of the project is to determine if employee perceptions of organizational trust, safety, and quality predict decision-making patterns in scenarios involving workplace safety and compliance with quality standards. Another outcome is to identify contributing factors in the decisions made by employees. Integrating these data with information from previous research, an event tree analysis will be used to determine the role of employee decision-making in the success of organizational quality management and safety programs. Using this information, targeted and responsive educational/training interventions can be developed for employees.
A Proposal to Incorporate Lean Manufacturing for Sustainable Agriculture

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Abstract and Program Rationale:
Purdue’s Agriculture programs are known worldwide for their students and the leadership graduates display upon commencement. The contribution of Purdue to the agricultural community is well-known. Likewise, the College of Technology and specifically, the Industrial Technology (IT) Department at Purdue University is well-known for strong undergraduate programs. Currently, there is little discourse or collaboration between these departments. The goal proposed here is to bring together the College of Agriculture (COA) and Technology by utilizing an IT core competency, Lean manufacturing, with COA curriculum to meet the growing global demand for sustainable practices in agriculture.

Program Description, Objectives, and Method Evaluation:
IT 214, Introduction to Lean manufacturing, is a regular course offering in IT and has been taught by this author. In coordination with course coordinators in IT and COA, the proposal here is to modify and potentially innovate a new course offering specifically targeted at COA and COT majors interested in applying sustainable, lean practice in a agriculture/agribusiness, a crucial national industry. Based upon the spiral curriculum design model currently used in Lean manufacturing, a new or modified course will be used to promote collaboration with the College of Agriculture, for the benefit of interdisciplinary study and education.

The first objective is to form a partnership between the College of Technology and the College of Agriculture for the purpose of co-development/modification for incorporating Lean manufacturing techniques into the curriculum of agriculture majors. Further study will be required to decide the proper positioning of the coursework into the Agricultural curriculum. The second objective is to research a thesis topic for graduate work by building on the first objective to promote Lean sustainable agriculture to a wider audience. Previous study demonstrates that Lean is broadening beyond its manufacturing roots but very little has been applied and incorporated into the agriculture and foods industry. What has been accomplished is novel, so information pertaining to this topic defines innovation in processes and further defines what applied research encompasses. Information gathering will be a hybrid process consisting of quantitative and qualitative techniques. A deliverable beyond the interdisciplinary work, curriculum, and applied research for the purpose of scholarship, is to describe Lean within a novel, innovative context of not only agriculture, but the wider use of handling biological products.

Following is the template for proceeding:
As the literature review is progressing, the data will be compiled into a useable format for references for approaching the College of Agriculture.

As previously stated, the existing Lean Manufacturing course is structured around Industrial technology students, and will need adjustments or a new curriculum developed pertinent to agriculture/foods majors. Since it is a spiral curriculum, changing the central case study will be an appropriate adjustment. If ag/foods students enroll in the Lean Manufacturing course, surveys will be conducted of the students for feedback in how they will apply Lean techniques to their field. This will take the form of entry and exit surveys. The evaluation of the success of this endeavor will be contingent upon how many students elect to enroll in the Lean manufacturing course. The survey tool used will have a numerical scale and statistical analysis will be performed on this data. In addition, excerpts from the literature review will be included in a final report.

This is a project in the very beginning stages, so there are no results at this time, but I hope to have some feedback by the time of the conference.