ATMAE

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ATMAE 2016 Annual Conference

November 2 - 5, 2016

Universal Studios, Florida

Entering the Future

The ATMAE 2016 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 2016 Annual ATMAE Conference in Orlando, Florida November 2-5, 2016. The proceedings include all of the conference presentation abstracts that were accepted through the peer-review process and which were presented at the conference, and the Conference Proceedings Papers, based on accepted presentations, which were submitted and accepted through a secondary peer-referee process.

The reviews of presentation proposals and conference papers were led by ATMAE Division and Focus Group leaders. The proposals and papers were reviewed by a panel of ATMAE members with expertise in the topical area in a double-blind process. Review panelists evaluated the presentation abstract and papers pursuant to the review criteria, ranked each, and a cumulative rank-ordering system was used to help select the presentations and papers to be presented and published.

Many ATMAE members and leaders dedicated their time and expertise to review of all the Conference Presentation Proposal Abstracts, Conference Proceedings Papers, Student Research Competition Abstracts and Best Papers for the ATMAE 2016 conference. Without their time and efforts, ATMAE could not provide a thorough double-blind peer-referee process. Our thanks go to all of those dedicated ATMAE members:

Conference Presentation Abstracts and Proceedings Paper Process:
Mahmoud Al-Odeh, Eli Aba, Taha Aldoss, Mark Angolia, Sherif Attallah, Burchan Aydin, Wutthigrai Boonsuk, David Brinkruff, Yi-hsiang Chang, Hans Chapman, Austin Cheney, Robert Chin, Shweta Chopra, Jerry Cloward, Phillip Cochrane, Curtis Cohenour, Jeff Cunion, Ulan Dakeev, Renu Dalal, Paul Deering, Raj Desai, Stephen Dunn, Immanuel Edinbarough, Susan Ely, Dominick Fazarro, Dennis Field, Rod Flanigan, Bandara Gamini, Mehmet Goksu, Kimberly Gordon, Denise Gravitt, Louis Hickman, Dave Hoffa, David Hua, John Irwin, James Jones, Ekaterina Koromyslova, Dennis Kroll, Heshium Lawrence, Edward Lazaros, Dan Lybrook, Tarek Mahfouz, Rachelle Mcfarlane, Richard Miller, Perry Moler, Gretchen Mosher, I. Richmond Nettey, Randy Peters, Patricia Polastri, Rukmini Srikant Revuru, Suhansa Roadchua, Cathy Robb, Marla Rogers, Clair Roudebush, Charles Schwab, Euysup Shim, Peter Shull, Sara Smith, Fariborz Tavangarian, Edem Tetteh, R. Thomas Trusty II, Ron Tuttle, Wafeek Wahby, Gerald Watson, Charles Weiss, Cheryl Wilhelmsen, Ronald Woolsey, John Wyatt, Justin Yang, Dave Yearwood, Faruk Yildiz, Jin Zhu

Best ATMAE Conference Proceedings Paper Award:
"Filling the Gap between Industry and Academia: Teaching Critical Skills in Automation and Control using Developed, Open-Source Programmable Logic Controller Software"
Dr. Aleksandr V. Sergeyev, Michigan Technological University
Dr. A. Nasser Alaraje, Michigan Technological University
Dr. Scott A. Kuhl, Michigan Technological University

Administration

Construction

Distance Learning

EECT

Graphics

Management

Manufacturing

Micro / Nanotechnology

Safety

Teaching Innovations

Thursday, November 3, 2016

Administration

A Model for Building Strong, Sustainable, and Program Specific Industry Relations

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Need: Having strong, meaningful relations with industry has been an ongoing pursuit in applied engineering for many years. There are many reasons for this pursuit, including keeping faculty current, keeping curriculum current, development of capstone projects, providing internship opportunities for both faculty and students, and even a source for new faculty members. Another reason for good industry relations often goes overlooked; ongoing program and faculty funding. As legislative budgets continue to shift funding away from higher education, it has become increasingly difficult for faculty to find the necessary financial resources to conduct research, to travel to industry and educational conferences, and to provide the necessary equipment for labs and other classroom exercises.

Overview: The diminishing funding model at state institutions, combined with the rising expectations on faculty to teach, conduct research, and secure outside funding has caused tremendous stress and concern among faculty members. The Industrial Distribution (ID) program at the University of Nebraska at Kearney (UNK) has developed strong industry relations with both regional and national companies. These companies may become ID program partners who provide annual financial contributions to the program to help sustain and promote the program as well as the discipline. This program partner funding is not subject to typical university share models that is common in higher education.

Major Points:

- Best practices in developing strong industry/program relationships. Learning from what works… and what does not work.
- How to generate funding to help faculty and students travel.
- Opportunities to keep faculty and staff engaged with industry.
- Ways to keep curriculum current.
- Less reliance on public grant money.
- How to develop a sustainable model for ongoing program improvement.
- Funding endowment funds, providing student scholarships, and more.

Summary: Attendees will learn about novel techniques used to attract state, regional, and national partners to the ID program at UNK. Attendees will also learn how the UNK ID industry relations model helps to build value for all shareholders, both internal and external.

Friday, November 4, 2016

Administration

Analyzing Enrollments Trends for All Construction Management and Manufacturing Programs Accredited by ATMAE

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Need: Program enrollments assist in developing the workforce availability and future considerations for many programs. The trends allow higher education to gain insight into programs or areas of study that could aid in the growth of the program numbers. Contrarily, it can also show or gage where resource allocations can best be served for programs or possibly the creation of areas of study within majors that may infuse growth.

Overview: A pilot study was completed in 2015 to identify the enrollment data trends for both manufacturing and construction programs accredited by ATMAE. As such, faculty at University are interested in finding enrollment data based on these major types for all ATMAE accredited programs. This information will give practitioners in the manufacturing and construction majors an opportunity to forecast potential future considerations for their programs or departments.

Major Points:

- Enrollment data for construction and manufacturing programs accredited by ATMAE.
- Forecasting from the National Labor Statistics on construction and manufacturing programs into 2025.
- Elevate awareness of opportunities for program growth in areas of specialization or existing majors.
- Development and use of a repeatable database for reference by ATMAE members and assist in future research opportunities.

Summary: Attendees will acquire enrollment trends for standard majors such as construction and manufacturing while finding potential areas of growth in their majors. Additionally, attendees will get the opportunity to see what majors are trending upwards in our current technological state toward the future and what majors are trending downward. Lastly, a glimpse at changes made in a program to attract students by incorporating specializations or areas to assist in trending enrollment back up.

Thursday, November 3, 2016

Administration

Application of Project Management Principles in Higher Education Administration

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Need: A project is defined as a one-time, multi-task job with clearly defined starting and ending dates, a specific scope of work to be carried out, a budget and a specified level of performance. Project Management uses a set of tools to create a work plan, manage work, anticipate and solve problems, allocate resources and implement the plan. Austin, et al (2013) reported the scarcity of research studies that show that higher education has embraced project management processes as a way of delivering products and services.

Overview: Higher education is fraught with many projects that if managed properly will contribute to effective, efficient and timely delivery of product and services to their customers-the faculty, staff, and students. While Project Management application is very popular in businesses and industries, it is not so in higher education settings. In his study, (M. Scherumann, 2013) found that subjects believe that organizations such as higher education, government, and the arts have been unsuccessful in project management due to turn over, resource constraints, competing interests, operating costs, a lack of need for efficiency or results and specifically within higher education, the governance that is involved receives faculty opposition. Given the diverse nature of projects in higher education, the use of project management methodology will help in the delivery of projects on schedule, on time and within budget.

Major Points:

- What is a Project?
- What is Project Management?
- The Project Life Cycle
- Leading a Project Team
- Implications for Higher Education

Summary: Setting up a Project Management Office and employing project management methodologies in higher education will deliver results needed to achieve strategic organizational goals and will alleviate overload of subject matter experts.

Thursday, November 3, 2016

Administration

Approaching Accessibility Needs of Both Students and Faculty in Technology Programs

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Need: While college campuses often focus on legal adherence to the Americans with Disabilities Act (ADA) requirements, administrators should look beyond these minimums when designing new or renovated educational spaces. By taking active and interactive leadership roles in the design and construction processes, administrators in technology programs will shape environments that are more conducive to learning for both students and faculty members with disabilities.

Overview: Technology programs are typically known for their "hands-on" learning emphasis, with students and faculty actively engaged together in the learning environment. Although disability requirements are followed in the construction and renovation of educational facilities faculty and student input can leverage this process to help in developing a successful learning environment. It is necessary for further conversation between administrators and technology professors to enhance a better understanding of making more effective accommodations in learning spaces. There are several issues to consider when developing building plans for a better teaching and learning environment. By discussing the possibilities that other faculty have or might face, a collaboration of ideas can be formed to assist technology administrators to better plan for their own space planning.

Major Points:

1. Accessibility issues in technology program classroom and laboratories
2. Tips to assist architects, owners, construction managers, and technology administrators
3. Facilitating input from faculty and students with disabilities regarding space issues and practical use
4. Brainstorming conversation between conference participants about what might be needed for success in a learning environment
5. Challenges, solutions, and lessons learned 6. Conclusions and recommendations

Summary: Attendees of this presentation will understand successful approaches for addressing accessibility issues for students and faculty members in the construction and renovation of learning environments . Perspectives of administrators and faculty members are provided, along with examples and case studies.

Assessing Student Performance of Program Outcomes: A Case Illustrating a Model Process for Continuous Program Improvement and Accreditation

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Need: Assessments and evaluations are vital to any dynamic agency for improving the quality of program performance and efficiency in accomplishing goals. They can have enormous benefits not only for the individual, but also to the broader organization. To assure the quality of higher education in management and technology related programs, the dynamic assessment program must be in place. The purpose of this study is to present a well-round developed model, mainly focusing on program outcomes, to assess student performance and learning effectiveness.

Overview: Two STEM graduate programs are used to development and implement this outcomes assessment model which has been offered since the 1960s with current enrollments over 250 majors in Fall 2015. Students have options of enrolling in courses on-campus, satellite campus, hybrid, or 100% online delivery. The programs developed assessment plans with a focus on students' learning and meeting national standards from Higher Learning Commission (HLC), Association of Technology, Management, and Applied Engineering (ATMAE), ACCE, and ABET. The model includes inputs from industrial advisory board members, students, faculty, and administrators. These inputs are identified and incorporated into the programs strategic plan. The related activities can be divided into six primary steps, the paper presentation focuses on student performance and program outcomes assessment.

Major Points:
Step1: Define the preliminary learning outcomes.
Step2: Identify the involved stakeholders and their tasks
Step 3: Design instruments for collecting inputs/feedback
Step 4: Link program outcomes, course contents, and assessments
Key topics covered in this study include:
• Statement of problems: quality assurance in higher education accreditation • M.S. in Industrial Management: 8 program outcomes with 42 measurable competencies • M.S. in Technology: 6 program outcomes with 38 measurable competencies • Student performance on 98 competencies, assignments and examination • Data analysis on student evaluation of program outcome • Cause-effect diagram of successful teaching and learning in higher education Step 5: Measure and evaluate the program Step 6: Feedback for improvement and restart the cycle

Summary: Student performance of program outcomes can be an efficient response for maintaining high levels of quality in teaching and course delivery. With a successful students' achievement, stakeholders' satisfaction, and increasing number of enrollment, this proposed model has been in development since 2004 and is in its fourth complete review cycle. The model is robust and useful as a mechanism for tying together various technical areas of curriculum review and assessment at the program level. This model using traditional grade book tools for assessing learning effectiveness and student satisfaction can assist course developers, instructors, and administrators to plan, design, implement, and manage productive learning systems. In addition, the study suggests other opportunities and challenges for the future research in implementing the assessment programs and the uses of technology in communication and meetings among academic stakeholders.

Thursday, November 3, 2016

Administration

Creating a Community as a Method of Retaining Female Students in a Male Dominated Academic Field

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Need: Being a female student in a male dominated curricula can be isolating. Retaining these female students can be challenging for administrators of technology programs. Providing a connection between the female students can strengthen their interest and commitment to both their current academic field and to their future profession.

Overview: Both technology industries and academia struggle with attracting and retaining females. This presentation examines one male dominated academic program's implementation of a plan for retaining female students, and how its approaches can be adapted by administrators in other technology programs. Over the course of the last two years various approaches, both successful and unsuccessful, have been put into practice as techniques to connect the females to both their current academic program and their future profession will be discussed. This presentation examines one program's implementation of a variety of methods and how these approaches can be adapted by administrators in other technology programs.

Major Points:

- Challenges to retaining female students
- Developing the plan
- Best practices for retention strategies
- Unsuccessful strategies
- Team-building and sharing
- Conclusions and recommendations

Summary: Attendees will learn proven methods to connect female students in a male dominated curriculum to both their current academic field and to their future profession. Perspectives of both faculty and the program director are provided.

Thursday, November 3, 2016

Administration

Creating a Cyber Security Major in a Liberal Arts Institution

Author(s)
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Need: Cyber attacks on the United States are increasing in frequency, scale, sophistication, and severity of impact. In 2015, the number of detected security incidents soared 38%. Cyber criminals are targeting both the public and private sectors and the annual cost of cyber crime is in the billions. As more colleges form cyber security, network security, and computer forensic majors, the need for a comprehensive curriculum formation is crucial to teach not only the technical aspects of the field but also the global, socio-political, and ethical views and implications of the field.

Overview: This presentation will address the benefits of a cyber security curriculum in liberal arts institutions as well as the challenges that curriculum formulators face that may be unique to non-technical colleges and universities.

Major Points:

- Increase in demand for qualified cyber security professionals
- Institutional challenges related to cyber curriculum formation
- Importance of interdisciplinary inclusion
- Importance of ethics and professional standards

Summary: The attendees will gain insight into curricular development for a cyber security program that focuses on both the technical and non-technical skills.

Thursday, November 3, 2016

Administration

Developing Accurate Rubrics for Both Classroom and Program-Level Assessments

Author(s)
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Need: Rubrics are a common tool used in assessment, however, not all rubrics are created equal. There are many different types of rubrics and the appropriate application of a rubric may depend on the type and scale used within the rubric. Unfortunately, rubrics are often inaccurately used when generating course-based assignment grades due to the fact that the levels of learning as measured by a rubric do not necessarily correlate with the traditional grading scales used in education. The importance of this presentation is it will provide participants with a thorough understanding of the correct design and application of rubrics for both course-based assessment and program-level assessments for accreditation.

Overview: A rubric is an assessment tool that provides a description of the varying degrees of performance for an assignment, project, or evaluation. The use of rubrics for critical assessments has become a necessity, especially at the program level for accreditation, and is an effective way to communicate levels of learning to a student or external reviewer. The purpose of this presentation is to discuss the different types of rubrics, explain the best practices in rubric design, identify the common mistakes in the application of rubrics, and explain different techniques that can be used when converting rubric scores to grade-based percentages.

Major Points:

- Define and describe a rubric
- Compare and contrast the different types of rubrics
- Differentiate the different applications of rubrics
- Explain how to design a rubric
- Identify common rubric design mistakes
- Discuss the rubric scale • Identify common rubric scale inaccuracies
- Describe appropriate methods for converting rubric scores to grade percentages
- Discuss the use of rubrics in the accreditation process

Summary: Participants in this presentation will gain a thorough understanding of the correct design and application of rubrics for course-based assignments and program-level accreditation assessments.

Friday, November 4, 2016

Administration

Eligibility of Master's Degree Applicants for Tenure-Track Faculty Positions in 4-Year Programs

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Need: The tendency of an academic program to thrive is dependent upon the recruiting and retention of quality faculty members. Faculty recruiting is a necessary and oftentimes challenging undertaking for engineering technology and applied engineering programs. One factor that affects faculty recruitment is whether an institution or program recognizes the master's degree as qualification for a tenure-track position. An examination of trends in the recognition of applicants possessing master's degrees as tenure-track-eligible is helpful in gaining at least a partial understanding of how to best recruit new faculty.

Overview: This presentation will provide attendees with a description and discussion of the results of an initial survey that examined trends among 4-year engineering technology and applied engineering programs and their recognition of a master's degree as valid for a tenure-track position. The presentation will also describe how trends in this area have changed over the years and discuss possible reasons for these changes.

Major Points: Whether a program recognizes the a master's degree applicant as tenure-track eligible plays a factor in faculty recruiting. There is a variety of stances on this topic amongst 4-year engineering technology and applied engineering programs. The trends regarding the master's degree and tenure-track eligibility have changed over the years, and continue to change.

Summary: Attendees will leave this presentation with a better understanding of how 4-year engineering technology and applied engineering programs view the master's degree applicant as tenure-track eligible. This information should be useful for any program's faculty recruiting efforts.

Thursday, November 3, 2016

Administration

Enhancing the Learning and Engagement of Women and Underrepresented Minority Students

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Need: There has been significant effort taken by the government, universities, companies, and other organizations to reduce the chilly environment, reduce the leaky pipeline, and increase the involvement of women and underrepresented minorities (URMs) in STEM disciplines. Despite these efforts, the number of women and URM in STEM disciplines remains low. Female and URM students often find the class and workplace climate "uninviting, unaccommodating, and unappealing". Other research suggests factors of social isolation, uninviting environments, chilly climates, bias, hostility, and the subtle differences that accumulate and make it more difficult for women and URMs to succeed in STEM fields.

Overview: Researchers have found that the feeling of isolation can be partially addressed in part by having seniors in the field to whom such individuals can look up to and consider mentors. These mentors can provide guidance on individual's journey in their career, work life balance and best practices for success in current and future workplaces. These role models and mentors from the STEM field can reinforce belongingness among peers. This study addressed the gap of providing a collegial climate to women and URMs to help them understand their field of study by organizing presentations by technology professionals, panel discussions, and industry visits. Such activities help reinforce students about the choice of work they intend to pursue. Furthermore, such activities increases students participation, retention and at various incidents recruitment of women and URMs.

Major Points:

- Perceptions of seminars, panel discussion and industry tours by students
- Ways of actively involving women and minorities.
- Role of mentoring in the retention of women and minorities
- Benefits and challenges of providing role models and mentoring services to women and minorities
- Challenges faced while organizing various activities to increase student mentoring

Summary: The audience will learn about a mentoring program used in retaining female and other underrepresented minorities in the field of technology. Challenges faced by women and URMs in STEM field at workplace will also be shared. Ways to successfully overcoming such challenges and identify ways to become successful in career of their choice will conclude the presentation.

Friday, November 4, 2016

Administration

Equal Opportunity Robotics Programs: Engaging Female Students for Future Careers in STEM

Author(s)
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Need: Females are under-represented in most STEM fields. When females are grade school age, studies show that females are just as interested in STEM fields as their male counterparts. But, as female students near junior high school, many tend to gravitate away from STEM areas. Finding ways to keep females interested in the STEM areas is imperative if universities want to see more females entering into the STEM fields in the future. One way to combat this lack of interest, is to offer female students robotic opportunities in high school. Partnerships with high schools and universities can deliver effective robotics programs that provide females hands-on and engaging STEM opportunities.

Overview: Many high schools have, or are starting to develop, robotics programs within their schools – but, many of these programs are over-represented by male students with females being the minority. When females do participate in co-ed robotics programs, they tend to gravitate toward the "non-technical" aspects of the robotics program (i.e. journal writing, business practices, photography, etc.). To ensure that females have equal opportunity with all technical aspects of the robot design and build process, educators must foster an environment that encourages equal female participation. Having an all-female robotics program may aid with this process and has the potential to keep females engaged and interested in future STEM fields.

Major Points:

- Overview of the need to engage females in robotics
- Challenges and successes of female robotics teams
- Keys to recruiting and retaining females in robotics to pursue future STEM careers

Summary: Keeping females engaged in STEM in high school and college is an important step in increasing female representation in future STEM fields. Having engaging robotics programs that allow equal opportunities for our female students can help achieve this goal. This presentation will explore successful female high school robotics programs and their partnership with universities. This presentation will also describe the connection of successful high school all-female robotics programs and the impact on future college and career choices in the STEM fields.

Thursday, November 3, 2016

Administration

Global Journey on Four Paths

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Need: We are transforming the experience for technology students here in the Purdue Polytechnic Institute. From the first semester of the freshman experience to graduation, our program is being redesigned to create a more applications oriented, integration based plan of study for our students. One requirement in this transformed plan of study in the Polytechnic is a college requirement that every student has a global experience. This is left to each department to design a program to meet this requirement. We feel that every student should experience a culture other than their own. This approach does this. The solution we developed is four separate "pathways" to achieve the Technology Global Experience goal that is easy to manage, does not burden advisors in the cross-hairs of non-compliant students, and provides flexibility to students / advisors / mentors to achieve this goal.

Overview: This session will discuss the development of the required Global Experience in the Technology Leadership and Innovation department in the Purdue Polytechnic Institute. This model offers flexibility and choice to students,

Major Points:

- Constraints in developing and implementing a Global Experience requirement
- Integration of research into the program design
- Description of pathways that offer choice, as well as student flexibility, in a complex demographic

Summary: Attendees will learn about the development of our Global Experience requirement, from idea to fruition. Details of how the requirement can be satisfied, of the design down to the individual courses, will be presented

Friday, November 4, 2016

Administration

Implementing Zero-based Budgeting in a Department of Technology: Linking Budget Priorities to the Mission and Goals of the Institution

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Need: In the last decade, higher education has been under increasing pressure to establish budget priorities and contain costs. Given the competitive higher education environments and shifting economic conditions, many institutions have begun to focus on zero-based budgeting. Likewise, many departments of technology within higher education are adapting to the zero-based budgeting process for establishing priorities for budgeting and allocating scarce resources. However, the prevailing economic shifts, political views and changes, and legislative mandates have placed stringent demands on managerial budgeting in such departments. These forces, together with concerns regarding quality, productivity, and sustainability, have intensified the movement for fundamental change in the way departments conduct budgeting practices and implement essential processes. Yet, such strategic, challenging change can accrue by connecting departmental priorities, budgeting functions, and processes to the mission and goals of the institution. Zero-based budgeting is envisioned as a more effective means of addressing higher education priorities and expectations because budget inputs are reset every budget cycle, with new inputs identified to reflect a changing educational environment.

Overview: Zero- based budgeting is a tool or method in which all expenses must be justified for each new period. This presentation will focus on the strategic zero-based budgeting concepts; budget development and management; and the departmental budget connection to the institution's mission and goals. The presentation will provide attendees insight on the zero-based budgeting techniques, and illustrate a structured approach/model for implementing zero-based budgeting at the departmental level. The presentation will also incorporate a strategy for justifying budget priorities. Relevant issues, techniques, and examples will be shared in the presentation.

Major Points:

- Rationale for and benefits of zero-based budgeting
- Relationship of zero-based budgeting to other budgeting tools/methods
- Components of zero-based budgeting
- Linking the priorities of the departmental budget to the institution's mission and goals
- Structured approach/model for implementing zero-based budgeting

Summary: As higher education institutions continue to employ zero-based budgeting in their decision-making and resource allocation processes, administrative personnel in departments of technology must ensure that scarce budgeted resources are prioritized and aligned with the institution's priorities. This presentation will provide attendees insight regarding the development of a zero-based budgeting model for linking departmental priorities to the mission and goals of the institution.

Thursday, November 3, 2016

Administration

Improving 2-Year Technology Program Member Engagement

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Need: Welcoming new members and reengaging itinerant members are two ways of ensuring the sustainability of ATMAE. Both can be achieved by delivering relevant value: a level of membership value that is specifically unique to the individual member. This would be in comparison to the basic value presented to the general membership. As an example, the mission of the Community College & Technical Institute Division (CCTI) of ATMAE is to carry out the purposes and objectives of the Association as they apply to colleges and universities offering associate level technology and applied engineering programs. What then is relevant to the CCTI membership? Before we can define what is relevant to CCTI members and potential members, or at least concurrently, we need a sense for the composition and potential composition of CCTI. Regarding the composition of CCTI, we can develop a membership profile of CCTI; we can examine the nature of CCTI accredited programs—degree names, option names, and the like; we can conduct surveys; and we can pursue a number of other initiatives.

Overview: The Classification of Instructional Programs (CIP) codes for all ATMAE accredited 2-year technology programs was compiled and sorted. According to the Association and the institutions housing those 2-year technology programs accredited by ATMAE, all were aligned with one of ten two-digit series CIP codes with the majority reporting that their programs were aligned with the Engineering Technologies and Engineering-Related Fields CIP codes. All these programs were also aligned with one of eleven different 4-digit series CIP codes with over a quarter of those programs being aligned with the Industrial Production Technologies/Technicians CIP codes and almost as many being aligned with the Drafting/Design Engineering Technologies/Technician CIP codes. While all the 2-year technology programs accredited by ATMAE are not coded as Engineering Technologies and Engineering-Related Fields programs, implications exist for ATMAE to welcome members and reengage itinerant members.

Major Points:

- Engagement
- Relevant Value
- The Nature of ATMAE Accredited 2-Year Technology Programs
- Classification of Instructional Programs Codes
- Two-Digit Series
- Four-Digit Series
- Six-Digit Series
- Implications

Summary: An examination of the 2-year technology programs accredited by ATMAE was undertaken. The data suggests that there are alternatives ATMAE can pursue to capture the attention, affiliation, and loyalty of its members and potential members. The data also provide some sense of the highly relevant value-building activities the Association can provide.

Thursday, November 3, 2016

Administration

Industry 4.0 or the Internet of Things (IoT): What Should ATMAE Program Undergraduate Students Know?

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Need: Industry 4.0 has been a key initiative for leading manufacturers for the past four years but little information has made its way into the general knowledge stream.

Overview: This presentation will provide an overview about Industry 4.0, its key principles, a summary of content that can be infused into existing manufacturing and business baccalaureate-level programs.

Major Points:

- Origin of Industry 4.0/IoT
- Key principles Emerging impacts/benefits
- Challenges that this new initiative faces
- Role of educators
- Curricular suggestions

Summary: Attendees will be gain insights and possible curricular implementation guidelines that will add value to ATMAE undergraduate program completers.

Thursday, November 3, 2016

Administration

Korean (GNU) Four-Week American Industry Internship and Cooperative Experience–2016

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Need: Some of the most important and valuable educational experiences for students are to participate in industry field experiences—industrial tours, cooperative work experiences, internships, and industry-based projects. GNU (Korea) finds that Korean students benefit greatly from international experiences in the United States and experiences in industry, as it enhances their future employment opportunities. A collaborative program with a partnering school in the US is needed to develop and implement a program to provide such experiences.

Overview: The presentation highlights the Korean (GNU) Four-Week American Industry Internship and Cooperative Experience project, from ideation to implementation, including the instructional experiences, industrial experiences, activities, and outcomes of the program during its three years of implementation.

Major Points:

- International collaborative program development between GNU (Korea) and PSU (United States).
- Development and implementation of the program, including structure and logistical issues are highlighted.
- Twelve (12) GNU--Korean students participate in four-week American industry cooperative experience program hosted by PSU
- Instructional orientation program provided to assist GNU students in working and visiting with American industry design teams.
- Minimum of four (4) three-day American industry internship and cooperative work experiences with regional industries are provided
- American industry practices are observed by Korean Team members, through field trip experiences to major and regional industries and interact with engineers and business management personnel (e.g. special Business Management/Industry sessions).
- Koreans conversational English skills are developed through interaction with PSU faculty, students, and cooperating industry partners.
- Oral and writing skills are also enhanced through oral presentations and written reports and logs/journals of student experiences.
- Three years of outcomes, lessons learned, recommendations, and next steps are shared.

Summary: Attendees will understand the development and implementation of Korean (GNU) Four-Week American Industry Internship and Cooperative Experience and how a similar international collaborative programs could be developed at other universities to provide international experiences and interactions that benefit both international students and American industries.

Friday, November 4, 2016

Administration

Korean (GNU) Innovation Engineering, Project Management & Disaster Shelter Design Program–Spring 2016

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Need: Understanding innovation engineering and engineering project management principles provides engineering students (Korean) with a competitive edge in today's engineering world. Coupling this knowledge with the latest tools in engineering design and their application towards solving real-world competitive design problems in a capstone environment (i.e., Disaster Shelter Design Competition) enhances their future employment opportunities. A collaborative program with a partnering school in the US is needed to develop and implement a program to provide such experiences.

Overview: The presentation highlights the Korean (GNU) Innovation Engineering, Project Management & Disaster Shelter Design Program, from ideation to implementation, including the development of GNU-PSU partnership, instructional experiences, industrial experiences, activities, Disaster Shelter Design Competition, and outcomes of the program during its two years of implementation.

Major Points:

- International collaborative program development between GNU (Korea) and PSU (U.S.).
- Development and implementation of the program, including structure and logistical issues are highlighted.
- Twelve (12) GNU--Korean students participate in a semester-long Innovation Engineering, Project Management & Disaster Shelter Design Program hosted by PSU
- Korean engineering students are introduced to Innovation Engineering (IE), engineering project management (EPM), creative thinking strategies, and engineering design of an emergency shelter.
- American industry practices are observed by Korean members, through field trip experiences to major and regional industries.
- Korean students form two teams and work alongside and American team to design and build Disaster Shelters, and then compete in the Disaster Shelter Competition, sponsored by Samaritan's Purse and John Brown University (Arkansas).
- Koreans conversational English skills are developed through interaction with PSU faculty, students, and in preparation for competition. Oral and writing skills are also enhanced through oral presentations and written reports.
- Two years of outcomes, lessons learned, recommendations, and next steps are shared.

Summary: Attendees will understand the development and implementation of Korean (GNU) Innovation Engineering, Project Management & Disaster Shelter Design Program and how a similar international collaborative programs could be developed at other universities to provide international experiences for students—international and domestic.

Friday, November 4, 2016

Administration

Leveraging Lean and Project Management Certificates within an Applied Engineering Program

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Need: Students who are enrolled in the Engineering Technology and Management (ETM) program at Ohio University are exposed to many different applied technologies. The diversity of skills acquired prepares the students for many opportunities within the workforce. Upon analysis of current job postings, the Engineering Technology and Management department at Ohio University repackaged courses into two complementary course offerings which allow students to take a few extra courses and extend the value of their educational experience by achieving a certificate in either Lean or Project Management.

Overview: The presenters will discuss the rationale for the development of the certificates in Lean and Project Management as well as the expected outcomes from the implementation of these certificates. Individual course competencies as well as the dynamics that was experienced during the implementation of the certificates will be discussed. In addition, how the requirement of these certificates can fit in an applied engineering type program will be discussed.

Major Points:

- Applied certificates as a strategy to extend the value of an applied engineering program without adding credit hour requirements to the base degree.
- Applied certificates as a method to recruit individuals to a degree program.
- Applied certificates as a marketability tool for the applied engineering graduates.
- Applied certificates as a way to engage alumni and also a means to developing industrial partnerships.

Summary: Attendees will gain an understanding of how two new certificates complement the curriculum within the Engineering Technology and Management department at Ohio University. The audience will gain insight into the certificate requirements at Ohio University and they will be able to ask questions on the prospects and outcomes of technical certificates.

Thursday, November 3, 2016

Administration

March of the Millennials: Rebranding a Blue Collar Program

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Need: This program highlights a purposeful endeavor– the regional workforce development program -- to close the chasm that now exists between the skills of the labor market and the needs of business and industry which in turn will support community stabilization and individual prosperity. With UAFS at the helm, industry partners and K12 educators joined efforts to revamp to stagnant programs to attract more youth to dual credit STEM programs while industry partners provided weekly mentoring to supplement classroom and lab learning with real world application which included pedagogy steeped in work ethic content.

Overview: Attendees will be introduced to a state-wide initiative to prepare the workforce of the future (today's high schoolers) for STEM-heavy careers. In particular, attendees will learn how synergy was created when Higher Ed officials teamed up with K12 officials and partnered with business and industry to create a best practice scenario to introduce teens to higher education programs, map the programs to careers with a variety of real-world jobs and levels of income, develop study and work ethics through mentoring pods, and graduate high school and college certificate programs simultaneously. Attendees will learn about the UAFS Cyber Systems and the UAFS Robotic Automation programs and why more than 200 teens signed up. Attendees will be encouraged to take the model back to their own institutions for consideration of implementation.

Major Points:

- Current labor market trajectory: aging workforce; growing dependence on electronics and automation; dry talent pipeline; low enrollment in trade/skilled programs
- Current labor statistics demonstrating skills gap
- Projections for next 15 years Focus Groups
- Industry Partners (Human Resource Managers)
- Higher Ed Partners (Program Faculty)
- Secondary Ed Partners (high potential students) Rebranding Blue Collar Programs
- Programming
- Electronics
- Impending challenges
- Possible solutions
- Launch of UAFS Pilots Cyber Systems and Robot Automation

Summary: Attendees will be given a historical account of the regional workforce development efforts at UAFS to rebrand and relaunch two STEM programs in conjunction with dual credit instruction and industry-heavy mentoring and coaching. Attendees will hear about the programs challenges, occasional stumbles, current successes, and projected expectations.

Thursday, November 3, 2016

Administration

Military Veterans Affinity Group Program: A Proactive Intervention for Transition to Higher Education

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Need: Returning military veterans are a rapidly growing population of non-traditional students in the United States. The Post-9/11 G.I. Bill has made it easier for military veterans to fund higher education costs upon discharge from the military. Student affairs support services at universities and four-year colleges, while accomplished at transitioning students who have recently finished high school, are not automatically well-positioned to address the unique non-traditional needs of military personnel. Veterans often find themselves returning home after being members of an intense and close community fortified by common experiences. Subsequent admittance into a college campus environment where veterans are surrounded by a majority of students who have no concept of the life and death conundrum that they, as veterans, leads to difficulties in assimilation and adjustment. This difficultly often results in undesirable academic performance.

Overview: The Military Veterans Affinity Group Program is specifically directed for recruitment and retention of veterans pursuing technology related degrees. Utilizing Schlossberg's adult learning 4S System as a framework, the four factors that persuade a person's ability to cope with transition and succeed -- situation, self, support, and strategies -- are closely tied to industry involvement. Mentoring connections that couple required internship experiences with job shadow opportunities, professional association involvement, and a network of military friendly employers are utilized to strengthen a sense of community and career resonance throughout the academic experience.

Major Points: Veterans transitioning into higher education require a unique support system unlike what exists for traditional direct from high school or community college transfer students. This support system should bridge institutional student affairs activities, such as those offered by campus veterans' centers, and academic affairs activities related to the fulfillment of academic degree requirements. An academic department-led Affinity Group Program serves as this bridge, building the comradery and career resonance required to support and successfully advance a veteran student's academic experience.

Summary: Attendees will gain an understanding of the needs of the returning military veteran and how those needs are addressed through the implementation of the Affinity Group Program. Though specific to an academic degree program and industry career opportunity, this program is suitable for use in its adaptability for meeting the unique requirements of many higher education/career pathways. The outcomes and lessons learned will be disseminated with intent to stimulate replication.

Friday, November 4, 2016

Administration

Recruiting Best Practices in Technology Undergraduate Programs

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Need: As the manufacturing industry continues to rebound in the United States, combined with the retirement of the 'baby-boomer' generation, an imminent talent gap has emerged in many channels of the supply chain. To further exacerbate this employment gap, the distribution sector of the manufactured products supply chain has seen a significant increase in the technological requirements and/or competencies of employees. As products become increasingly more complicated so, too, do the strategies to market, sell, and service said products. In higher education technology programs continue to be marginalized; therefore, it is incumbent upon existing technology programs to actively and strategically recruit new students to help sustain not only the academic programs, but also to help fill the pipeline of qualified talent to industry.

Overview: Just as the industrial products market sector has become extremely competitive in recent years, it has also become quite competitive in the recruitment of students for many programs on college campuses. Recruiting is often necessary at the program level, but is fraught with complications, including cost, management, and sustainability. The Industrial Distribution (ID) program at the University of Nebraska at Kearney (UNK) has been successful in recruiting new students to the university, the program, and the discipline. The UNK ID program has developed a highly successful, systematic, and sustainable model for recruitment that has enabled the program to be in the top 1-2 programs on the entire campus for several years.

Major Points:
Best practices in recruiting for technology programs. Learning from what works… and what does not work.

- Need to re-examine how we recruit students to our programs.
- How to get faculty and staff engaged in the recruitment process.
- How do we overcome 'anonymity' in our own college, and on our own campus?
- How to develop a sustainable model for student recruitment and retention.

Summary: Attendees will learn about novel recruiting techniques that have allowed the ID program at UNK to attract top talent from throughout the region. The proposed recruiting "best practices" have improved not only the numbers of students in a program, but also the quality of students recruited. These recruiting strategies have allowed the UNK ID program to be a leader on the UNK campus, as well as in the industrial distribution industry. Top companies from throughout the country come to the UNK campus each semester to recruit ID students during the UNK ID Career Event.

Friday, November 4, 2016

Administration

Revision of the Master's Program in Engineering and Technology Management (MSETM) at Morehead State University

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Need: As recent as 2015, there was a re-structuring of academic units within Morehead State University. This re-organization resulted in the merging of the Department of Engineering and Technology Management (ETM) with the Department of Computer and Information Systems (CIS), to create the School of Engineering and Information Systems (SEIS). Thus, it became pertinent to update the master's program of study in Engineering & Technology Management to provide two tracks—Engineering & Technology Management and Information Systems & Analytics which also provides opportunity for coursework in Healthcare IT and Data Mining.

Overview: The Master's program of study in Engineering and Technology Management (MSETM) at Morehead State University is undergoing revision. The purpose of the revision is to update the MSETM core of offerings to offer two technical tracks - Engineering & Technology Management as well as Information Systems and Analytics. In the revised curriculum, all students will be required to take a common core of engineering and technology management graduate course offerings, blended with a selected track—based upon career aspirations and professional leadership desired.

Major Points:
Establish a common, required core (body of knowledge) of course offerings (15 credit hours)—which better reflects changes in business & industry, and are perceived as foundational and valuable interdisciplinary content for the proposed tracks.

- Continue to allow for non-thesis or thesis option in both tracks of the degree.
- Make modifications to the admissions index requirements—given the new scoring system for the GRE.

Summary: These changes will provide increased efficiencies in scheduling courses for the program and will increase the competitiveness of the MSETM program, throughout the Commonwealth, given the two tracks of specialization. The updated MSETM program will better align with current research findings at other institutions, marketability and currency.

Survey of Manufacturing Programs Taking SME Certification Exam and Manufacturing Student Outcome Assessment

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Need: Student learning outcome assessment is one of the important components in the teaching and learning loop that every educational institution cannot ignore. As all the accrediting agencies such as ABET and ATMAE prefer outcome basis for accreditation, getting a true picture of student learning outcomes will help universities move to the right direction for continuous improvement. Though the SME four pillars provides a basis for formulating manufacturing curriculum, there is no standard format among universities to provide the student outcome assessment of manufacturing technology programs. Certification exams administrated by professional societies such as SME and ATMAE have been formulated by taking this aspect into account. Therefore it would be natural for the universities to utilize these certification examinations a way for assessing their student outcomes.

Overview: Certification examinations such as SME and ATMAE cover a broad spectrum of knowledge, which provides a solid foundation for manufacturing program graduates to play their roles on manufacturing product/process analysis, design, research, development, control and management in variety of industries. With an idea to get the general consensus on the use of the certification examinations as pursued by manufacturing programs, a survey was conducted. The main aim of this survey is to find how the manufacturing programs are motivating student learning, assess student learning outcome, and even promote employment opportunity. This survey will help answer questions such as: Is certification exam required or recommended by manufacturing program? What is the average passing rate for students before graduation? What is the main barrier if it is not used? What is the students' opinion about taking or not taking this exam?

Major Points:

- Development of survey questions
- Data collection and data analysis
- Insights from the survey
- How students learning outcome can be improved by using the certification examinations.

Summary: Manufacturing certification exams from professional societies such as SME, ATMAE and others can be useful in student learning outcome assessment. This study presents a survey that will reveal how manufacturing programs practice this task. The insights obtained from the survey will help academic programs carry out student outcome assessment and therefore improve teaching quality continuously and help in easy accreditation.

Thursday, November 3, 2016

Administration

Technical Curricula of ATMAE Accredited University Programs

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Need: The ATMAE 2011 Outcomes Assessment Accreditation Handbook section 7.5 states that baccalaureate programs/options shall meet minimum-maximum semester hour requirements in the foundational areas of general education, mathematics, physical sciences, management, and technical. The specific list of courses and credit hours counted towards the technical category should be 24-36 hours. Many students who transfer from two to four-year institutions exceed this requirement, but students who enroll in four-year programs must take certain technical courses. What types of technical courses do typical ATMAE accredited university programs most frequently require? ATMAE accredits four-year manufacturing, industrial, construction, and information technology programs. To what degree are these accredited programs similar in technical content? Is there a convention of content for university technical courses? The objectives of the research were to (a) determine the extent of the variety of ATMAE programs and their constituent technical courses, (b) identify the composite technical curriculum of ATMAE programs, and (c) determine the perception of students from multiple ATMAE accredited programs regarding the importance of the technical content and its applicability to their future employment.

Overview: This presentation discusses research on the technical content of ATMAE accredited four-year programs in manufacturing, construction, industrial technology, and applied engineering. Specifically, the study sought to answer the following questions: What technical courses appear most frequently in these programs? What technical competencies do students value in university programs? Which are most covered? Is there a generally accepted technical core of knowledge perceived as important for an entry-level technical professional?

Major Points:

- Background of the study
- Methodology of the research
- Findings
- Summary and interpretation

Summary: This presentation presents research on the technical curriculum of ATMAE accredited university programs and student perceptions of its value. The information will show the types of technical courses in typical ATMAE accredited university programs and how students in the baccalaureate curriculum rank the technical competencies in terms of value and coverage.

Thursday, November 3, 2016

Administration

The ATMAE Lean Six Sigma Prep Course: Affordable Training Just a Click Away

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Need: As more and more companies and organizations embrace lean six sigma philosophies, more employees are required to earn some type of lean six sigma belt certification to document their knowledge in this area. Although ATMAE offers one of the most affordable lean six sigma certifications, the number of individuals seeking this certification is limited due to the lack of training materials being provided.

Overview: This presentation will focus on the key factors that are involved with offering training programs to prepare individuals for ATMAE certification programs. Furthermore, this presentation will focus on the content this is covered in the ATMAE Lean Six Sigma Prep Course and the preliminary results of its affect on passing the exam. A live demonstration will also be presented showcasing its delivery and ease of use.

Major Points:

- Overview of the purpose and development of the ATMAE Lean Six Sigma certification program
- Description of how ATMAE exams are currently being used and who are the main customers
- Discuss the premise for training and its important link to certification
- Review the content covered in the ATMAE Lean Six Sigma Prep Course
- Assess the implications of ATMAE training programs and their impact with industry

Summary: As ATMAE certification programs continue to improve and provide academia, individuals, and industry with important assessment data, individuals not associated with academia seldom earn the certifications since there is no opportunity for them to find training to prepare for them. This presentation details the first online training program associated with an ATMAE certification and its impact on improving the pass rate on the ATMAE Lean Six Sigma Exam.

Thursday, November 3, 2016

Administration

The Defined, Measured, Analyzed, and Improved ATMAE Lean Six Sigma Exam: What You Need to Know for the Future

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Need: The ATMAE Lean Six Sigma Exam has been available since 2015 and ATMAE members have successfully passed by obtaining either a yellow, green or black belt status. Although everyone who has taken the exam has passed, only one has earned black belt status. Because of this issue, a thorough analysis of its merits has been conducted and problematic questions have been revised and validated.

Overview: This presentation will highlight the improvements that have been made to the content of the Lean Six Sigma certification exam based upon an item analysis of past examinees performances. Revised questions will be discussed in detail in an effort to benefit the new patrons of the exam.

Major Points:

- Discuss training programs for the LSS exam
- Overview of 2nd year exam results
- Discuss problematic questions and why
- Review strengths and weaknesses of the exam

Summary: As the term "continuous improvement" is a concept that resonates with Lean Six Sigma, the Lean Six Sigma Certification Exam was improved; questions were revised and analyzed. Since this exam was the first one to be developed under the new ANSI accreditation standards, the exam has to be checked periodically to make sure that it continually meets those standards. The focus of this presentation will be to review the revised Lean Six Sigma Exam as well as give the audience an update on future training programs associated with the exam.

Thursday, November 3, 2016

Administration

The Journal of Technology, Management, and Applied Engineering: Data Analytics

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Need: The Journal of Technology, Management, and Applied Engineering (JTMAE) is the flagship publication dedicated to those devoted to solving complex technological problems and developing the competitive technologist and applied engineering workforce. While JTMAE has served the professions of technology, management, and applied engineering for more than 30 years, little data have been shared with authors, readers, and other technology professionals on the patterns in authorship, readership, and citation analytics. Information of this nature is helpful to researchers, prospective authors, administrators, and others who read and wish to publish in the Journal.

Overview: An extensive collection of data on readership, author characteristics, and citation rates was compiled in 2014. This presentation will characterize the Journal based on selected data on feature articles published from 2010 through 2014. The following topics will be emphasized: type of articles published, author characteristics, citation statistics, and citation keyword analysis. The scope of the Journal, implications for publishing in the Journal, and opportunities for improvement will conclude the presentation.

Major Points:

- Data collection processes
- Author characteristics
- Citation information
- Citation keyword analysis
- Implications for future publication and improvement

Summary: The audience will learn about current data analytics drawn from the Journal of Technology, Management, and Applied Engineering. Implications for publication choices and continuous improvement of the Journal will be discussed.

Thursday, November 3, 2016

Administration

The Tradition Trap: How Low Turnover in Successful Programs Can Lead to Resistance to the Different Skill Sets that New Faculty Bring

Author
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Need: As programs experience retirements in what were once relatively unchanging faculty groups, resistance can occur when new faculty bring in a complementary, yet different skill set. Recognizing this reality, planning for it, and embracing the new possibilities that can emerge from an influx of new talent are opportunities to grow and enhance programs and to offer new opportunities for students. There is a need for faculty and administration to open their minds to new ideas rather than perceive new/unfamiliar skill sets as a threat to the traditions and success of their programs.

Overview: This session will look at ATMAE programs where faculty turnover has been limited historically and how new faculty with backgrounds that include traditional as well as additional skill sets can be recognized and embraced so that new ideas can be integrated in what has been and will continue to be a strong and successful program. New and exciting opportunities for programs and students can be explored when embracing the differences rather than sticking with the status quo.

Major Points:

- How to integrate new ideas and backgrounds into current curriculum
- Creating new opportunities for students upon graduation outside the program's normal hiring circle
- How to use the interview to determine how potential faculty would be able to apply and integrate their backgrounds into a successful curriculum
- Discuss the importance of seeing opportunities rather than threats to the traditions and success of programs.
- What new faculty with different backgrounds can bring to students by opening up non-traditional career opportunities but still retain the tradition and success of programs
- Do not let fear of the less familiar ruin the possibilities

Summary: Programs, students, and faculty can all benefit when new talent are hired. For programs that have experienced very low turnover and now face the task of replacing retiring faculty, new faculty can bring opportunities and fresh insight that can complement current curriculum and create opportunities for students that would have otherwise been untapped and unknown. Administration and faculty must open their minds to see the benefits and embrace the possibilities rather than resist opportunities for change and not see new faculty with backgrounds that include more than what has been the status quo. Don't miss out on new opportunities just because a person may have a more diverse background! It could be a great new adventure where everyone wins!

Friday, November 4, 2016

Administration

The Unintended Consequence Resulting from Superior Preparation of Students in Technology for Industry; Diverting the Pipeline Away from Advanced Degrees and Academic Careers

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Need: To meet industry's demand for employees with practical experiences and confirmation of usable knowledge, educators have begun integrating projects into the classroom and preparation for certifications along with degree requirements. This powerful combinations positions students in STEM fields, especially technology students, to be highly marketable at graduation. The authors recognize cooperation with industry serves an immediate need; they are able to ensure that students will graduate with the knowledge and skills necessary to be successful for today's careers. However, a long term unintentional result looms. By encouraging students to work on real world problems and stay industry focused, attention to graduate studies and scholarly research is minimized. The attractive salary offers from industry often deter students from seeking advanced degrees or pursuing an academic career. This diversion of talent is having a monumental effect on the pipeline of potential qualified professors in technology to meet the future demands of higher education in the United States. "We need to create an all-hands-on-deck approach to science, technology, engineering, and math… We need to make this a priority to train an army of new teachers in these subject areas…." "President Barack Obama Third Annual White House Science Fair, April 2013. A national challenge was put forth to produce one million additional college graduates with degrees in science, technology, engineering, and mathematics That's why President Obama challenged the nation to recruit and prepare 100,000 new effective teachers over the next decade. The department of labor projects a need for 40% of the workforce to be technically trained employees with a bachelor's degree or higher in a STEM field to meet the workforce demands the year 2018 and beyond.

Overview: The forum will present the type of industry partnerships developed and projects executed by students for experiential learning. Linkages of experiential learning to preparation for external certifications from national and international certifying bodies will be displayed. The resulting impact of earning certifications in concert with a STEM degree will discussed from the perspectives of various stakeholders.

Major Points: Major Points · Formation of industry partnerships which lead to project based learning and tangible outcomes · Industry partnerships can be implemented and scaffolded in various courses · How project based learning supports students' development of technical skills and preparation for credentialing · The value of additional credentialing in an industrial environment · The lack of preparation for graduation school resulting the when focus is on educational cost containment · The effect of student loan debt on the transition to the workforce and career planning · Why additional credentialing is gaining momentum with today's employers Strategies to enhance investment in education

Summary: The authors will discuss the current climate of student preparedness, educational cost containments, workforce readiness and STEM pipeline issues in higher education. Realistic scenarios, relevant terminology with data will be presented. Plausible solutions to address the unintended consequence will be explored.

Friday, November 4, 2016

Administration

University and Industry Partnership for Training for Middle Management

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Need: Industry/Education partnerships can prove beneficial to the educational institution in a myriad of ways. Learning about a multiyear training program contract between a university and an industrial partner could provide attendees with ideas for future partnership initiatives.

Overview: This presentation provides attendees with a description and discussion of results of a multi-year training program where faculty members from the University partnered with local industry leaders to provide leadership training for selected employees.

Major Points:

- Program Development
- Program Participants
- Implementation Issues
- Program Assessment
- Benefits Realized

Summary: Attendees will leave this presentation with an understanding of how a regional university created a comprehensive leadership training program in partnership with a local industry that might be duplicated in some form at other institutions.

Friday, November 4, 2016

Administration

WTII Boot Camp Session—An Educating the Wood Industry Professional Workforce Collaboration

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Need: Today's woodworking industry professionals—product managers, sales managers, sales professionals, and executives need to broaden their understanding of secondary wood manufacturing processes. The Wood Machinery Industry Association (WMIA) and PSU Wood Technology program partnered to form the Wood Technology Industry Institute (WTII) to deliver the week-long, intensive Boot Camp Session to meet this need.

Overview: The presentation highlights the Wood Technology Industry Institute Boot Camp Session (www.wtii.net) from ideation to implementation, including development of its curriculum, delivery of instruction, assessment, and outcomes of the three Boot Camps to date, industry's response, and next steps.

Major Points:

- Collaborative effort between WMIA and PSU Wood Technology in Boot Camp development
- Project based curriculum provides a hands-on exposure level learning to many facets of wood processing
- Knowledge, machinery and application for wood industry professionals.
- Week-long workshop geared toward supply-side companies in the wood industry who wish to further educate their workforce--sales professionals, sales managers, product managers, and executives, about secondary wood manufacturing.
- Topics covered include: Wood Science, Primary Processing, CAD, CAM, CNC, Veneering Cabinetry, Machine Woods, Millwork, Finishing, Tool Technology, and Facilities Management
- Delivery of instruction, assessment, and outcomes of the three Boot Camps, and next steps.

Summary: Attendees will learn about the collaborative development and implementation of the WTII Boot Camp Session and how a similar program could be developed to meet needs of professionals--product managers, sales professionals, executives, associated with other manufacturing industrial fields..

Friday, November 4, 2016

Construction

ABET, ACCE, and ATMAE Accreditation Requirements of Construction Management Degree

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Need: Accreditation of undergraduate academic programs are the trademark of academic quality and rigors, in case of public universities it conveys to the public the needed confidence that what is being taught and contained in curriculum meets the thoroughness and minimum professional standards of the discipline, it also augments the employability of graduates.

Overview: Traditionally, Construction Technology (CT) degrees were accredited by ATMAE formerly National Association of Industrial Technology (NAIT) and Construction Management (CM) programs were accreditation by American Council for Construction Education (ACCE). During fall of 2015 Accreditation Board for Engineering and Technology (ABET) Construction Management accreditation criterial was approved.

Major Points:

- Program/Student Outcome Base Accreditation Criteria.
- ABET Accreditation Prerequisite.
- ACCE Accreditation and Course Requirements.
- ATMAE Accreditation and Curriculum Stipulations.
- Regimented Course Requirements of ABET, ACCE, and ATMAE.
- Comparison of Three Accreditation Organization

Summary: All three accreditation organizations dictate Student Outcome / Program Outcome base accreditation norms. Some stresses regimented and rigid course work in the construction curriculum while others provide moderate flexibility to the construction program. In fact many construction management and construction technology programs may be eligible to receive multiple accreditation from accreditation organizations.

Thursday, November 3, 2016

Construction

An Assessment of the Impact of Green Building Training on the Quality Characteristics of U.S. Residential Contractors

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Need: It is significant that residential contractors continue to build affordable green building homes and help preserve our environment for the next generation. According to United States Green Building Council (USGBC) there is substantial growth in the green home division throughout our nation. New single family homes in the U.S. have grown tremendously from 2% in 2005 to 23% in 2013. Due to the changes in the economy, the USGBC predicted a continuous increase in residential green building construction over the next few years. Consequently, it is important that residential contractors are more knowledgeable regarding green building practices. This purpose of this research study was to assess the impact of Green Building training on the quality characteristics of residential contractors.

Overview: The presentation will summarize findings obtained after analyzing data from residential contractors who have successfully implemented the National Association of Home Builders single-family residential green building recommendations. Specifically, the study will address the impact of green building education and training on the quality characteristics of residential contractors.

Major Points:

- Introduction
- Purpose of Study
- Research Methodology
- Results
- Conclusion

Summary: Attendees will be exposed to key components of green building training, education and professional development. The implementation of effective green building training programs could improve the quality characteristics of residential contractors. In the long term, U.S. residential contractors should be better prepared to meet housing demands with minimal impacts on the environment.

Thursday, November 3, 2016

Construction

Analysis of Smart Home Susceptibility to Intentional Electromagnetic Interference Attacks

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Need: Practices within the construction industry are affected tremendously by current advancements in technology. Like all sectors, the residential construction has experienced this phenomenon including concepts of modularization and automation processes. With the increase in the market of so called "Internet of Things", the idea of retrofitting an already existing or building a new Smart Home is becoming more realistic. Thus, Smart Homes have become a reality and in some cases a trend due to these advancements. Although the literature includes multitude of efforts addressing the technologies used, integration processes, and privacy issues, little exists about their vulnerability to Intentional ElectroMagnetic Interference (IEMI). Consequently, an analysis of the existing defense mechanisms and a cost assessment model of the best suitable ones is highly needed to address this gap.

Overview: The concept of utilizing technological advancements in computing and information technology to achieve better comfort, security, and convenience level of occupants has grown over the recent years. It is estimated that, by 2022, a typical residential house will have more than 50 internet connected devices. In addition, a multitude of corporations, devoted in this domain, are creating platforms to facilitate such aspects. Furthermore, governmental agencies have allocated funds to serve these purposes. For example, the "Smart Housing Initiative" adopted by the State of California specifies broadband connectivity in low income housing build through public funding. However, the literature in this domain does not address the susceptibility of these technologies to IEMI. Thus, the current research analyzes the existing defense means against IEMI suitable for the residential sector and creates a cost estimate model of these mechanisms.

Major Points:

- Definition of IEMI and its types;
- Case studies of construction projects;
- Available mechanism of defense against IEMI; and
- Cost assessments of the most suitable mechanisms of defense.

Summary: Attendees will gain knowledge about IEMI and its types, susceptibility of Smart Homes to IEMI attacks, currently available mechanisms of defense, and their associated costs for new or remodeled residential properties. They will be engaged in a lively discussion about the topic.

Thursday, November 3, 2016

Construction

BIM: A New Tool for Planning and Managing Safety

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Need: Sadly, according to the Bureau of Labor Statistics, in 2014 there were 874 workplace fatalities on construction projects across the United States. There is always a dire need to save lives by improving safety. Moreover, new tools are needed to plan and manage safety more effectively. It would be most helpful if safety professionals could analyze on-site hazards through 3D visualization in real time. Building Information Modeling (BIM) is already gaining popularity as a design and construction management tool. However, BIM has not been widely used as a safety management tool. Hence, there is a need to find new ways that BIM can be used to enhance safety throughout the industry.

Overview: The use of BIM is gaining popularity for creating 3D models to assist in the design and construction of complex building projects in real time. BIM has been proven to be an effective management tool for clash detection, estimating, planning, scheduling and constructing. However, this technology has not been fully utilized for safety planning and management. BIM offers great potential as a new tool for improving safety. In this study, the researchers evaluate the perceived benefits of using BIM for safety planning and management in the construction industry. Ten construction companies currently using BIM for general project management are surveyed to ascertain possible uses of BIM for safety. Moreover, the survey attempts to identify the barriers to using BIM for safety management along with the training needs anticipated for full utilization of BIM for safety.

Major Points:

- BIM is gaining popularity throughout the construction industry as a tool for design and management of construction projects through the use of 3D modeling.
- There are potential uses of BIM to plan and manage safety on construction project sites.
- The construction industry has not been fully utilizing BIM in this fashion.
- There are several barriers to adopting BIM fully as a safety management tool.
- Safety personnel may be reluctant to use BIM without proper training.

Summary: A survey of 10 construction companies is analyzed to determine possible uses of BIM for safety planning and management. Barriers to use and training requirements are also considered in the survey.

Friday, November 4, 2016

Construction

Characterization of Sugarcane Fiber Stabilized Earth Bricks for Low-Income Housing

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Need: Housing is a global crucial issue as one billion of the earth's people are either homeless or live in very poor housing, particularly due to high costs associated with conventional building materials such as steel and concrete. There is an urgent need to develop and promote cheaper building materials with minimal impact on the environment. A return to natural and earthen construction materials seems to be one of the most sustainable options for building materials Earth brick construction presents good insulation, fire resistance, energy saving and sustainable material properties. However they are not without defects.

Overview: Despite the numerous advantages associated with earth construction, earth bricks have low physical and mechanical characteristics. In particular, they have low compression strengths, low aptitude to resist moisture penetration and poor ability to resist shrinkage when drying. With these in context, the main purpose of this research study was to improve the characteristics of earth bricks by stabilizing these bricks with sugarcane fiber waste. The results are promising and support the hypothesis that sugarcane fiber wastes can be used to improve the physical and mechanical properties of earth bricks.

Major Points:

- Introduction
- Purpose of Study
- Methodology
- Results
- Conclusion and recommendations

Summary: Attendees will be provided with the materials and methods required for the development of sugarcane fiber reinforced earth bricks. Also, an improved understanding of the physical and mechanical properties of natural fiber reinforced bricks could advance the diffusion and adoption of this sustainable material. The use of this material for low-income housing has several economic, social and environmental benefits.

Friday, November 4, 2016

Construction

Cost Study of Nano-enabled Thermal Insulation in Construction Projects

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Need: Nanotechnology has recently emerged as a possible advanced and efficient option in various construction applications. One of these applications is the thermal insulation for envelopes in buildings. The need for such utilization of nano-enabled materials stems from the growing demand on reducing heat transfer through building envelopes, which is affected by the value of the thermal resistance (R) of the different envelope components. Several products have been introduced to the market; however, there are still barriers against full utilization in the market especially in terms of cost. Therefore, there is a need to assess the comparable cost of nano-enabled insulation materials versus traditional insulation, which can enable the project owners and designers take a more informed design decisions.

Overview: The construction market usually shows resistance to changes especially related to systems that have been used for long time and where installation procedures are well established among contractors. What makes the resistance higher is the relatively high capital cost for new materials introduced to the market. A clear example of this is the use of the new insulation materials that utilize nano-properties in increasing the R value of the building envelopes. This research aims at exploring the cost difference between traditional (most commonly used) insulation and the new insulation materials in a residential project.

Major Points:

- Nanotechnology
- Thermal insulation
- ·Thermal resistance
- Cost of envelope systems

Summary: Attendees of this presentation will get insights on the cost of thermal insulation products with enhanced nano-properties in comparison to traditional insulation materials in the USA market. The comparison is based on a typical residential project located in the state of Indiana

Thursday, November 3, 2016

Construction

Environmental Life Cycle Analysis of Timber Flooring versus Carpet in Residential Projects

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Need: The construction industry is known to have a major impact on the environment due to the diversity of materials, processes and systems involved in buildings. Sustainable construction, therefore, seeks reduction of this impact by targeting less energy and resource consumption and reducing harmful emissions. The most effective way to optimize this reduction is looking at the complete life cycle impact of the materials used and taking design decisions based on this objective quantification technique. One of the choices that are usually involved in residential projects is the use of different flooring materials that can have very different impact on the environment if we consider the overall life cycle analysis (LCA). Therefore, there is a need for clear identification of the impact of various flooring options for an improved decision making process.

Overview: Life cycle analysis is a technique that involves accounting for the complete impact of using a given material inclusive of material extraction, transportation, installation on site and use during the lifetime of the buildings. This technique is an objective quantification technique that enables environmental decision making to be improved and better achieve the objectives of sustainable construction. When designer choose the type of flooring materials in a "green" or environmentally friendly building in residential projects, they should consider not only the cost of materials but also the actual environmental impact of such materials. Calculations of LCA for materials like timber flooring and carpet can always be valuable in such cases and works as a solid reference for any "green" design process.

Major Points:

- Sustainable construction
- Need for optimization
- Life cycle analysis
- Impact of flooring materials

Summary: Attendees of this presentation will understand how life cycle analysis is used to assist in environmental decision making related to design of sustainable construction with an emphasis on decisions on selection of timber flooring versus carpet as typical choices for flooring materials in residential projects.

Friday, November 4, 2016

Construction

Evaluating the Impact of Stakeholder Management on the Construction Industry in Jamaica

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Need: Project Management in the construction industry has continued to emerge as a critical skill that focuses on the process of planning, and managing the complex array of activities and processes in delivering a completed project. One of these arrays of activities is that of stakeholder management. Stakeholders attached to a construction project include individuals and organisations outside of the typical building team. All these individuals have to be efficiently managed to ensure that a project is successfully completed to the required standards within the established budget and on time. In Jamaica, the Office of the Contractor General (OCG) stated that in 2011 there was an overrun in government project totalling around JA$1.2 billion. This was in part due to post-contract issues of concern included poor project management and/or poor performance on the part of contractors and consultants which ultimately resulted in increased costs to the respective public bodies.

Overview: This research seeks to evaluate the impact stakeholder management has on the construction industry in Jamaica. This included a survey of the top ten (10) stakeholders in the local industry and documentation of their best practises in comparison with international best practises and their effect on projects, the role of ICTs on construction projects and stakeholder management. A local project was also used to create a case study of actual processes on the site in respect to stakeholder management. The results showed that by not managing your stakeholders properly is risky and can lead to a project's cost, quality and time being affected. In the long run, projects that continue to have problems with stakeholders will lead to a bigger problem as this will start to affect the country's Gross Domestic Product (GDP) and also employment.

Major Points:

1. Project managers need to realise the importance of stakeholder management in the local industry, and its role in converting Jamaica's construction industry to a sustainable one.
2. Companies should invest time in adding a stakeholder management strategy to their project plan.
3. Increase the use of ITCs on construction projects in Jamaica.

Summary: Attendees will be exposed to the many challenges that hinder timely 'turn over' of projects in the Jamaica by sharing data collected from different local projects. The presenters will also outline measures and techniques that can be used to efficiently execute projects in Jamaica.

Thursday, November 3, 2016

Construction

LEED Documentation Requirements for Commercial Building Projects: Problems and Solutions

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Need: Construction management professionals are overburdened with the additional documentation requirements necessary for obtaining LEED credits for the certification of LEED buildings. Traditional document management practices cannot adequately meet the documentation demands associated with the LEED program. Consequently, construction organizations are exposed to the risk of failing to attain LEED credits and building certification in a timely and cost-effective manner.

Overview: The Leadership in Energy and Environmental Design (LEED) program is a green building rating system that certifies buildings after the submission of accurate documentation by the LEED project team. The required LEED documentation usually includes calculations, narratives, specifications, drawings, and other related documents. The capacity of any construction management organization to attain its targeted LEED certification is largely dependent, but not limited to its project team and their document management practices. The purpose of this presentation is to examine the problems and solutions associated with LEED documentation processes for commercial building projects. A mixed-methods approach utilized a case study of an ongoing education building project pursuing LEED certification, and survey questionnaires completed by construction management professionals.

Major Points:

- Introduction
- Purpose of Study
- Research Methodology
- Results
- Conclusion and recommendations

Summary: Attendees will be provided with practical solutions for addressing LEED documentation problems. Recommended LEED documentation practices should enhance the ease of attaining LEED credits and building certification in a timely and cost-effective manner.

Thursday, November 3, 2016

Construction

On the Automated Demand-Response Infrastructure and High-Performance Green Buildings

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Need: Assessing the on-going domestic economic recovery and global energy market, the Energy Information Administration (EIA) in its Annual Energy Outlook 2015 predicts that fossil fuels will remain as America's leading source of energy supply between now and 2040, accounting for about 80 percent of the total energy needs. The heavy reliance on non-renewable energy sources prompts building design, construction and engineering professionals to strive for strategies to enhance building energy efficiency and environmental sustainability. It is noteworthy that the notion of Demand-Response (DR) is gaining research and industrial attention as an emerging trend that connects individual high-performance green building with smart grid infrastructure via building energy management and control system (EMCS) to optimize the holistic energy performance.

Overview: The building systems, including lighting, heating, air-conditioning, domestic hot water system, etc., collectively consume approximately 40 percent of the total energy use in the U.S. The electricity grid must function to satisfy the energy necessities. Due to the concurrent demands by facilities clustered in urban area, the electricity load of peak periods often overwhelms the grid delivery infrastructure. To increase grid reliability and reduce greenhouse gas emissions as a part of the integrated national energy strategic plan, in 2010 the Federal Energy Regulatory Commission (FERC) developed the National Action Plan on Demand Response to facilitate the DR program. In addition, the International Green Construction Code (IgCC) also addresses the requirements of Automated Demand-Response (Auto-DR) infrastructure in section 604. Thus, it is critically important for building design and construction professionals to look into the DR strategies.

Major Points:

- Demand-Response (DR) program and technology
- Energy metering and Building Automation System (BAS)
- Smart grid electricity delivery system
- International Green Construction Code (IgCC) Section 604 requirements
- LEED V.4 Energy & Atmosphere- Demand Response requirements
- Automated Demand and Response (Auto-DR) strategies

Summary: Automated Demand-Response (Auto-DR) technology provides an opportunity for high-performance building to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods. A building energy management and control system (EMCS) shall be installed to integrate with building systems in order to receive an interoperable Auto-DR relay or internet signal so as to reduce peak electricity demand.

Thursday, November 3, 2016

Construction

Smart Home Module Development for Education of Construction Management Majors

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Need: Smart Home is used to improve the quality of life of household inhabitant. It must provide convenience, energy efficiency and better security. Smart Home System has been applied to newly built high-end housing in the United States for few decades. However, many average and conventionally constructed homes lack Smart Home system. Off the shelf system to retrofit an existing homes and converting them to smart homes are growing market. Graduates of Construction Management / Technology programs are expected to have the first-hand knowledge of smart building systems and components. Demands on energy efficiency and echo friendly structures compels bachelor degree programs to incorporate smart building concepts into their curriculum.

Overview: Smart home service offerings from the big telecommunication companies and cable providers will help drive the market from under $2 billion worldwide in 2012 to $10.9 billion by 2017. Since smart home can significantly improve convenience, security, accessibility, energy efficiency and resale value over conventional homes, implementing smart home project into education is important. Especially, the construction management graduates are the potential future builders, educators, and construction leaders. Their understanding/knowledge of the smart home will be essential to achieve aforementioned benefits that smart home can offer. When developing smart home module that will be used specifically for education purpose, there are many aspects to be considered, such as what kind of hardware should be selected in terms of cost, power consumption capacity, reliability, and upgradability, what kind of sensors should be selected, and what kind of software should be selected out of so many options available. A brief comparison among the available software and hardware options will be introduced.

Major Points:

- Need for a smart home section into construction education
- The module development for smart home education
- Advantages and disadvantages of different smart home modules
- Educational application of the smart home

Summary: Attendees will understand the smart home module development procedures into construction education and how it can be used to educate construction management program students.

Friday, November 4, 2016

Construction

The Capability of Technology in Representing Identity Value in Designing Kinetic Facade of Buildings

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Need: To optimize the daylight performance in an interior space, the implementation of building kinetic facades is an innovative method. Through the design process of kinetic facades, various patterns are used as the underlying geometry of design. The rich geometric characteristics of Persian patterns, which are potentially applicable to kinetic facades to enhance daylight performance of building envelop, entail more research attention. Persian geometric patterns are syntactically proper to derive kinetic facade design since the pattern variations enable daylight optimization in interior spaces.

Overview: Sharaidin, Burry, & Salim (2013) assert the Environmental performances of kinetic facade depend on patterns of geometry, kinetic surface behaviors, and the size of the surface. Surveying the related literatures shows that there are not concrete researches to clarify relationships among daylighting performances of kinetic facades and patterns of geometry. As a result, impact of aesthetic factors such as patterns of geometry on environmental performances of building has high potential for further research. The study will be designed to identify which geometric characteristics of Persian patterns are associated with high daylighting performances of kinetic facades.

Major Points:

- kinetic building façade
- technology
- socio-cultural function
- identity

Summary: Façade of building as the exterior layer of each construction has a dual role of performance, as a sustainable envelope which is adjusted with environmental fluctuations and as public face of building which has the socio-cultural function. Kinetic Façade of Buildings is considered as a new approach in design of building façade in contemporary architecture, which is a logical response to solve thermal and visual problems in international full glass-covered skyscrapers. Since existed Kinetic Building Façade performs the techno-functional roles, there are some argues in cultural value of these building facades. The purpose of this study is to investigate the capability of technology in representing cultural identity in designing kinetic faced of building. The research question is how much technology capable in representing cultural values in design of kinetic building façade. In this concern, a few existing kinetic façades were studied as socio-cultural landmarks, and their success in representing the identical values of nations was evaluated in the quantitative approach. The research finding represents that kinetic façade of building designed based on techno-functional performance so cultural value is not considered as design requirement in designing of these type of façade.

Thursday, November 3, 2016

Construction

The Effects of Envelope Design on Building's Thermal Performance and Energy Efficiency in Relation to Human Health

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Need: The lack of consideration for building's energy efficiency is responsible for the high consumption of fossil-based fuels, causing air pollutions, and other related environmental issues. Living and working environment should be considered because sick building syndromes and building related illness give a lot of negative effects to people. Providing healthy building environments is a significant social issue because the problems give economic impact on society. The present research intends to study how envelope design affects building's thermal performance, energy efficiency, and indoor environmental quality.

Overview: The present research intends to study how envelope design effects building's thermal performance, energy efficiency, and indoor environmental quality. To address the thermal performance of buildings, the study will investigate building behavior in response to surrounding climate conditions. Knowing that the thermal resistance value, R-value, and glazing types, are directly related to heat gain/ loss and the operation of Heating, Ventilating, and Air-conditioning (HVAC) system, the research attention will be placed on thermal resistance property of construction materials and solar heating gain of glazing. In addition, the research will look into energy consumption and indoor environmental quality, thermal comfort, and daylight, for the health and wellbeing of building users.

Major Points:

- Literature review of the research
- Introduce the building envelope design effects building's thermal performance, energy efficiency, and indoor environmental quality Investigate building behavior in response to surrounding climate conditions
- Analyze Directly related to heat gain/loss of Heating, Ventilating, and Air-conditioning (HVAC) system
- Identify the health and wellbeing of building users

Summary: The research adopts a qualitative approach to data collection and retreated analysis. Energy-related information will be collected from Energy Information Administration while the thermal property of construction materials will be based on American Society of Testing and Materials. In addition to analyzing available data to synthesize finds and draw conclusions, the research will intergrade sustainable design principles into the study. In this regards, the qualitative research method will be used in analyzing the impact of building envelope design on thermal performance and energy consumption in HVAC building systems.

Friday, November 4, 2016

Construction

User's Perception of the Effectiveness of Current Facilities Management Practices at a Selected Tertiary Institution in Jamaica

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Need: The core of facilities management is to keep a company or organization's physical assets operating smoothly; it requires the flexibility to respond to demands of an evolving world. Universities are often plagued with rising operating cost, increasing number of students, varied operational needs than any other organization, therefore the challenge is greater. It is imperative that facilities managers remain alert to the trends that affect their practice, and how it affect its end users while remaining competitive with other tertiary Institutions. This presentation will discuss how well university facilities are meeting the performance expectations of users against what is being delivered.

Overview: The role of the facilities manager and his team is to support the goals and objectives of the organization, as these practices affect the performance of students and staff. Performance of students and staff are clearly a result of the physical environment. Facilities managers' responsibility is to conduct various performance measures to ensure that the facility complies with the users standard as best as possible, as well as to make sure that the building is operating at its optimal potential.

Major Points:

- What are facilities management practices and how does it affect users perception and their performance ·
- What is the Role of facilities managers and what challenges facilities managers face
- What are some methods used to analyze the effectiveness of current facilities management practices
- How perception of an institution's facility affects the attraction of prospective students and staff

Summary: Attendees will learn the importance of facilities management practices in how users feel in an environment they occupy . Attendees will understand that performance measurement provides the basis for an organization to assess how well it is progressing towards its predetermined objectives. It helps to identify areas of strengths and weaknesses and decide on future initiatives with the goal of improving organizational performance.

Friday, November 4, 2016

Construction

Using Collaboration Between Industry, Students, and Alumni to Design, Develop and Install a Solar Project at a University Nature Center

Author(s)
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Need: The development of the alternative energy industry has presented opportunities for many construction management (CM) students who are graduating. The solar industry, in particular, has seen tremendous growth and with it, opportunities for students. But, many programs do not have the facilities or coursework to prepare students who are interested. Students interested in solar or renewable energies at a University received an opportunity to collaborate with an industry partner and alumnus in solar to conduct research and prepare a proposal for the development and installation of a solar field at the university's nature center.

Overview: Industry relationships, student research, and alumni interaction are all activities of focus for any program in higher education. The ability to grow these relationships are strong indicators of involvement and program direction which reflect on future considerations in the program or department. The focus of this project was to: (1) Engage students in the research process for innovative technologies such as solar power, (2) Foster industry relationships in emerging technology (3) Engage alumni who are currently working or have an interest in solar power (4) Encourage university and CM program to partner on activities or building opportunities. The results of the project allowed undergraduates a chance to network, alumni the chance to give back, and industry a chance to build a relationship with the program and university.

Major Points:

- Development of industry/alumni partnerships for CM programs.
- Research and development of a solar field installation for the university.
- Elevate the awareness of sustainability concepts for students interested in the renewable energy field.
- Increase service learning opportunities for CM students while working with industry experts.

Summary: Attendees will have the opportunity to see the development of the project and how faculty enlisted the assistance of alumni and industry to bring together a project with university administration. Secondly, the opportunity to participate in the discussion of how to get alumni engaged in mentoring undergraduates and forging industry relationships for emerging markets. Lastly, the opportunity to see how solar fields are calculated and possible granting sources available for educational research geared toward renewable energies.

Friday, November 4, 2016

Distance Learning

Developing Leadership at a Distance

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Need: Leadership education has long relied on face to face instruction. This type of instruction relies on the instructor demonstrating leadership knowledge and ability and the students learning through observation. At present, there is an emphasis, supported by administration and students, on transitioning toward distance delivery. What makes leadership education different from other distance content is its heavy emphasis on reflection and internalization. Simply knowing what the right course of action is does not necessarily translate to a student's ability to take that action. The department of Technology Leadership and Innovation at Purdue University is actively working to develop a leadership degree with multiple modes of instruction (i.e. face-to-face, hybrid, and distance). This presentation will highlight many of the challenges that the program has encountered during the development and implementation of the degree. Particular emphasis will be placed on discussing how to convert courses (similar to leadership) that pose particular challenges in an entirely distance environment.

Overview: This session will discuss the development of a distance modality for a leadership program in the Technology Leadership and Innovation Department. Challenges, obstacles, best practices and solutions will be discussed.

Major Points:

- The transformation of a leadership program from face to face to a distance modality
- Integration of research into the program design
- Leadership curriculum for the program as well as details about the various integrations

Summary: Attendees will learn about the development of a distance model for our leadership program, from idea to fruition. Details of the program, of the design down to the individual courses, will be presented.

Friday, November 4, 2016

Distance Learning

Distance Learning: Blackboard and its Impact on 21st Century Learning for Nontraditional Students in the Contemporary Workforce

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Need: The need for blackboard in the 21st century learners such as nontraditional students or those that are in the current workforce. It's beneficial to them because some nontraditional students might have situations to where they cannot come face to face to class. Blackboard is a good start on changing the way in higher education. Whether you at home or on the go because now they have a mobile app just for blackboard to where it keeps students up with what assignment is due. For students that have just online classes and want to join in there is a spot for students to join class at home with the software called Blackboard Collaborations it give students the opportunity to be a part of the class.

Overview: Blackboard is the heart of college and universities now in the 21st century learning process. It has set a status of distance learning throughout the U.S. Blackboard is the root of distance learning because it generates the purpose of teaching students with or without being in the classroom. 21st century learning has progressed over the years for traditional and non-traditional students. Blackboard is a trending learning tool for colleges and universities. Having blackboard helps generate students when it comes to being a learning tool for teachers and providing a way to communicate with students outside the classroom.

Major Points:

- Blackboard is beneficial to 21st century nontraditional learners—promotes innovative use of technology
- Blackboard allows for online assignments to be accessible to students
- Blackboard allows students to work as own pace and self-govern; thus, encouraging more discipline

Summary: Blackboard for 21st century nontraditional students had the best way to becoming more involved with school without being there. Having blackboard is a great tool for teachers to use because it cuts down different assignments to grade. Blackboard is mostly distance learning as in you do your online assignments at your own pace. The best part about blackboard is the way students can go on a virtual chat with the teachers and they can assist you when you are online. Each school provides students assignments online and gives them responsibility to do complete assignments and actives by promoting self-governing.

Friday, November 4, 2016

Distance Learning

Fluid Power Laboratory Modes versus Resource Utilization Effectiveness

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Need: This paper concerns a 300 level (junior) mechanical engineering fluid power technology course, MET 329. MET 329 is a hybrid course with online elements, lecture elements, and a laboratory experience. From a breadth of fluid power knowledge content perspective, MET 329 is unremarkable. The content pertains to hydraulics, pneumatics, Pascal, Bernoulli, a design project (usually designing and building a log splitter), and 5 weeks of laboratory exercises with hydraulic and pneumatic trainers. When considering the depth of content, the unique nature of MET 329 becomes apparent. MET 329 has no prerequisites and yet is required for nearly every engineering technology related program in the college. By virtue of the lack of prerequisites, literally any undergraduate student on campus is eligible to take the course. Thus, achieving the desired student learning outcomes becomes problematic. The significant laboratory experience is critical to overall student success in the course. However, during the past year: a.) the number of MET 329 sections needed per academic year has steadily increased from 3 sections to now 8 sections per year (in terms of annual SCHs, from 3 classes of 20 students for 3 credit hours per student = 180 SCH, to 160 students X 3 credit hours = 480 SCHs), and b.) the faculty workload has increased to a critical point. Furthermore, there is the continuing pressure to deliver all coursework in distance learning format.

Overview: MET 329 has been redesigned to accommodate additional students. The laboratory and lecture portions of the course have be separated such that one large lecture accommodates several smaller laboratory sections; additional changes will include separating the laboratory into its own course. An ongoing study suggest that no learning objectives will be compromised by going to a virtual laboratory mode. However, there a major concerns regarding the additional workload involved the managing a virtual laboratory.

Major Points:

- Breaking apart the traditional lecture with laboratory course can lead to resource savings
- The use of virtual laboratories as opposed to traditional trainers may actually lead to course improvements without compromising learning objectives
- While virtual laboratory environments have learning advantages there might be a tremendous increase in workload
- When dealing with an expanding population of students who are ethically challenged, a virtual laboratory might offer them too much temptation which would be labor intensive to detect

Summary: The planned changes to MET 329 will make the course more palatable for students. Greater emphasis on labs and experiential learning have proven track records for increasing student success. Additionally, breaking apart the lecture and laboratories into separate courses will provide greater scheduling flexibility, as well as provide a measure of damage control when student performance is lacking in either the theoretical lecture or the hands-on experiential learning laboratory. The greater challenge will be finding a suitable interface that gives faculty insight in students' virtual lab activities.

Thursday, November 3, 2016

Distance Learning

How Does "Quality Matters" Help? — Effectiveness Analysis of Development and Implementation of Online Courses Containing Intensive Technical Contents

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Need: Industries' demand for sufficiently trained engineers and technologists is increasing in order to remain competitive in manufacturing globalization. The development of educational technologies powered by high speed personal computers and computer networks has enabled many universities to offer online and hybrid courses/degree programs, in addition to the traditional face-to-face instruction method, to accommodate the educational need. However, there is still a challenge to provide quality delivery and teaching effectiveness when courses with intensive technical contents are offered online.

Overview: The Quality Matters (QM) program is a nationally well-known quality assurance program for online and blended courses. After attending QM workshops and training sessions at the University of Northern Iowa (UNI), with the support from the Continuing Education Office, the presenters developed several online courses with ample amount of technical information for the Master of Science graduate program and Technology Management undergraduate program, by integrating QM's principles and rubrics. TECH 3142 (Statistical Quality Control) and TECH 3143 (Managing Manufacturing System) are two course that intensively involve statistical and mathematical calculation, reasoning and software demonstration. Analyzing the qualitative and quantitative data collected by the presenters, this study compares the teaching effectiveness of TECH 3142 and TECH 3143 online courses with a face-to-face class, respectively.

Major Points:

- Need and Challenges to implement online teaching in technical contents courses
- How Quality Matters rubrics are applied to assure online design quality
- Application of Panopto, a lecture capturing software
- Qualitative data analysis through comparing background survey data obtained in the online and face-to-face courses through virtual and real classroom observations
- Quantitative data analysis through t-test to compare the student performance in assignments, quizzes, and exams
- Conclusions, reflections and improvement suggestions for online courses with intensive technical contents

Summary: Despite of the success of online education in many disciplines, there is still a challenge to provide quality and teaching effectiveness when the online course contains rigorous technical contents, such as subjects related to math and sciences, whereas the traditional face-to-face teaching shows more advantages. Attendees will view how online courses are developed and implemented with the QM and new educational technologies, how effectiveness of the courses is assessed in qualitative and quantitative approaches, and how insights are reflected for continuously improving online education at UNI.

Thursday, November 3, 2016

Distance Learning

Implementing a Distance Learning Course for Control and Automation Applications

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Need: Many Technology programs include technical courses taught with a traditional Face-to Face (F2F) lecture/laboratory style. Nontraditional learners can have difficulty scheduling these types of courses around work and family. In some programs, these types of learners are increasing due to an economic downturn in certain industries, changes in traditional manufacturing processes resulting in industry downsizing, or ex-military personal entering college after completing military duty. The authors have observed that these types of learners typically have difficulty completing a degree program within the normal 5-6 year graduation cycle. To determine if a traditional F2F lecture/laboratory course can be successful in a Distance Learning format, a prototype course was developed and pilot tested with a select group of non-traditional volunteer students. The topic area selected was controls and automation(C&A) because it is a required topic area, a senior level topic, limited enrollment due to equipment limitations, and cost constraints.

Overview: Electronic prototyping platforms have become a popular medium for implementing electronic designs. These platforms consist of a microcontroller installed on a printed circuit board with various supporting components, and a user friendly software package known as an IDE. Using this technology, topics investigated by the pilot course included: fundamentals of microcontrollers, computer programming, transducer applications with C&A, and prototyping methods. Results of the pilot course demonstrated that an inexpensive microcontroller can provide a Distance Learning platform for students to learn the fundamentals of C&A with implementation of a prototype design.

Major Points:

- The need for a Distance Learning course in C&A
- The structure of a Distance Learning course in C&A
- The advantages and disadvantages of a Distance Learning course in C&A
- Student feedback of the course and possible future work

Summary: The presentation will demonstrate the differences between a traditional course that covers the area of C&A and a Distance Learning course that covers C&A.

Friday, November 4, 2016

Distance Learning

Improving Online and Hybrid Courses using Quality Matters (QM) Rubric

Author(s)
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Need: Due to the rapid technological changes in higher education sector, many universities start offering online degree programs to meet the workforce needs. Online courses provide students with more flexibility in completing their degrees. However, maintain quality and teaching effectiveness are the main concerns when considering developing and teaching online courses. Quality Matters responded to these challenges (e.g. maintain online course quality) by providing proper techniques (e.g. QM rubric) to obtain and maintain the quality of online or/and hybrid courses. Faculty may or may not aware of the benefits that can be gained from using QM rubric. Therefore, there is a need to highlight the advantages that can be gained from applying QM standards. A strategy that may help faculty to meet the QM standards will be presented.

Overview: Technological innovations have significant impacts on education. Universities start offering online and hybrid courses to meet the needs of their students. Online courses provide students with more flexibility in scheduling classes and completing their degrees at their own pace. Quality and teaching effectiveness should be maintained in online teaching. These challenges (maintaining quality and teaching effectiveness) may increase with the online technical or hands-on courses. Quality Matters (QM) Program, one of the most well-known programs in the United States, became aware of these challenges and realized the need to provide proper techniques and programs to maintain quality of online courses and teaching effectiveness. QM Program is a nationally recognized, faculty-centered, peer review process designed to certify the quality of online courses. This research aims to familiarize faculty with QM standards, rubric, and the review process. A six steps strategy will be shared with faculty to help them meet QM standards. A graphic model for the strategy will be illustrated to summarize and simplify the process. Techniques and solutions will be offered to overcome the challenges that might be faced during the QM review process. Sample of a QM certified course will be shared.

Major Points:

- Many challenges could be faced when faculty teach online courses.
- Quality and teaching effectiveness should be maintained in developing and teaching online courses.
- Quality Matters (QM) Program created standards to obtain and maintain the quality of online and hybrid courses.
- The peer reviewed process is the technique that is used for reviewing courses.
- Faculty need to be aware of QM rubric and the advantages that might be gained.
- A strategy consist of six steps might be helpful for faculty to meet the QM standards.
- Sharing screenshots of QM certified course's activities might be helpful to understand the standards.
- Graphical illustration for the strategy is useful to summarize and simplify the process.

Summary: Attendees will be exposed to an example of a QM certified course and will learn about strategy that might be used to help faculty improve their online and hybrid courses. Attendees will have a better understanding of how to prepare a hybrid and/or online course to meet the QM rubric.

Thursday, November 3, 2016

Distance Learning

Quality Courses: Using the Quality Matters Rubric as a Measuring Tool

Author(s)
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Need: During the past decade, there has been an increase in the delivery of online courses in higher education. As enrollment in online courses increases, education institutions are under increasing pressure to ensure consistency and quality to increase engagement, student knowledge, and retention. It is not enough to put a course online, and say it is a quality course. It is vital for online courses to promote rigor, engagement, retention, and academic standards for success. This is the reason our school has adopted the Quality Matters rubrics for our development process of online courses.

Overview: We will share our process and the results of our surveys from the faculty after taking the APPRQM course. Also as instructional designers, we would like to share the success stories of how the QM rubrics and the instructors attending APPQMR course has impacted the quality of our online courses.

Major Points:

- Process of our development of online courses using the QM Rubrics
- Working with faculty that have been through APPQMR
- Surveys for faculty on how QM has changed their view of quality online courses

Summary: The purpose of this presentation is to discuss how our use of the QM rubrics has improved the quality of our online courses. Also, how enabling our faculty to take the APPQMR course it has helped them to better understand what it takes to implement a quality course. Lastly, results of how our process has affected the faculty, students, and staff. We would like to share success stories from the implementation of QM.

Thursday, November 3, 2016

Distance Learning

Teaching and Learning On-line - Staying in Touch with Our Students

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Need: As faculty we have attended several conferences, presentations and webinars …and as informative and instructional as they are, we feel a large point is still being missed. There are check points available to faculty members in order to make sure their courses are increasingly better and more effective. Yes, structure and organization is very important; however once you have created that, you need to continue improving. The next step we need to focus on is the need to work on the faculty presence. It is important that the contact between the students and the faculty in on-line classes is an excellent one. We need the connection between all the students that we get in regular classes. Students also need prompt feedback, relevant comments from the instructors and reinforcement of our high expectations. Through the use of research literature and personal experience, we will share with the group the prime areas of concern about Internet classes in higher education.

Overview: What is the all the fuss about creating an effective online course? It is not something to dismiss as non-important! Success or failure of a class generally hinges on the effectiveness of development in the online course. How often is the instructor present? Is he available during the day or evening hours? To ensure the effectiveness of the course, we will first first exam ine the techniques, practices, and processes used in the course. An effective course will warrant the student's success within the course. If a student can maneuver through an online course with a feeling of consistency, and recognize the paths they must follow, how they can contact instructors or one another, they are more prone to succeed than if they are constantly trying to endure an ineffective course. Learning to build a course using the basic concepts, preparing the learner, and creating a good deal of interaction throughout the course will ensure an effective online course. We did not always do this and learned the hard way students not only need consistency and organization, they need the Instructor to be available and the couse to be effective, in order to achieve the most benefits from learning. Through research literature and personal experience, we will bring best practices of instructor to student and student to student communication for an effective online course.

Major Points:

- Techniques, Practices, and Processes that help ensure a successful course
- Basic Concepts of Teaching and Learning Online
- Preparing the Online Learner
- Interaction in the Online Course
- Creating Effective Communication Online Courses

Summary: Attendees will gain thoughts and ideas of how to create an effective and organized internet course. They will understand the importance of the creation of an effective communication system between themselves and the students and between the students themselves. Creating a good deal of interaction and communication throughout the course will help ensure an effective online course. We have learned the students not only need consistency and organization, they need the Instructor to be available throughout the course and the communication to be effective, in order to achieve the most benefits from learning. We will look at ways to communicate, as well as how to make the communication more effective.

Friday, November 4, 2016

Distance Learning

Using Video Forums to Increase Peer-to-Peer Interaction in an Online Class

Author(s)
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Need: Online classes remain a viable option for students. One major aspect of learning in the classroom is interaction. This interactions is more difficult in an online course. Forum discussions can provide a learning environment with interaction. This interaction is typically student to instructor. Often, students feel disconnected from their peers in an online class because of the lack of interaction. They fear this lack of interaction will impact their performance in the class. Adding videos in the online class can also capture the student's attention and encourage participation.

Overview: Many online classes will have students read passages from a textbook or view a PowerPoint presentation and then have the student answer questions in an online forum. This type of forum discussion may not stimulate the student to think critically, but to merely repeat the content learned. Videos provide engagement and allow students to apply concepts and interact with fellow students. Interaction is important for an online class. Providing the peer-to-peer interaction in online forums can benefit both instructors and students. This presentation will provide strategies for creating video forums and methods for effective feedback.

Major Points:

- Strategies for creating engaging video forums
- Methods for providing feedback
- Examples of video and forum discussions will be provided

Summary: This presentation will discuss the need to increase peer-to-peer interaction in an online class through video forums. The strategies for creating engaging video forums will be introduced, along with methods for giving feedback. Conference attendees will be provided with examples meant to enhance their forum discussions in online classes.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

A Study of Solar Powered Electric Go-Kart

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Need: As we move towards more sustainable future, we should consider ecological and clean transportation options. According to the U.S. Environmental Protection Agency a typical passenger vehicle emits about 4.7 metric tons of carbon dioxide per year. Solar powered electric go-kart is fundamental base in practicing to create carbon emission free vehicles.

Overview: Impact of using emission free vehicle around campus would be delivered. Mechanics of solar powered electric go-kart would be presented. Each part of go-kart will be explored to exemplify impact to performance of the go-kart. Additionally, improvement options will be included. Future project development would be discussed.

Major Points:

- It is imperative to find emission fee vehicles
- Hands on practice of solar powered go-kart
- Mechanics of solar powered go-kart
- Integrative study on go-kart with electric vehicles

Summary: Solar Powered Electric Go-Kart is environmentally friendly application for reducing carbon emissions. This presentation will introduce the audience with a simple solar powered electric go kart, including the basic working principle, component and systems, control and possible improvement. It is hoped that this project will help to explore solar power for transportation needs and draw an interests from students.

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

An Arduino GPS Clock for Image Time Registration

Author(s)
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Need: A means of verifying the time an image is captured is required for research and development of aerial surveillance systems. These systems are common in military, commercial, and law enforcement applications. The location and attitude of the camera are typically provided by the Global Positioning System (GPS), and an integrated Inertial Measurement Unit (IMU). The image is provided by a camera and is synchronized with the GPS IMU data. The GPS time can be read directly from an image of the clock. The GPS Clock described in this presentation provides a means of verifying the synchronization of the image and the pose data.

Overview: Aerial surveillance is used for military, law enforcement, mapping, and border security. One application is Google Earth. An aerial image is recorded along with the location and attitude of the camera. The image comes from a camera. The camera position and attitude, collectively known as the pose, come from an integrated GPS IMU. The image and the pose are collected simultaneously from two different sources. The image and the pose are combined in a one-to-one relationship, such that each image is attached to a pose. Since the projection of the image depends on the pose, if there is a misalignment of the pose, and the image, the projection will be off. If the pose is recorded at a slightly different time than the image, there will be an error in the projection. To detect and correct these timing errors, the GPS clock was developed. By recording the GPS clock in the image the time of the image is measured. The time of the image can then be compared with the time recorded in the pose.

Major Points:

- What is aerial surveillance
- Why is time registration important What is a GPS Clock
- Details of the clock
- Performance, and case studies

Summary: Attendees are given an introduction to aerial surveillance, and image projection. The importance of time registration in accurate projection of aerial imagery is explored. With this background the importance of the clock as a diagnostic tool is provided. The features and operation of the clock are discussed. Case studies are given, and performance is evaluated.

Applied Software Defined Networking (SDN) Research: Equivalent Test Between Openflow and Ethernet Pipelines of Latency and Jitter to Evaluate the Use of SDN Controllers of Disaster Recovery Exercises (DREs)

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Need: Availability of mission critical applications is one of the most important requirements for modern enterprises. Data centers, where these applications run, are often very complex systems comprised of network, compute, and storage resources. These resources typically consist of both physical and virtual components. In order to ensure high-availability of mission-critical applications, most businesses conduct Disaster Recovery Exercises (DREs). While it is possible to have a complete physically separate DRE area comprised of duplicate hardware and software, many organizations find it cost prohibitive. For this reason, it is common for organizations to temporarily reassign a subset of resources for DREs. After the DRE is completed, the resources are reassigned back to the production environment. For many companies, the temporary reassignment of resources to the DRE area is currently done by physically recabling resources from the production area to the DRE area. While this meets the objective of isolation between the two areas, it can drastically increase the amount of time a resource is unavailable for production activities and also increases the operational expense (OPEX) of conducting the DRE. In order to rapidly decrease the time it takes to temporarily repurpose production resources for DREs, the manual process of recabling network resources needs to be replaced by software.

Overview: A study was conducted in which equivalent tests were run between OpenFlow and Ethernet pipelines to determine the differences in Jitter and Latency. These results were used to make an evaluation on the use of SDN controllers for Disaster Recovery Exercises (DREs). To this purpose, the researcher developed an application, SDN Rapid Adjustable Networking (RAN), that's purpose, is to rapidly isolate virtual and physical resources needed for a DRE via an SDN controller. This application reduces the OPEX and capital expenses (CAPEX) required for DREs by drastically reducing the time to setup and teardown an isolated DRE environment and by temporarily repurposing production resources to the DRE environment. This study presents a principled approach to DREs that takes advantage of a recent development in computer networking called Software Defined Networking (SDN). Traditional network devices contain both the control plane and data plane in the same physical device. SDN abstracts the control plane from the physical network device and centralizes it in a SDN controller. Network administrators can use an SDN controller to centrally reconfigure the forwarding path of network devices instead of manual configuration of each separate network device. The SDN RAN Application is written in Python and takes advantage of the OpenDaylight Controller. OpenDaylight is a Linux Foundation Collaborative Project that has an open platform for network programmability that enables SDN. SDN RAN is able to work in conjunction with the OpenDaylight Controller to isolate physical and virtual production resources in a matter of seconds for DRE testing and repurpose them back to production after the DRE is completed. The uniqueness of this approach that the researcher is suggesting is using an SDN controller on a traditional Ethernet network with traditional Ethernet switches instead of an SDN network comprised of switches that utilize SDN protocols. This approach allows SDN automation capability to be used in an existing traditional Ethernet network comprised of traditional Ethernet switches and override the forwarding path of data packets on only the network resources that have been selected to participate in the DRE. The traditional switches become hybrid-SDN switches meaning it has both traditional network processing and SDN processing capabilities. This approach provides the capability to choose port by port which resources will participate in the DRE and which will remain part of the traditional Ethernet network.

Applied Software Defined Networking (SDN) Research: Equivalent Test Between Openflow and Ethernet Pipelines of Latency and Jitter to Evaluate the Use of SDN Controllers of Disaster Recovery Exercises (DREs)

(Continued from previous page)

Major Points:

- Disaster Recovery Exercises (DREs) are typically expensive and time-consuming
- The need for a Software Enabled DRE is clear.
- By utilizing Software Defined Networking (SDN) Controllers, it is possible to replace physical isolation procedures with automated software applications.
- SDN controllers can be utilized in existing Ethernet Networks in conjuction with DRE Software Applications to quickly isolate thousands of servers for testing and repurpose them back into the production network when done.
- The quality of a network can be tested for two important attributes: Latency and Jitter.
- The data from the study suggest both latency and jitter are not statistically significantly distributed differently between a network using an Ethernet pipeline and a network using an OpenFlow pipeline.
- In the study, the maximum Latency in the OpenFlow pipeline was .980 ms with a mean of .91366 ms; these sub 1 millisecond measurements are well below the 200 ms latency round-trip time requirement for quality networks.
- In the study, the maximum Jitter in the OpenFlow pipeline was .488 ms with a mean of .06278 ms; these sub 1 millisecond measurements are well below the 50 ms jitter requirement for quality networks.
- The data from the study suggests that it is possible to use Software Defined Networking (SDN) controllers to program network devices and automate the isolation of network resources for the purpose of disaster recovery exercises (DREs).

Summary: Attendees will gain an understating for the need to lower the costs and automate Disaster Recovery Exercises (DREs) for businesses. Software Defined Networking (SDN) will be discussed and its possible use to help automate DREs. This will be followed by an overview of a recent study that was conducted in which equivalent tests were run between OpenFlow and Ethernet pipelines to determine the differences in Jitter and Latency. In this study, an evaluation of the pipelines is used to make a determination on the use of SDN controllers for Disaster Recovery Exercises (DREs). The uniqueness of this approach will be discussed in regards to deploying an SDN controller in an existing Ethernet Network instead of an OpenFlow network. A review of the hardware, software, and data flows of the SDN Rapid Adjustable Network (RAN) experiment will be covered. The results of the Independent-Samples Mann-Whitney U test will be reviewed along with other important data. This will be concluded with a discussion for future work in the area of Software Enabled DREs.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Assessment of Syngas Production from Various Biomass Feedstock

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Need: The energy from the sun is stored in biomass through the photosynthetic process. Biomass is a carbon-neutral energy resource and the potential for the conversion of biomass into energy is rapidly expanding. Gasification is the thermochemical conversion of a solid biomass to a gaseous fuel by heating with a gasification agent such as oxygen. The advantage of gasification technology is a decentralized energy conversion system that operates economically even for small scale. However, it is well known that the gasification of biomass still has some technical issues such as quality of the gas produced and tar cracking. The composition and amount of syngas produced are determined by the flow rate, type, and characteristics of the biomass feedstock and operating conditions including equivalence ratio, gasification pressure, and temperature profile. The use of different biomass feedstock for the production of hydrogen-rich gas will be emphasized in this project. Along with other possible technical solutions, to use the mixture of various biomass feedstock for gasification could be a solution.

Overview: The objective of the study is to better understand the effects of biomass type on the gasification performance of a downdraft gasifier. The wood pellets, paper pellet, and miscanthus is studied because of local availability and potential as energy feedstocks. The decomposition of different biomass fuels was studied in the laboratory reactor. The fuel samples consisted of recycled paper pellets, wood chips, and miscanthus. The high heat value (HHV) and major gas compositions are analyzed. The main components of the biomass feedstock are cellulose, hemicellulose, and lignin. Thermal degradation of these components produces volatiles such as hydrogen, methane, carbon dioxide, carbon monoxide, and hydrocarbons in different proportions. Lignin produces four times more hydrogen than cellulose and almost three times more than hemicellulose. For this reason, to increase hydrogen content in syngas, the various biomass feedstock, and its chemical composition is studied during gasification performance.

Major Points:

- Evaluating the performance of downdraft gasifier while using mixture of biomass feedstock based on syngas composition, higher heating value (HHV) and tar content
- Discussing the effect of biomass type on tar content and syngas composition
- Comparing various operating parameters such as pressure and temperature for various biomass fuels

Summary: The attendees will understand the gasification performance of downdraft gasifier while using different biomass feedstocks such as wood pellets, miscanthus and recycled paper pellets in order to obtain the syngas. The present work allows estimating the better possibilities of the gasification of the different biomass feedstocks studied. The effect of the operating parameters such as temperature, various type of biomass fuels and the performance of the gasification system while using the different mixture of biomass feedstock will be discussed.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Biomass Go-Kart: An Alternative Energy Vehicle Manufacturing and Testing

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Need: Biomass gasification technology was used widely during the 1800s and World War II. However, biomass gasification technology had been gradually forgotten after people discovered massive oil reserves in the Mid-East and also due to war ending. In recent years, some scientists started to review the understanding of this old technology and began trying to improve it because the masses were starting to become worried about the consumption of fossil fuels. Combustion engines can be easily modified to use a biomass gasification system. This system has several advantages. First, it can reduce the consumption of fossil fuels. Second, it can help vehicles achieve carbon neutral. Third, a biomass gasification system will not cause air pollution. Those superiorities lead people to reevaluate biomass gasification technology and improving the system. A biomass go-kart is a good experimental project for sustainable energy students to understand the principles of biomass gasification, build a gasifier and apply the gasification system. Meanwhile, this topic may help biomass become the future alternative energy for vehicles.

Overview: The presentation can be generally divided into three major parts which are gasification and filtering system, gasification go-kart assembling process, and project forecast. In the first part, the presentation will cover the principles of a downdraft gasification, a downdraft gasification design and a filtering system design. The second part, major materials, processing technologies, assembling process will be introduced to audiences. The last part will show the data analysis, project photo exhibition and project forecast. Through the presentation, audiences will be able to understand how a gasification system works, the operating conditions of the biomass go-kart and possible applications of a gasifier system.

Major Points:

- Introduction to gasification system
- My gasifier and filtering system design and manufacturing
- Assemble the gasification system with a Go-Kart
- Project review and data analysis
- Biomass gasification vehicle future forecast

Summary: Manufacturing your own gasifier system and applying it to a go-kart will be a good lab project for mechanical and sustainable energy major students. Similar as electric, natural gas and solar energy vehicles that you can currently find in the market, a well improved and developed biomass gasification system as an application of alternative energy may have a bright future in the vehicle market.

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Calculating the Real Energy Costs of Running Successful ATMAE Programs

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Need: In recent years, universities across the country have had to tighten budgets or reduce spending to continue effective operation. Could some reduction in spending have been spared if there had been a reduction in energy usage by utilizing analyses to determine best practices? Universities can reduce the amount money spent on every day operational costs by becoming more energy efficient in their academic buildings. However, first universities must know how much is currently being spent on energy, and what is consuming said energy.

Overview: An in depth look at the cost of energy that is needed to run typical manufacturing and construction management programs. Research was conducted to determine actual energy consumption and costs of operating and maintaining offices, laboratories, and equipment at Ohio Northern University. After calculating real costs, analyses were conducted to determine practical solutions for reducing the amount of energy consumed by Department of Technological Studies.

Major Points:

- What is the real cost breakdown of operating and maintaining quality programs?
- What are the possibilities for reducing the amount of energy consumed?
- If improvement measures are taken, how much money can be saved on a yearly basis?

Summary: In this presentation, attendees will see the breakdown of total energy costs of running accredited manufacturing and construction programs. Attendees will be provided detailed solutions that were developed to cut energy spending. The information provided can allow programs to save money without harming the integrity of the faculty, equipment, or teaching.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Coding the Proportional Integral Derivative (PID) Controller

Author(s)
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Need: With the explosion of miniaturized computing hardware platforms such as the Raspberry Pi, and the Arduino, there is a need to implement Proportional Integral Derivative (PID) Controllers in software. While PID Controller is not difficult to code, a sound implementation of the PID is required for optimal results. Important items to consider when coding the PID include ensuring "bumpless" transfer from manual to auto, elimination of integral wind-up, "bumpless" response to changes in tuning parameters, and inputs for manual adjustment.

Overview: The traditional PID equation does not lend itself to direct implementation into software. Even if one starts with a digital implementation, the controller will have a number of issues. These include large changes in the output variable when one changes the gain or moves from auto to manual. In addition, for long periods of saturation such as in a heat up from a cold start, the integral will wind-up and cause a significant overshoot as the process error goes to zero. These problems occur even with single-loop commercial controllers produced by the leading manufacturers in the control industry. The implementation described here eliminates all of the common problems with the PID implementation, and allows for integrated manual control.

Major Points:

- The traditional PID equation
- Rearranging the PID to facilitate "bumpless" operation
- Tuning parameters
- Integral wind-up
- Auto/manual transitions
- Manual inputs
- The flying start
- The value of personalizing your PID
- Bringing it all together

Summary: Starting with the traditional PID control equation, attendees will rearrange the terms of the equation to eliminate many common problems in the implementation of the PID controller in software. Solving problems of discontinuities, manual inputs, and integral windup will improve control. Discontinuities may occur when changing gains, transitioning from manual to auto, or introducing manual input. Integral wind up can cause large overshoot as the controller approaches the set-point. These problems can all be avoided by properly coding the PID controller. In addition attendees will learn a number of customizations that can be added to improve process control.

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Collaborative Robots: Future of Robotics and Automation

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Need: Robotics and flexible automation are crucial factors in the survival of enterprises. This presentation addresses the emerging field of collaborative robots, robots working as robots should, robots collaborating with humans to improve performance and productivity. Our students to be at the cutting edge of technology; our automation and robotics courses must include collaborative robots.

Overview: The labor cost of manufacturing a product can be reduced by 65% by producing it overseas [1]. The lowest wage of an American autoworker is about $38; the average autoworker in Mexico gets $10. Thus Mexico manufactures many of America's bestselling vehicles, Cadillac SRX (Ramos Arizpe) Chevrolet Silverado (Silao); Chrysler's Dodge Journey (Tolouca) and Ford's Fusion and Lincoln MKZ (Hermosillo), among others [2]. Due to NAFTA, we have lost jobs in computer and electronic (150,300 jobs lost, 22 percent of the total number of jobs) and motor vehicles (108,000 jobs, 15.8 percent) [3]. Yes, while exporting jobs offshore reduces labor costs, there is a "silver-lining": replacing workers with robots is substantially a greater saving…up to by 90%. Capitalizing labor saving via robotics is to reverse the trend of exporting jobs. Robotics and Automation are crucial factors in the improvement of productivity and the very survival of industrial enterprises. However (maybe because of our technologist mindset), some Industrial Technologists may not fully comprehend, automation and robotics are very challenging to implement and maintain. Not only is the technology expensive (at least in the short run) but mostly, the technology is not user-friendly. For example, programming a standard robot to move in a smooth circle (like in a welding application) is a very complex set of DOS like archaic statements. Furthermore, robots are "dangerous" in that, humans come dead last (pun unintended) in a physical conflict between a robot and a human. To keep humans safe from these dangerous robots, we have demarcated work cells that occupy value real estate on the factory floor. The answers to these challenges are addressed in the emerging field of collaborative robots, robots working as robots should…machines collaborating with humans to improve performance and productivity. This presentation addresses the emerging field of collaborative robots. Collaborative robots or Cobots as they are often abbreviated, are "force-limited". They have sensors to limit the force and distance from external objects. This technology would immediately stop the robot when, for example, if the robot were to bump into a worker. In addition, Cobots are programmed using zero-G mode, Lead Through technologies. Therefore, they do not require hundreds of hours of arcane Cartesian, arc, joint and frame programming hurdles as in traditional robot programming [4]. Collaborative robots are best suited in small and medium-sized enterprises (SMEs). They promote agile automation, working cage-free, alongside their human coworkers in factories and distribution centers. Collaborative robots, for example, Rethink Robotics' Baxter and Sawyer, Universal Robot's UR3, and KUKA Robotics' LBR iiwa are stacking up Return on Investment ROI in just 10 months [5]. Since we are trendsetters to industry, our automation and robotics courses must include collaborative robots. This presentation shall demonstrate implementing collaborative robots in tasks that reserved for traditional industrial robots. In addition collaborative robots have a smaller footprint, are a less risky investment and greater flexibility. In addition, collaborative robots are lead through and intuitively programmed, simpler and easier to use than traditional industrial robots. Furthermore, collaborative robots are designed to meet the challenges of high mix manufacturing found in most SMEs [6]. Collaborative robots can perform most of the applications of traditional robots, handling operations (38% of robots are in these applications) Welding (29%) Assembly (10%) Dispensing (4%) Processing (2%) [7]. Since we are training our students to be "state-of-the-art" our automation and robotics courses must include collaborative robots. Collaborative robots perform tasks while being simple and fast to program by non-experts, use a small footprint, comparatively inexpensive, usually don't require fencing, can be repurposed easily for new tasks, and are simple to integrate into a production process. Capitalizing labor saving via robotics is to reverse the trend of exporting jobs. Robotics and Automation are crucial factors in the improvement of productivity and the very survival of industrial enterprises. It is imperative our innovative and leading-edge academic industrial programs include collaborative robots.

Collaborative Robots: Future of Robotics and Automation

(Continued from previous page)

Major Points:

Exporting jobs offshore may reduce labor costs by 65%. Replacing workers with robots is substantially a greater saving…up to by 90%. · Traditional Robots are very challenging and expensive to implement and maintain, and are not user-friendly. Robots are "dangerous" in a physical conflict between a robot and a human. Robot cells occupy value real estate on the factory floor.

- Collaborative robots are robots working, as robots should… machines collaborating with humans to improve performance and productivity.
- Collaborative robots or Cobots are "force-limited", having sensors to limit the force and distance from external objects, the robot immediately stops if the robot were to bump into a human worker.
- Cobots are programmed using zero-G mode, Lead Through technologies, negating hundreds of hours of arcane DOS like programming Collaborative robots promote agile automation, working cage-free alongside their human coworkers.
- Collaborative robots have a Return on Investment ROI in just 10 months, thus less risky investment.
- Collaborative robots are simple and fast to program and implement, use a small footprint, can be repurposed easily for new tasks, and are simple to integrate into a production process.
- It would behoove Industrial Technology and the associated ATMAE programs to implement Collaborative robots as a viable option in their Robotics and Automations programs.

Summary: This presentation will provide attendees with a working knowledge of the trend in automation and robotics, collaborative robots. It is imperative Industrial Technology and the associated ATMAE programs implement Collaborative robots as a viable option in their Robotics and Automations programs. This presentation will compare the implementation of traditional robots compared to collaborative robots. Furthermore, the attendees will gain knowledge why industry must automate in order to retain and improve market shares and retain American jobs.

Design of a Mobile Grid-Tied Solar Photovoltaic Laboratory Unit for Demonstrations and Laboratory Experiments

Author(s)
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Need: A recent worldwide interest has increased in developing technology to improve the applications of renewable energy systems. Solar photovoltaic technology in particular has experienced an important increase recently, and by the end of the decade, solar photovoltaic is expected to be cost-competitive with retail electricity prices without subsidies in a significant portion of the world. Academic community started developing solar photovoltaic related curricula in order to respond industry needs by producing qualified graduates who are familiar with solar photovoltaic systems. Technology and engineering programs in many higher education institutions are developing alternative energy-related curricula in classes, projects, training, and certification programs. RE teaching systems and projects help students to better comprehend complex concepts by including a renewable energy project or series of laboratory experiments. Energy knowledge and renewable energy-based projects are important in order to prepare students to be competitive for careers in the growing fields of energy related engineering, science, and technology.

Overview: Renewable Energy (RE) related course work is becoming an important part of the science, engineering, and technology curricula. Hands-on training in RE-related coursework is a major part of engineering technology-related technical coursework. RE courses typically require hands-on laboratory experiments for the students, unless the course is being taught in business and education related programs. Laboratory experiments for the related courses necessitate two major laboratory tools, first, a good laboratory workbook pertaining to what is being taught in the lectures and second, the related laboratory equipment. There is a variety of laboratory equipment available on the market for the RE related courses. The cost of the equipment varies between $2,500-$100,000 or more depending on what is expected required in the course. Some of the training/laboratory equipment companies offer manuals/workbooks to accompany their equipment. Those technical and engineering programs covering specific renewable energy curricula, but lack funding to purchase necessary lab equipment, seek ways to build their own equipment and prepare related laboratory activities. This research describes design and development of a Grid-Tied with battery backup Solar Photovoltaic Training Unit using micro- and string- inverters. The unit is completely designed and built in the design and production laboratories of an engineering technology program by faculty and students. The available lab equipment is used in lab sections of two renewable energy courses offered in the program.

Major Points:

- Solar photovoltaic systems
- Solar photovoltaic curriculum development
- Laboratory experiments
- Multidisciplinary curricular activities

Summary: This research describes design and development of a Grid-Tied with battery backup Solar Photovoltaic Training Unit using micro- and string- inverters. All the steps of the design proses and curriculum development will be shared with academia.

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Development of Mobile Robot for 3D Indoor Mapping Using Lidar Sensor

Author(s)
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Need: Lidar or 3D laser scanning has been used for capturing shapes of objects in variety of applications including landscapes mapping, scanning of buildings and bridges, and remote-sensing. This technology utilizes laser light to illuminate a target in order to produce highly accurate distance measurement. With recent advances in sensor technology, lidar sensor becomes compact, low-power consumption, and low-cost. This study presents the development of mobile robot using lidar sensor for creating 3D point cloud of indoor environment. Compared to other types of 3D sensors such as stereoscopic sensor and RGB-D sensor (Kinect), the lidar sensor may allow users to produce higher quality of 3D point cloud.

Overview: Typically optical ranging sensors use the principle of "Time-of-Flight" (TOF) which computes distance by measuring the time it takes light travels back and forth from the sensors to an object. Lidar sensor using the same principle has been well known to provide highly accurate distance measurement. In this study, a mobile robot was built and equipped with a lidar sensor that is mounted on a pan/tilt system. Micro controller board (Arduino) was used to control parameters in the scanning process (e.g., speed of motors, pan/tilt angles) and to record the measured distance from sensor. The purpose of this study is to present a custom built system that will provide users with better data quality using lidar sensor that allow them to experiment with innovative algorithm to develop 3D point cloud. This presentation benefits not only researchers who wish to create their own data collection and algorithms, but may serves as initial point of several applications such as mobile scanning robot, mobile navigational robot, compact surveying system, and autonomous vehicle.

Major Points:

1. Practicality of lidar sensor for developing 3D point cloud
2. Design and development of mobile robot with lidar sensor
3. Data collection process for 3D indoor mapping system
4. Example algorithm for transforming pan/tilt angles and measured distances to point cloud in Cartesian coordinate

Summary: Attendees will learn the usefulness of lidar sensor for producing 3D point cloud. The steps to design and develop mobile robot equipped with a lidar sensor will also be discussed. Finally, data collection process and algorithm for 3D transformation of point cloud will be demonstrated.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

DSL and the Telephone: Paying for Unwanted Telecom Services in Rural Areas

Author(s)
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Need: Congress stated in the 1996 Telecommunications Act that advanced telecommunications and information services should be provided in all regions of the Nation. Rural and high cost areas are required by Congress (USC 254(b)(1-7) to have access to the Internet with bandwidth and cost that is reasonably comparable to that provided in urban areas. A recent study titled Residential Internet Access Cost in Nebraska (Obermier, in press) found that rural residents in the State of Nebraska pay on average 170% more for digital subscriber line (DSL) services than their urban counterparts. DSL Internet access uses the transmission lines of the telephone system allowing both telephone and Internet access to be bundled together. While the extent is unknown as of the writing of this proposal, anecdotally many telecom carriers require their DSL customers to also pay for a telephone line, which has the effect of increasing the real cost to the consumer for Internet access when the telephone line isn't used or wanted. This is potentially in part due to federal government subsidies paid to the carrier for each telephone line in rural areas to help cover the high cost of providing service to remote customers. This subsidy would go away if the customer doesn't pay for a telephone line. The problem lies in the fact that many rural consumers utilize cellphones, and would rather not have to pay for the additional cost of a land line telephone they don't use. Equally problematic is the realization that many rural customers only have one effective means of Internet access and are therefore forced into paying for a telephone line they don't want or need.

Overview: This presentation will review the major findings of a research project to determine the true consumer cost of DSL Internet access in a rural state with only one metropolitan area. All telecommunications carriers offering DSL Internet access services were contacted to determine if they offer DSL access, if so they were queried to determine if they offered those services with or without also requiring the purchase of a telephone line. Some industry professionals refer to the absence of a telephone line bundled with DSL as "naked DSL". Once the status of each carrier was known, the cost of the service was used to calculate a before and after analysis of the cost per Mbps taking the cost of the telephone line into consideration.

Major Points:

- What is the prevalence of "naked DSL" offerings in a rural state?
- What is the per Mbps cost of DSL when factoring in a required telephone line.
- What is the urban/rural economic comparison of actual cost of DSL access?

Summary: This presentation will review the results of a study to determine the prevalence of "naked DSL" services in a rural state and will examine the cost comparison of rural and urban Internet access when DSL carriers also require the purchase of a telephone line.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

GIS Application for Sustainable Energy

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Need: The utilization of biomass gasification for energy production has the potential to see mankind move beyond the use of fossil fuels for energy production. Fossil fuels are running out and other renewable energy sources are not available in all locations. Biomass gasification is environmentally friendly with only trace amounts of CO2 and SOx emissions while providing 0.75 kWh per kilogram of biomass. To utilize biomass resources in a sustainable manner it is necessary to identify and collect localized sources, establish adequate storage location, and develop efficient transportation networks. The Renewable Energy Center at Eastern Illinois University operates two large scale bio-gasifiers which provides a framework that can be studied and scaled to accommodate a myriad of communities.

Overview: Development of a GIS application from existing GIS software and data that is tailored to sustainable energy production through biomass gasification will be presented. The conceptual framework will be discussed along with its vast potential applicability in the development of additional sources of renewable energy. Differences in the emissions rates of fossil fuels when compared to biomass gasification will be highlighted to show the viability of this resource. Various biomass sources and their potential will be discussed in order to demonstrate how this can be applied globally.

Major Points:

- Utilizing biomass gasification can reduce the dependence on fossil fuels for energy production
- The development of this application is aimed at identifying local biomass resources which mitigates cost while increasing the overall sustainability potential
- The GIS application is scalable and can be used anywhere biomass can be found
- Wide range of biomass resources can be identified using GIS and their subsequent logistics analyzed for viability
- Merging GIScience and Sustainable Energy has immediate benefits in addition to long term sustainability objectives necessary to combat climate change while providing a secure energy future

Summary: Biomass gasification can reduce the dependence on fossil fuels and provide a renewable energy source that is also environmentally friendly. Geographic information system (GIS) can be an effective tool to facilitate a wider application of biomass as a renewable energy resource. The creation and implementation of a GIS application to identify sustainable resources is significant for production planning of biomass energy.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Hardware-Accelerated Machine Vision using Field-Programmable Gate Arrays (FPGA)

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Need: Machine vision continues to be a significant element in the suite of technologies used in robotics and embedded systems. While these systems are commonly used in path planning, image processing, environment feedback, or object tracking tasks in mobile and industrial applications, they often consume a significant proportion of the system's processing time. To reduce these processing requirements, hardware acceleration techniques can be implemented in machine vision designs, allowing robotic and embedded systems to react faster to the surrounding environment.

Overview: The development and implementation of a hardware-accelerated vision system for object tracking will be presented. This will include a discussion of the FPGA hardware system architecture, finite state machine logic, VHDL design code, and speedup results. Also, a brief description of suitable applications for the vision system design will be presented.

Major Points:

- Design development and implementation of the hardware-accelerated machine vision system
- Functional results and comparison to a software implementation design

Summary: A hardware-accelerated vision system for object tracking was developed and implemented using FPGAs. Based on Amdahl's Law equation, the final hardware design outperformed a similar software implementation by a factor of 7.7.

Implementing PID Control in an Autonomous Robot Car

Author(s)
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Need: Mechatronics is an integration of Mechanical Engineering, Electrical Engineering, Computer Engineering, and Control Technology. A Mechatronic system combines all these technologies to make simpler, more economical, reliable, and versatile automated manufacturing systems. Giurgiutiu et al. (2002) describes the impact of Mechatronics on the engineering education in the new millennium. They discussed how that Mechatronics will change the basic nature of engineering education in fields of mechanical and electrical engineering, and described how it can provide a new academic model for developing multi-disciplinary programs within engineering and technology schools across the nation. Their research concluded that discipline-based Mechatronics professionals are multi-skilled and will be in high demand in the future. This presentation will introduce and demonstrate an autonomous robot car project with PID (proportional-integral-derivative) control implemented in a mechatronics course for engineering technology students.

Overview: Mechatronics is an integration of Mechanical Engineering, Electrical Engineering, Computer Engineering, and Control Technology. A Mechatronic system combines all these technologies to make simpler, more economical, reliable, and versatile automated manufacturing systems. Giurgiutiu et al. (2002) describes the impact of Mechatronics on the engineering education in the new millennium. They discussed how that Mechatronics will change the basic nature of engineering education in fields of mechanical and electrical engineering, and described how it can provide a new academic model for developing multi-disciplinary programs within engineering and technology schools across the nation. Their research concluded that discipline-based Mechatronics professionals are multi-skilled and will be in high demand in the future. This presentation will introduce and demonstrate an autonomous robot car project with PID (proportional-integral-derivative) control implemented in a mechatronics course for engineering technology students.

Major Points:

- Background of mechatronics
- Course design and project implementation
- System hardware components
- PID control and implementation
- Assessment and feedback

Summary: This presentation will introduce and demonstrate a mechatronics project in designing and building a PID-controlled autonomous robot car with mechanical components, motors, sensors, and a microcontroller. The design and construction of the autonomous robot car will demonstrate an application of mechatronics in solving a real world problem to people from industry as well as academia.

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Implementing UL Lafayette Solar Plant as a Lab for Technology and Engineering Students

Author(s)
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Need: Solar power plants are needed in order to meet the growing demand of electricity, to take care of the shrinking fossil resources and to reduce the CO2 emissions. Many developing countries are trying to use their abundant natural energy – solar radiation - in order to reduce their reliance on fossil fuels. College of Engineering at UL Lafayette was successful in securing a grant to set up a solar thermal power plant in Crawly of Louisiana. Environmental and energy conscious students would benefit by conducting research and understanding technical aspect of solar energy plant and widen their career horizon.

Overview: Energy flows from many sources and exists in a variety of interchangeable forms, and drives all systems. It is fundamental to the quality of our lives and today, we find ourselves totally dependent on an abundant and uninterrupted supply of energy for living and working. The carbon gas emissions and non-degradable nuclear waste produced by these plants have caused dangerous environmental problems such as the greenhouse effect which led to the depletion of ozone followed by global warming and climate change. These energy production methods are non-sustainable. Solar thermal plants are basically power plants that generate electricity from high-temperature heat. The difference between them and conventional power plants is that instead of deriving energy from gas, coal or oil, the sun provides the energy that drives the turbines.

Major Points:

- Technology students should conduct hands on experiments in as many technical courses as possible.
- Careers in fields of environmental and energy technology are in demand.
- US Department of Energy funded the proposal for construction of a small solar thermal power plant in 2011 and construction started 2013 and was completed in 2015. The power plant is located at Crawley, Louisiana. The UL project is expected to produce 150 MWh of energy annually, and provide a learning environment for students in technology and engineering.
- Smart energy consumption and its environmental impact are most important subjects in many societies.
- Faculty in the Department of Technology applied studies of sustainable energy in the environmental technology lessons.

Summary: Louisiana which is a developing state mainly depends on conventional plants for its electricity. 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. At present, the solar levelized energy cost is relatively high compared to conventional electrical power generation methods. This will be reduced in the future by technology improvements and mass production. Faculty and students involved in the solar power plant project conduct presentations and workshops during the school year. Students give presentations and distribute handouts on how to reduce energy consumption and improve their energy usage habits.

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Intelligent Vehicles and Autonomy: Why Are We Safer With Cars That Can Drive Themselves?

Author(s)
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Need: In the field of Automotive Technology consistent changes in vehicle technology are commonplace. This means that many technicians must adapt to changes about the way they think the industry should head and the way they go about diagnosing vehicles that do not work correctly. In the automotive technology education area, where graduates are being hired into positions that place them in upper level automotive positions with vehicle manufacturers, educators and institutions must also change to reflect and cover these upcoming and emerging technologies. Autonomy and driving aids are quickly becoming commonplace in nearly every vehicle.

Overview: This presentation will give a brief introduction and foster open discussion among the group about what constitutes an autonomous or intelligent vehicle, what vehicle autonomy brings to the marketplace, how we are working towards vehicle autonomy, legislation and how it pushes manufacturers to meet new safety standards, and global outlooks on new safety records for vehicle collision and occupant injury/death statistics.

Major Points:

- History of intelligent vehicles
- Defining Autonomy vs. Intelligence
- Intelligence vs. Intelligent Design
- Why have machine intelligence on roadways?
- What does machine intelligence look like today?
- Computer predictability/reliability
- Conclusion

Summary: Participants will understand and be able to describe the intelligent vehicle based on technology of the past, present and future. They will also understand the history of intelligent vehicle and route guidance systems and be able to explain how that history plays into current technology. They will also be able to define autonomy as it applies to vehicles, and decipher between intelligence and intelligent design. Attendees will understand the need for autonomous vehicles. Attendees will participate in a lively discussion and Q&A with the presenter in an open discussion format.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

IPv6 is Here Now: Transitioning to the Latest Addressing and Routing Mechanisms in Networking Laboratories

Author(s)
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Prof. Jeff Kilgore
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Need: The InterIPv6 World Launch day back on June 6, 2012, marked the day when major Internet Service Providers permanently enabled IPv6 and began or continued the transition from IPv4. However to date global IPv6 connectivity among Google users is barely at 10%. With the last of the 4 billion Internet addresses handed out in February 2011 by the Internet Corporation for Assigned Names and Numbers (ICANN) IPv4 address, its successor IPv6 should mean more than a buzzword to network technologists. It is poised to provide the foundation for the innovation laded future of the Internet in terms of 340 undecillion (trillion trillion trillion) addresses, stateless address auto-configuration, multicasting, integrated mobility, security and privacy is communications.

Overview: With IPv6 or IPng (next generation) gradually building momentum worldwide, students in computer network technology programs should have more than an awareness of this vital Internet addressing scheme. IPv6 and its associated technologies will need to be deployed and managed effectively for the foreseeable future. In some ways the IPv4 to v6 transition is similar to the switchover from analog to digital over-the-air high definition broadcast television including multiple digital sub-channels. The presentation will highlight how network node identification is simplified and communications are significantly improved by this transition. It will discuss ways in which students in computer/networking classes can be better prepared for enabling this transition for a more stable Internet through structured in-class, simulation, and laboratory activities.

Major Points:

- Anatomy of network addresses: Hardware and software addressing on a network
- IPv4 versus IPv6 smack-down: Comparing form and functionality In-class and laboratory activities for training technology students to use large numbers so common to IPv6, simplification of network addressing and subnetting procedures
- Static and dynamic network routing using IPv6
- Reliance of future security appliances and technologies on IPv6
- Improving wired, wireless, and mobile network connectivity with enhanced security
- And in the meantime: Technologies helping cope with the expansion of the Internet

Summary: With the exponential increase in mobile and other networked devices computer network engineers will find an increasing need to deploy, manage, and troubleshoot devices with only IPv6 addresses. The global adoption of IPv6 as the addressing mechanism for the Internet, along with significant enhancements built into its framework is already result is innovative technologies. The virtually limitless computer addressing space with updated networking capabilities will allow household appliances, sensor grids and distributed networks to be configured and supported. Learning how to use this new expanding address space effectively is of importance to network designers and managers. In the presentation attendees will learn about practical ways in which IPv6 concepts can be introduced and reinforced across the curriculum. This will enable graduates to enter the future workforce well prepared for deploying these technologies.

Photovoltaic Laboratory Exercises for Renewable Energy Courses

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Need: Renewable energy is an important and economical energy source to partially fulfill world's increasing energy demands. Over the last several years, many courses have been developed to train students to meet the needs of a rapidly emerging national green energy workforce. Although, these courses are well- planned, many of them still suffer from offering hands- on activities that will help students to gain better understanding of concepts in renewable energy. This presentation provides a series of cost-effective laboratory exercises in solar energy that can easily be implemented by institutions.

Overview: We will present a series of laboratory experiments in solar energy in which students will learn the basics of photovoltaic (PV) and investigate the optimal condition to obtain maximum power from a photovoltaic. These laboratory exercises are designed to reinforce classroom curriculum to include the job related aspects of Photovoltaic systems. Also, the integration of the photovoltaic laboratory exercises into the curriculum will enhance the contents of course in renewable energy.

Major Points:

- Basics of Photovoltaic
- Cost effective hands-on laboratory exercises in solar energy
- Design and analysis of Photovoltaic Systems
- Determine the optimal conditions for operating a PV panel in a circuit with a known load and understand maximum power point tracking
- Importance of I-V Curve P-V Curve of the PV cell
- Investigate the effects of solar insolation, shading, tilting angle of a solar panel, and temperature on electrical characteristics
- Laboratory manual for the suggested hands-on activities
- Conclusion and suggestions

Summary: This presentation is focused on hands-on activities, especially designed for students taking renewable energy courses. The integration of these activities will strengthen curriculum in the department. All of the information including the laboratory manual of the activities will be shared with the academia so they can be implemented easily at different institutions.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Projection and Calibration of Aerial Surveillance Imagery

Author(s)
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Need: Projection of aerial imagery is used in military, law enforcement, border security, and mapping. The aerial image is recorded at some elevation and at some angle with respect to the ground. The image must be projected onto the ground, accounting for the elevation, and attitude of the camera. For example in Google Earth, the images are projected onto the ground such that the image is coordinated spatially with a map of the area. Accurate projection and camera calibration are required to ensure that the image correctly overlays the map.

Overview: The usability of aerial imagery is tied to the accuracy of the projection. For example, a Google Earth image that is displaced by 100 meters from the street map will not be very useful. The accuracy of the projection depends in large part on having a calibrated camera projection model. In this presentation, one method of projection will be discussed along with a means of calibrating the camera. The camera calibration routine relies on a set of related points in the image and on the ground. Ordinary Least Squares (OLS) is then used to adjust the camera calibration parameters such that the errors between the projected locations of the image points and the ground reference points are minimized. In addition, common errors sources, and their minimization are discussed.

Major Points:

- Camera optics
- Basic projection
- Projection of aerial images
- Attitude corrections
- Elevation corrections
- Residual errors
- Calibration
- Conclusions

Summary: Attendees will learn the basics of camera optics, projection of aerial images, and calibration. The basic operation of a camera is presented, followed by modifications to facilitate the projection of aerial images. The aerial image is first projected into space, then rotated to compensate for the attitude of the camera with respect to the ground. Given the location of the camera and the ground, the image is then mapped to the ground. The means of calibration is described along with methods of identifying and resolving errors. The attendees will leave with a basic understanding of how aerial images are recorded and projected to the ground with a calibrated camera model.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Simulation Application in OSRAM Glass Technologies Tractor

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Need: The purpose of this study is to simulate an industrial machine. It is a good demonstration on how theories learned in class can be applied to real world. The simulation and system analysis with automation studio will help us better understand the application of pneumatic control system and provide a good opportunity to improve the current system.

Overview: A lime glass tractor is a machine which is currently operating at OSRAM glass technologies-Versailles plant in Versailles, Kentucky. Automation studio is used to do the simulation and system analysis of the pneumatic control system on this machine. The results of this study will be used to better understand the machine and provide the possibility to improve the whole control system. It is a good example on application of technology to related industrial area.

Major Points:

- Introducing the background of a lime glass tractor from OSRAM glass technologies;
- Introducing the main functions of automation studio and procedures of simulation;
- Demonstrating the results of simulation and system analysis;
- Demonstrating how the simulation technology is applied to real-world industrial engineering;
- Comparing the simulation results with physical machine performance and discussing the future work.

Summary: This study will design, build and study the performance of a pneumatic control system, i.e., a lime glass tractor, using automation studio. The presentation will emphasize the results of simulation and system analysis. Attendees will gain insight into an integrated pneumatic control system and understand the applications of simulations to this area.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Solar Power Plant Optimization through Automation

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Need: The University of Louisiana at Lafayette solar thermal power plant is a research project that works toward optimizing solar thermal power generation. The power plant's control system consists of three programmable logic controllers (PLCs) that once operated independently of one another. To generate electricity, an operator was required to closely monitor several Human-Machine Interfaces (HMIs). If certain conditions were met, the operator had to make system adjustments to ensure that the power plant would not overheat, which would result pressurized fluid bursting into the environment. The power plant was in need of a single HMI that is capable of hardware integration.

Overview: The solar thermal power plant, which is located at the Cleco Alternative Energy Center on the University of Louisiana at Lafayette Energy Research Complex, involves the investigation and implementation of new methods that will potentially improve the overall efficiency of the power plant. One improvement to the project was recently established by developing a Wonderware InTouch Platform to replace the HMIs that were used to operate the power plant. The new application integrated PLCs by forcing them to communicate and operate based on QuickScript programming and as a result, the operation of the power plant is less dependent on the operator. The application is a single HMI that allows the operator to focus on one screen when generating electricity. It provides real-time efficiency calculations as well as the opportunity to make system adjustments to potentially optimize the generation of power. The Wonderware InTouch application is the initial step toward a fully-automated solar thermal power plant and it provides opportunity for many future improvements.

Major Points: The solar thermal power plant, an alternative energy solution, is a project that seeks the optimization of power generation. Wonderware InTouch software application was used so three different PLC can communicate with each other and reduce number of simulation control panels to one. The application made power generation less operator dependent and is the initial step toward a fully automated power plant.

Summary: The goal of this project was to ensure that damage to the power plant would not be a result of human error. The three PLCs that control the power plant were integrated and a process that de-selects the Virtual Track control and selects the Stow control whenever the HTF flow rate decreases to a value that is less than 50 gpm was automated. The Wonderware InTouch software allowed the development of a one-screen Human-Machine Interface application that displays all of the controls and data needed to operate the plant.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Sustainability Analysis for an Emerging Technology: Drones

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Need: Sustainability is defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations General Assembly, 1987). There are three pillars of sustainability; economic, societal, and environmental. The three pillars approach indicates that a development must be economically profitable, ecologically proper, and socially acceptable in order to be accounted as sustainable. It is important to evaluate the sustainability impacts of emerging technologies to fulfil the immediate needs of our society without jeopardising the future generations' ability to meet their needs. An emerging technology that is growing rapidly is 'drones'. According to a report from Business Insider, the market for commercial and civilian drones is forecasted to grow at a compound annual rate of 19% between 2015 and 2020, and also 5 % for military usage. Currently, drones are being used in several industries including (but not limited to) agriculture, energy, construction, mining, real estate, news media, and film production. The application base of drone technology is predicted to expand even more in the near future. Considering the growth forecasts and limitless possible future applications, there is a need to determine the sustainability impacts of drones. The presentation will specifically emphasize the following research question: What are the positive and negative effects of drones with regards to economical, societal, and environmental pillars of sustainability?

Overview: The economical pillar will be presented by a cost justification analysis for drone utilization. The cost justification is performed by referring to the results of an interview with a company that uses drones in the construction industry. The social and the environmental perspectives will be presented by collection of case studies. Finally, the results of a survey for recommendations for future drone applications will be presented.

Major Points:

- Cost justification of drones
- The environmental, and social impacts of drones
- The existing and future drone applications
- Recommendations for future drone applications

Summary: The attendees will gain understanding of the economical, societal, and environmental impacts of the drone technology, and the existing and future applications of drones.

Thursday, November 3, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Systematic Study of Efficiency Limiting Factors of High Efficient Solar Cells for their Algorithm Development for Adaptive Photovoltaic Tracking Systems with MATALAB/Simulink

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Need: To efficiently control adaptive solar tracking systems, understanding of efficiency limiting factors of solar cells plays a pivotal role in choosing a set of optimized algorithms of solar tracking systems. Developed models and simulation with analysis on efficiency limiting factors will provide the guidance to achieve the maximum efficiency at various external limitations such as seasonal factors, climate, and location.

Overview: Attendees will gain the knowledge about the efficiency limiting factors of high efficient solar cells which play critical roles to determine adaptive solar tracking algorithms. LabVIEW and MATALAB/Simulink are used to communicate through a microcontroller to efficiently control solar tracking systems with a set of optimized algorithms. Based on simulation results, the efficiency limiting factors will be analyzed to maximize the performance. Efficiency limiting factors will be taken into consideration at various types of climate, locations, and seasonal factors. This simulation results will provide better understanding of maximum power point tracking systems (MPPT) in the industry.

Major Points:

- Photovoltaic renewable energy systems
- Models and Simulations on efficiency limiting factors of solar cells
- Development of adaptive solar tracking algorithm and impact on solar efficiency limiting factors.

Summary: Attendees will gain the concept about efficiency limiting factors of solar cells and their systems which determine a set of solar tracking algorithm to maximize maximum power point (MPPT).

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Tabletop Automation: Comparing Microcontrollers for Teaching Control Concepts in the Technology

Author(s)
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Need: Microcontrollers are transforming the way automation or electronics is being taught in various EECT and Applied Engineering and Management (AEM) programs. Conventionally the teaching of electricity and/or digital and analog electronics precedes (micro) controller hardware and software courses which are needed for automation. This allows students the opportunity to take supporting classes related to programming and to strengthen math competencies. With the exponential increase in smart devices, and microcontroller technologies being introduced through various STEM initiatives in secondary education systems, these provide the impetus for integrating microcontrollers earlier and across the undergraduate curriculum. There is a need for students to become familiar with these technologies, and have the opportunities to extend the range of their applications through practical projects based learning activities

Overview: Microcontrollers are currently a $16 billion industry worldwide with an approximate growth rate of 10% in the industrial applications market followed by 6% in automotive; projected to reach $20 billion and 27 billion units annually by 2020. That is a lot of smart technology making its way into our lives. Graduates entering the future workforce with microcontroller hardware/software competencies will be well poised to make a contribution and to advance professionally. In the presentation various types of microcontrollers will be reviewed from the perspective of teaching. Classroom strategies for introducing and strengthening understanding of various families of controllers across the curriculum will be discussed. It will provide opportunity for members of the audience to share their ideas for teaching/learning about microcontrollers.

Major Points:

- Making automation accessible across the applied engineering and technology curriculum using microcontrollers
- Comparing different microcontrollers: Parallax STAMP, Arduino, or single-board computer systems (Raspberry Pi), etc., for teaching monitoring and control
- Introducing microcontrollers in introductory digital/analog electronics and automation courses: ongoing changes in the curriculum Prerequisites anyone: Programming, mathematics, electricity/electronics
- Scaffolding to assist students using microcontrollers deepen understanding, strengthen lab skills, and improve online research techniques
- Project samples created by students using STAMP, Arduino, and other controller technologies

Summary: The presentation will emphasize the need to strengthen microcontroller-based competencies in EECT/AEM graduates. With a multitude of reasonably priced microcontrollers and single-board computers available, deciding on the right system is not easy, and care should be taken for matching each with the appropriate learning tasks. It also requires faculty members to update skills regarding these technologies which are themselves evolving. Key resources which can be used for making these decision and for ongoing training will be shared with the participants. In this interactive session, suggestions for improving teaching with microcontrollers are especially welcomed, helping improve competencies vital to the future.

Unmanned Aircraft System (UAS) Technology: The Future of Modern Agricultural Industry

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Need: The traditional method of crop scouting hundreds or thousands of acres is nearly impossible and highly inefficient, in terms of accuracy and resource management, when using the old methodologies of walking the entire field. Utilizing an unmanned aircraft system (UAS) technology, a farmer can simply fly the unmanned aerial vehicle (UAV) over their field to find a stressed area through crop health analysis. Aerial imagery provides an accurate and enhanced perspective of the crops with the ability to cover a large area and focus resources on the current problems. UAVs can cover up to hundreds of hectares/acres in a single flight without the cost and hassle of manned services, and at a far greater resolution than satellite imagery. The geo-referenced image data collected by UAVs can be exported into any modern farm management software, thereby allowing for a prescription-based solution and precise application.

Overview: Researchers are working with commercial customers to develop key applications to which Unmanned Aerial Vehicles (UAVs) are well suited. UAVs provide a dynamic platform for a multitude of sensors and instruments that directly support the operational and business requirements of customers working in these sectors. Flying frequent missions over fields eliminates repetitive, costly tasks, while creating a valuable data archive that can be analyzed by computer to automatically detect minute changes. In recent years, there has been a significant level of interest in the use of UAVs/UASs in agriculture, especially precision agriculture. The goal of precision agriculture is to more efficiently apply a farm's limited resources to gain maximum yield. The technique involves generating three main types of data; geo-tagged images, equipment data, and management data. By using image-processing software one can then transform these images into one large image (orthomosaic) and apply algorithms like Normalized Difference Vegetation Index (NDVI) to create a reflectance map of crop.

Major Points:

- Overview of small UAS (sUAS) technology (<55lbs) and its components
- UAV platforms/airframes, sensor payload integration, ground control station (GCS) Government Laws and Regulations for sUAS operations for commercial/civilian applications Practical applications of sUAS in Precision Agriculture (ex. Sensefly eBee Ag)
- Mission Planning using eMotion, NDVI image data post processing using Terra Flight 3D/Pix4D

Summary: Using UAS technology (UAV, sensor payload, software, ground control) for crop surveillance can drastically increase farm crop yield while minimizing the cost of walking the fields or airplane fly-over filming. Long-term, the data generated by UAVs can help farmers gain a more accurate and detailed picture of how crops are reacting to their management strategies, which can lead to more effective use of limited resources to improve farming operations in the agricultural sector.

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Wearable Devices and Platforms for Senior and Patient Health Monitoring

Author(s)
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Need: Our society grows older and the percentage of seniors in population keeps increasing in many developed countries. One of the interests is to provide a close health monitoring of seniors and patients with low cost and less intruding. This would not only benefit the society as a whole but also may help individuals to make better decisions on their own health issues. Healthcare provides are also looking for ways to improve the monitoring of seniors in their own homes. As the advances of wireless technology and sensing technology, many applications for wireless sensor networks have emerged. The emerging technologies make it possible to provide wearable "smart" devices that are able to communicate wirelessly for the purpose. Here related issues in wearable devices and platforms for senior and patient monitoring will be discussed.

Overview: In past decades, research has been done in various areas of wireless sensor networks. The concept of Internet of Things, which connected various physical objects, such as devices, vehicles, and buildings, through a wireless sensor network, have been proposed. In those networks, many embedded devices, typically in a small or tiny size, collaborated with each other to collect and exchange data. Along with big data analysis, these systems may provide various potential services to people to make our daily life easier and safer. One of applications is to provide senior and patient health monitoring. Various low-cost small-scale wearable devices have been developed in past few years and started to gain more popularity most recently since 2014. In this presentation, wearable devices specifically designed for senior and patient health monitoring are to be investigated. Various current systems and platforms will be compared and future research work will be discussed.

Major Points:

- Overview of emerging technologies in wireless sensor networks
- Discussion of currently available wearable devices and platforms for senior and patient monitoring
- Comparison of advantages and disadvantages of various technologies in wearable health monitoring
- Future research topics and challenges

Summary: As the society is aging, advances in wearable devices technologies may provide more benefit in the area of seniors and patient health monitoring. The current technologies, devices, and platforms for seniors and patient monitoring will be investigated and compared based on cost and performance. Emerging technology and research topics will also be discussed.

Friday, November 4, 2016

Electricity, Electronics, Computer Technology & Energy Issues

Weather impact on the Surface of Energy Production solar Photovoltaic Solar Arrays

Author(s)
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Need: Solar energy is one of the best energy resources, calculate the energy losses due to the weather effects.

Overview: Weather is most important factor of performance reduction of solar energy system, This study has been design to study all the factors of weather that can impact on the energy production

Major Points:

- Solar is best resource of sustainable energy.
- Study the major impacts because of weather
- Factors pushing the productivity
- Methods of cleaning of solar panels
- Analysis the up and down of energy production after and before cleaning

Summary: Solar as the renewable energy source, is anticipated to help reduce the nation's dependency on foreign oil or other fossil fuels. The world is moving towards more solar energy, the pace is improving day by day. It is important to study the factors which encouraging the performance of solar PV systems. This Study will help identify impact of dust accumulation on efficiency of PV plant. This study will further identify the suitable methods to avoid these energy losses

Thursday, November 3, 2016
Electricity, Electronics, Computer Technology & Energy Issues

Web Crawling and Data Mining with Apache Nutch

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Need: Data lies in the heart of all businesses, especially when the business is technology orientated. With open standards today such as RSS feeds and APIs, sharing data across systems becomes possible. However, when data is unstructured or does not have RSS/API for users to access, it is tedious and impractical to have people manually log on and save the information into an Excel spreadsheet. This is where web crawling comes into picture. There is a very good chance that your business will need automated web crawling to gather data, which will then be processed to support business decision making. Web crawling technology was made popular by Google for its use in their web search. Google saw the importance of immense amount of data on the web, which was then had not been crawled and indexed.

Overview: Web crawling is a process through which computers systematically browse the World Wide Web, typically for the purpose of web indexing. Web search engines use web crawling results to update their web content and to index others sites' web content. Web crawlers can copy all the pages they visit for later processing. A search engine indexes downloaded pages so that users can search with much better efficiency. An important purpose of web crawling is data mining, where web pages are analyzed for statistical properties, for example, a company may monitor the web for copyright and trademark infringements. Among many open source crawlers, Heritrix and Nutch are top two choices. Apache Nutch is an open-source web search engine package that aims to index the World Wide Web as effectively as commercial search services. Started as a research platform, it is also promising at smaller scales, because its flexible architecture allows users to customize their implementation. Nutch can even be scaled down to a personal computer. The founding goal of Nutch is to increase the transparency of web search process as searching becomes a daily task. The nonprofit Nutch organization supports open-source development effort as it addresses significant technical challenges of operating at the scale of entire public web. Nutch server installations have already indexed more 100M-page collections while providing state-of-the-art search result quality. Smaller organizations have also adopted Nutch for intranet and campus networks. At this scale, all of its components may run on a single server.

Major Points:

- The need of transparent web crawling
- Overview of open-source crawlers Introduction to Apache Nutch web crawler
- Nutch workflow: setup, crawling, and searching
- Examples of web crawling and indexing with Nutch

Summary: In this presentation, we will explain why web crawling and data mining are important for business intelligence. We will introduce common features of web crawlers and design issues in web page fetching and indexing. We will focus on Apache Nutch web crawler, discuss its architecture, illustrate system configuration, and demonstrate web crawling examples.

Thursday, November 3, 2016

Graphics

A Study of Ideas and Perceptions of Sustainability in Packaging

Author(s)
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Need: Sustainability is now an issue of key concern to governments, business and the public throughout the world. The production of packaging is a huge industry. Given the size of the industry and the ubiquitous place of packaging in all of our lives, the potential for packaging to have a negative impact on the world environment is enormous. Therefore, there is a huge responsibility on the makers of packaging to ensure they eliminate any potential negative impact of their products. The idea of sustainability varies from papermaker to plastic recycler; the context of any given country lends itself to a different understanding of sustainability. The purpose of this project is to study relevant existing knowledge available in terms of sustainability packaging, packaging design, environmental legislation, available alternative materials, and current industry practice.

Overview: The primary goal of sustainable packaging is to meet effectively all of the functions: provide convenience, protection, containment and information, and to facilitate sales and distribution. Sustainability in packaging is the adoption of a suite of methodologies that individually have a positive environmental impact at one or more stages of the supply chain. The minimization of packaging waste is the main element of strategy. Other key strategies lead to cost reduction and energy conservation. The sustainability issue will continue be one of the strongest driving forces for the packaging industry worldwide and its customers in the future.

Major Points:

- Sustainable packaging defined.
- Available alternative materials used in sustainable packaging.
- Case studies of current industry practice in sustainable packaging.

Summary: Attendees will (1) develop an understanding of sustainable packaging; (2) gain knowledge about available alternative materials for sustainable packaging; and (3) be aware of current industry practice in sustainable packaging.

Friday, November 4, 2016

Graphics

Applications of Unmanned Aerial Vehicles (UAV) in Graphics and Media

Author(s)
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Need: The topic of UAV's is quite popular in society today with both hobbyists and organizations. 700,000 consumer UAV"s were sold in 2015 with the CTA predicting an increase in sales of 57% in 2016. Just over $2 billion will be directly spent on UAV's in 2016, with the economic impact reaching over $4 billion. With their popularity, practical purposes are still being deciphered by these multiple entities. Examples of applications in construction, agriculture, distribution, law enforcement, and energy industries are plentiful. In the field of graphic communication and cross media the question is posed "what is the graphic communication application of UAV's"? Outside of videos and photos, what other applications are relevant to graphic communication and cross media?

Overview: This presentation identifies techniques and applications being utilized by photographers, videographers, advertising, media, and marketing specialists in operation of UAV's. Additionally, those that educate in the field of graphics will be able to ascertain differences between the respective technology providers, examine boundaries set forth by regulatory agencies, research the capability of quality of image capture, and where possible, integrate the content into curricula.

Major Points:

- Description of UAV types
- Regulatory boundaries and licensing
- Technological limitations of various UAV's and image capture
- Current and future applications of UAV's
- Addressing challenges of integrating UAV education into the graphics curricula

Summary: Attendees will be able to discuss the applications of UAV's in graphics and cross media production, research governmental regulations related to utilization of UAV's, and assess integration of UAV's in graphic communication and/or cross media programs.

Thursday, November 3, 2016

Graphics

Are We Missing an Opportunity Here? How Adding a Sales Component to your Graphic Communications Capstone Course Could Yield Great Results!

Author(s)
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Need: Anyone looking at the jobs available in the printing industry (or any industry for that matter) can see that there are a large number of sales positions advertised on any given day. There is always a need for sales people but many companies are looking at their sales force and suddenly realizing that it won't be long before their current sales force begins to retire. These retirements will leave a huge gap in not only the work force but will also result in the loss of print knowledge that could help customers see the continued benefit of print as the uninformed naysayers try to tell us that print is dead.

Overview: Graphic Communications programs have a unique opportunity to prepare students to learn about opportunities in sales as a career. As the sales force of many businesses moves toward retirement age, a unique and lucrative opportunity is created for our students. Sales, especially technical sales, positions are in high demand and there are never enough people to fill the positions that are available. Many students are unaware of the opportunities in sales because many programs do not address sales as a career in the curriculum. This presentation will provide insights into the needs of the print industry in terms of sales positions students could be hired into upon graduation and provide suggestions on how to integrate sales opportunities/experience to existing courses.

Major Points:

- What kind of sales positions could our students fill?
- How can sales skills be part of the graphic communications curriculum?
- Where are the jobs?
- Why consider integrating sales as part of the curriculum?
- Why the capstone course may be the perfect place to add a sales component
- How to get students excited about sales positions

Summary: Sales positions are in constant demand and provide a great opportunity for graphic communications students to make a good living upon graduation using the knowledge, skills, and aptitudes developed in their coursework. By creating and cultivating opportunities for our students to learn about careers in sales, we are helping to fill a need that is going to grow as the current sales force moves towards retirement age.

Thursday, November 3, 2016

Graphics

Color Science Exploration for Graphic Communications

Author(s)
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Need: A broader understanding of color science beyond basic terms, theory and practicum is essential in delivering curriculum about color. If an effort to expand color knowledge and increase student competences, an exploration of color should include the physiology of light, the physical and chemical causes of color, principles and observations in science, the perceptions and psychology of color, the application and craftsmanship, and incorporate the history of color as it spans across the sciences and early humans' pursuit to acquire and understand color.

Overview: Color plays a vitally important role in the world in which we live. Color can sway thinking, influence actions, and cause reactions. Color can irritate or soothe your eyes, raise your blood pressure or suppress your appetite. When used correctly, color can even save on energy consumption. As a powerful form of communication, color is unique. Color is also associated with physical properties of objects such as light absorption, reflection, or emission spectra. This course provides an introduction to the science of color, also referred to as chromatics or colorimetry. This course includes the foundations of color knowledge, the perception of color by the human eye and brain, the origin of color in materials, color theory in art, and technological processes for the color reproduction. Color furthermore conveys meanings in primary ways, through natural associations and psychological symbolism. Color can be predictable and color can be transcendent. Students enrolled in this course will explore and expand their knowledge about the science of color, color space and practicum, and develop a general comprehension on color theory through demonstrations and discussions. Student will have the opportunity to observe use of color in science exploration, apply methods for problem solving in color reproduction, explore color perceptions in the field, and design, create and disseminate new color knowledge.

Major Points:

- Develop Competencies for Color Science Exploration Course
- Color Science and Technology
- Color Society and Culture Color and Vision

Summary: This presentation will provide both the foundations for developing or revitalizing a course or components of color science curriculum for your Graphics Programs. Competencies will be presented, examples of lectures, and lab projects.

Thursday, November 3, 2016

Graphics

Designing Solid Models for 3D Printing

Author(s)
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Need: 3D Printing is very popular and can add excitement in graphics programs. An argument can be made that 3D printing adds another dimension to some parts of graphics programs. 3D printing really belongs in the technology management focus that ATMAE has developed.

Overview: 3D printing is exploding in popularity and it is time for a practical discussion about the hands on aspects of getting things done. In this presentation the participants will likely share their experiences with the each other during the presentation.

Major Points:

- Scanning in 3D is rather difficult with the inexpensive 3D scanners which are presently available especially when the solid model that needs to be edited and changed.
- Drawing in 3D solid models for 3D printing.
- Point cloud, STL files, and other 3D scan representations.
- Different model build parameters
- Wash away model support
- Non-wash away model support
- The advent of combination 3D scanners and 3D Printers.
- 3D scans create a 3D digital photographs.
- A special focus of this presentation will be save for the end of the presentation and will be on handling 3D images. Imagine a 3D picture or graphic representation of a class.

Summary: Attendees from graphic design, Architecture, engineering, engineering technology, and industrial technology will be encouraged to discuss what is new in their areas of 3D printing, 3D image capture, processing, and printing. The contemporary nature of this topic usually brings out exciting and lively discussions in these presentations.

Thursday, November 3, 2016

Graphics

Deviation Comparisons of 3D Printed Features Produced from Material Extrusion Machines

Author(s)
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Need: Additive manufacturing (AM) technology is transforming the future of design and manufacturing. The additive manufacturing industry has witnessed strong growth in sales of desktop 3D printers. Companies are using desktop 3D printers as a low-priced solution for creating form, fit, and function prototype models or end use parts and assemblies. Students are being inspired by desktop 3D printing as they design, make, and experience physical creations. 3D printing offers many advantages, but the selection of a 3D printer or 3D printing technology can be overwhelming and complex. This presentation will bring forth quantitative data on the deviation of 3D printed features produced from desktop material extrusion machines.

Overview: This presentation presents results from a study regarding the deviation of features 3D printed from material extrusion systems. The study involved 3D printing a total of 30 parts, 10 parts from each of three desktop 3D printers. The 3D printers used in the study were the Afinia H480, a MakerBot Replicator 2X, and a Stratasys Mojo. 3D printed parts were laser scanned using a Faro Edge ScanArm ES to collect data regarding deviation of feature size. A total of 2,940 deviations, 98 from each 3D printed part, were analyzed using Multivariate Analysis of Covariance (MANCOVA) in IBM SPSS 21 statistical software. Pillai's trace reveals that, based on mean deviation of 3D printed features, there is a significant effect of mean deviation ($V=1.861$, $F(24,28) = 15.635$, $p < .05$) on the Afinia H480, a MakerBot Replicator 2X, and a Stratasys Mojo. Regarding mean deviation, this study revealed that there is a statistically significant difference ($p = .000$) between the Afinia H480, a MakerBot Replicator 2X, and a Stratasys Mojo.

Major Points:

- Brief discussion of the seven major 3D printing technologies
- Discussion of the 3D printers used in the study: Afinia H480 ($1,299), MakerBot Replicator 2X ($2,499), and the Stratasys Mojo ($5,999) Elimination of a 3D printer from the study: 3D Systems Cube Duo
- Overview of the 3D printing and data collection process
- Results of the study
- Based on mean deviation of 3D printed features, there is a statistically significant difference between the Afinia H480, a MakerBot Replicator 2X, and a Stratasys Mojo
- Interestingly, when comparing six of the twelve dependent variables, there is no statistically significant difference between the Afinia H480 and the Stratasys Mojo

Summary: Attendees will gain knowledge of the mean deviation of features 3D printed from an Afinia H480, a MakerBot Replicator 2X, and a Stratasys Mojo. Attendees will gain insight from the 3D printer deviation comparison and the resulting information can be considered when purchasing a desktop 3D printer. Attendees will have the opportunity to ask questions about specific desktop 3D printing technology and hear a firsthand account of utilizing desktop 3D printers.

Thursday, November 3, 2016

Graphics

Entering the Future: Re-Imaging Popular Photography With Smartphones

Author(s)
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Need: Smartphone cameras are redefining the meaning of popular photography for a new generation of college students. As new mobile technology brings imaging to an increased level of quality with a robust user interface, students concurrently are redefining photography as a medium, requiring a fresh look at how photography is perceived and taught.

Overview: Recent research into smartphone imagery practices cautions educators that camera phones should not be see as similar to other cameras of the past. Because of the ubiquitous nature of smartphone cameras, and the ever-increasing desire of the masses to share everything all the time, there is a proliferation of these devices to record visual evidence and narratives of everyday occurrences of life. Less often people make prints or are concerned with editing, storing or archiving images, choosing simply to make new images to replace those already captured. These facts have ushered in a new wave of imagery cutting across the grain of traditional processes and practices.

Major Points:

- Smartphones are globally ubiquitous.
- Smartphone cameras and imaging applications are developing into powerful imaging devices.
- There is a paradigm shift toward realism in every day photography more than technological quality for 'creating social relationships' and 'constructing personal and group memory' of events.
- Popular photography is being altered to fit the ramifications of new lifestyles.
- There are new understandings of ways photographs can communicate and express oneself challenging established thoughts and mores of photography.
- The size and discreet operation of smartphones allow them to be taken and used in private and public places that traditional cameras could not.
- The above mentioned points convey that digital images are 'liquid in nature' existing as binary code and easily can be manipulated and reinterpret as in a state of flux redefining photography as a communication medium and as an academic discipline.

Summary: In this environment an opportunity exists for education institutions to consider smartphone integration into many course curriculum that can not only teach the basics of photography, photographic vision, composition, and creativity, but also utilize the power of mobile communication to drive student active learning instead a hindrance and annoyance in classrooms. But there must be research and reflection on our practices and curriculum to facilitate the use of the shifting in imaging technology. The result can be captivated students learning relevant visual skills utilizing cameras and editing devices to communicate visually using smartphones they already possess and use daily.

Friday, November 4, 2016

Graphics

Hack Attacks on Digital Related Printing Services: Safeguarding Digital Assets

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Need: Commercial printers today do a wide variety of jobs that include the use of customer data, sensitive and otherwise, whether it is for variable data jobs, direct mail pieces, or just address information for mailing purposes. Hackers frequently steal client data from major businesses and organizations, including our federal government. Ransomware has become the latest threat to businesses making computers unusable until hackers are paid using bitcoin (an untraceable form of currency). Are commercial printing businesses immune?

Overview: What do Target, Home Depot, Anthem Blue Cross Blue Shield, The Ohio State University, and the Federal Government have in common? They have all experienced data breaches of some type over the past several years. While initially this seems to be identified with only large organizations that handle customer sensitive data, the phenomena of data and database breaches has the potential to reach into the smallest corners of our existence, affecting data from wireless transmissions of personal cell phones, personal computer printers, cloud computing services, or even automobile maintenance/ performance computers. Printing businesses need to carefully secure and handle the data they are entrusted with, regardless of how unimportant it might seem. This presentation examines the problem of secure data and measures that commercial printers do or do not take to secure their use of client data. Literature is reviewed as well as information from selected printing plants in Indiana and North Carolina.

Major Points:

- Discussion of information security issues related to the printing industry.
- Identify vulnerabilities associated with IP-based printing services.
- Provide best practices for securing IP-based printing services.

Summary: The contents of data handled by printers, whether variable data and digital printing or content manipulated in cloud computing, no matter how harmless it may seem, can lead to greater data security breaches. This presentation will be discuss information security issues and provide best practices for securing printing resources.

Thursday, November 3, 2016

Graphics

Influence of Substrate Properties (weight/thickness and brightness) on Color Quality of Electro-Photographic Digital Color Printing

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Need: Over the past two decades, the printing (or graphic arts) industry has been revolutionized. Technologies, workflow systems, management strategies, markets, and customer expectations have changed. Due to advancements in computer networking and digital printing technologies, print media has become a powerful multi-channel marketing and communications tool. Modern printing has evolved from a craft-oriented field toward color management science. This demands greater color reproduction control among the devices and substrates (paper for printing) used in the print and imaging industry. The quality of color image reproduction of any type of printing (digital or traditional), is largely influenced by the properties of paper. Paper is considered a commodity but its properties are a long way from standardized. The objective of this research is to determine the effect of (impact or influence of paper properties) paper properties (thickness and brightness) on the color quality based on the statistical evaluation among the nine different types of substrates (printing papers).

Overview: The experiment was conducted in a digital color printing workflow (DCPW) to determine the effect of (impact or influence of paper properties) paper properties (thickness and brightness) on the color quality based on the statistical evaluation among the nine (K = 9) different types of substrates (printing papers). Each substrate (paper) in the experiment will be considered as a group, noted by letter "K" (K = 9). Paper samples with different properties (weight and brightness) were used (or selected) for the experiment. This study was focused on the measurement of color prints, printed on multiple types of substrates by using dry-toners on a digital color printing device which uses a color electro-photographic (color laser) printing technique. The digital color printing device used in this experiment is a Konica-Minolta bizHub C6000 Digital Color Press. It uses a Creo IC-307 raster image process (RIP) application (front-end system). This study was utilized an experimental research method. Nine (K = 9) different types of substrates with various properties (weight/thickness and brightness) were be used for the printing. Two page custom test image (12" x 18") size was created for proofing and printing use for the experiment. The test target contained the following elements: an ISO 300 and generic images for subjective evaluation of color, and an ISO 12647-7 Control Strip, and an ECI 2002 target for gamut/profile creation. Colorimetric, Densitometric, and Spectrophotometric data was extracted by using X-Rite hand-held Spectro-densitometer and X-Rite i1iO Scanning Spectrophotometer from the color printed samples for the statistical analysis to determine the significant differences that exist among the nine different types of substrates. Print/Color attributes (primary colors and gray hue) from each group were analyzed/compared with one another. For all the nine groups (K = 9), a total of 900 samples of target color images were printed, 100 prints for each substrate group, noted by letter "N" (N = 100). Of 100 samples of each group, 80 samples (n = 80) were randomly selected from each substrate group, and measured, noted by the letter "n" (n = 80). Color quality was determined by carefully evaluating the printed primary colors [Cyan, Magenta, Yellow, and Black (CMYK) and gray (overlap of CMY). Colorimetric, denstometric, and spectrophotometry computations were used to determine the printing colors (solid CMYK) and gray color (overlap of C = 50%; M = 40%; and Y = 40%) "hue variation" (DH) among the nine (K = 9) types of substrates with various thickness/brightness. Type of paper used for the printing have a significant impact on the print attributes, in turn they affect the print quality/visual appearance of colors.

Graphics

Influence of Substrate Properties (weight/thickness and brightness) on Color Quality of Electro-Photographic Digital Color Printing

(Continued from previous page)

Major Points: In order to print a quality halftone image, the printer (or press operator) must carefully manage several variables and attributes which are associated with the printing process. The technology of interest for this study is dry-toner color electrophotography. The following one-tailed non-directional hypothesis was established, because of the multiple types of substrates (groups, K = 9). Ho: There is no significant difference (or relationship) in the printing CMYK DH and Gray DH (CMY overlap) of multiple types of substrates, when the printed colorimetry is compared against the reference colorimetry. Ha: There is a significant difference (or relationship) in the printing CMYK DH and Gray DH (CMY overlap) of multiple types of substrates, when the printed colorimetry is compared against the reference colorimetry.

Summary: The presentation will be limited to colorimetric and densitometric data only. This presentation is based on the outcome of a research experiment. Session participants will learn about the influence of substrate properties for quality digital color printing. Graphic communication educators, industry professionals, and researchers may find this information meaningful and useful, however the colorimetric and densitometric data collected in this study may not be generalizable to all digital printing systems. Additional studies using similar systems (dry-toner) and substrates is recommended.

Thursday, November 3, 2016

Graphics

Modifying the Recipe: How to Combine the "Cookbook" Approach with Inquiry-Based Teaching

Author(s)
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Need: Teaching a hands-on lab to a group of 20 or more students has always presented challenges for higher education teachers who primarily teach skill-based courses. While students still gain a solid understanding of the concepts of the course from the "cookbook" approach, the inquiry-based approach offers a more effective teaching method by encouraging problem solving and critical thinking skills. Using the inquiry-based method in a hands-on lab offers students the opportunity to explore creative design through real-world problem scenarios. For the past several years there has been a growing trend in education to adopt inquiry-based learning to promote engagement in the classroom and help students be better prepared for the real world upon graduation. This presentation offers classroom testimony and recommendations on resources that can be used to combine both "cookbook" approaches to teaching with inquiry-based models.

Overview: In order to offer students a solid understanding of the concepts of the course, step-by-step, or "cookbook" approaches to teaching are now being combined with inquiry-based models for teaching to keep students engaged in large hands-on classes. While the cookbook approach introduces students to new tools and methods for creating a product, the inquiry-based approach offers the opportunity to analyze the problem scenario, brainstorm possible strategies for designing a solution, and playing with different ways to reach their end goal. When presented with a task and no instructions, the task is more about adapting what you've recently learned, combined with your own strategies, for producing a product.

Major Points:

- The difference between the "cookbook" approach and inquiry-based teaching
- Transitioning from the "cookbook" method to inquiry-based approach to teaching
- Benefits of inquiry-based teaching in a hands-on lab
- Sticking to the learning objectives

Summary: The challenge in teaching a hands-on lab is to provide students with ways to develop hands-on skills while offering them the opportunity to use those skills to design solutions to real-world scenarios. Attendees will be offered a new strategy to incorporating the "cookbook" approach with inquiry-based teaching for student engagement. Recommendations for teaching methods, lesson planning, and supplemental resources will be provided.

Friday, November 4, 2016

Graphics

Out of the Box Recruitment Strategies for Graphic Communications Programs

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Need: Many of the graphic communications and related programs in the nation are being discontinued. The reasons may vary but most can be tied to enrollment issues. This may be the result of a continued use of the same old recruitment techniques and philosophies, or is recruitment just not being done? In order to insure the survival of Graphic Communications related programs across the nation a resurgence in recruitment needs to happen, in addition, new recruitment strategies need to be developed. This presentation will review new thoughts and promote discussion on recruitment philosophies and techniques for Graphic Communications programs.

Overview: All Graphic Communications programs across the nation are at risk due to declining enrollment and lack of recruitment. The presenters will discuss past and present techniques for recruiting to both high school students and potential community college transfer students. Additionally, the presenters will offer ways to think outside of the box for recruiting to high school, two-year college, and undecided majors on campus. The presenters will offer their own experiences about recruiting and encourage discussion from other attendees about recruitment. Attendees will walk away with multiple strategies for increasing enrollment in their programs.

Major Points:

- Possible reasons enrollment is declining
- Look at current techniques for recruitment and why they are failing
- New techniques for recruitment in Graphic Communications programs
- How to leverage industry support for recruitment

Summary: Current recruiting practices will be presented. Successes and failures for recruiting will be reviewed. Out-of-the-box techniques will be presented and discussed.

Thursday, November 3, 2016

Graphics

Physical to Virtual to Physical: Using 3D Scanning to Create Rapid Prototypes

Author(s)
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Need: Both 3D printing and 3D scanning have been around for a number of years now. While 3D printing has received a lot of attention for the fast evolution it has made in recent years, 3D scanning has made some equally impressive strides. Gone is the need for a standalone scanner with a price tag in the tens of thousands. Similar results can now be achieved using a standard camera and computer or even a free app on a phone. Scanned objects are instantly digitized and can be manipulated as needed. These scans can then be used virtually, 3D printed or even reproduced on a larger scale using a number of techniques (such as being converted into 2D drawings, cutout and reassembled as a template or finished product). The application of 3D scanning technology is endless. What used to take weeks or months can now be accomplished in days or even hours.

Overview: The presentation will walk the audience through the process of creating full size prototypes by scanning in scale models and then using advanced technology to assemble the finished product.

Major Points:

- 3D Scanning Techniques
- 3D Printing
- Generating 2D CAD files from a scanned 3D model
- Using 2D CAD to generate 3D templates
- Exporting Files for assembly
- Benefits / Limitations

Summary: The audience will gain a basic understanding of rapid prototyping using 3D scans and the slicing/2D assembly processes. Using real-world examples, the presenters will demonstrate how easy it can be to go from an idea to a finished product in no time at all.

Friday, November 4, 2016

Graphics

Principles of Casting Pattern Design Using SolidWorks and 3D printing: A Class Challenge Exercise.

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Need: Teaching the fundamentals of casting has traditionally been a passive exercise where the students are provided with basic lectures about the casting process, general terminology and common industrial applications. Typically, students are given the opportunity to cast a part from prebuilt molds, which gives them practice performing the casting process. With advances in CAD tools and 3D printing, it is now possible to provide a deeper educational experience where the students design and 3D print the parts that they want cast. Students then validate their design by casting their parts.

Overview: Students were provided with the traditional lecture about casting and then they performed a design challenge where they were challenged to use the CAD tool SolidWorks to design parts to be cast. Because they had lectures and experience casting, they were able to use that knowledge to apply these skills to create actual cast parts. The intention of this project was to provide a deeper understanding of the casting process by allowing them to design manufacturable parts, then cast those parts from the 3D printed molds.

Major Points:

- Using SolidWorks in the design of parts, patterns, molds, and post casting machining operations to teach modern manufacturing processes.
- Designing part which can be cast from molds using SolidWorks mold tools.
- Using 3D printing technology to create the pattern used in a casting operation.
- Developing a challenge task for students to engage in the design, analysis of features and build for casting operations.

Summary: The use CAD software such as SolidWorks in the creation of a mold or a pattern design for the casting process is important because it provides the students with a quick and practical use of 3D printing to apply the principles being taught in the classroom. After printing the pattern using a MakerBot 3D printer, preparation of the part though sand casting was performed and pouring was achieved as part of the course laboratory exercises.

Friday, November 4, 2016

Graphics

Virtual Reality and Exhibit Design

Author(s)
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Need: With the advancement of virtual reality in the last few years, the ability to truly immerse an individual in a virtual space has come to fruition. What used to be conveyed in renders and basic fly-throughs can now be truly experienced through the use of virtual reality headsets. 3D Spaces can be explored in real-time and in 360 degrees. They can include interaction, sound, video and much more. These virtual reality spaces can be shared with anyone in the world and can be truly experienced by anyone with a smartphone.

Overview: This presentation will cover the basics of creating virtual reality spaces. While the presentation will focus primarily on exhibit design, the same process can be applied to any type of interior, exterior or interactive design.

Major Points:

- Basic 3D modeling
- Basic Exhibit Design
- Creating models for virtual reality
- Exporting for virtual reality -Basics of virtual reality headsets
- Benefits / Limitations

Summary: The audience will gain a basic understanding of virtual reality. The presenter will demonstrate the workflow for creating Virtual Reality spaces and getting those spaces to run in real-time. The presentation will also showcase real-world technology and applications.

Friday, November 4, 2016

Graphics

Web Design Gone Mobile

Author(s)
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Need: In 2015, it is estimated 74% of all American owned a smartphone, and 85% of Americans between the ages of 18 and 25 owned one. This number continues to increase and is a sign of how people are interacting with the Internet more and more. As an educator it is essential to understand this shift in the way information is being accessed, and be able to teach our students the correct way to design responsive websites.

Overview: This presentation will examine the current statistics and data regarding the increased usage of smartphones and mobile devices to interact with the World Wide Web, as well as the necessity to include responsive web design in any curriculum that teaches web design. Basic responsive web design features as well as the fundamentals of responsive web design will also be discussed.

Major Points:

- Increased use of mobile devices to access the Web
- Designing mobile websites
- Fundamental design elements
- Importance of responsive design

Summary: Attendees will leave this presentation with a better understanding of the changing role of mobile devices when it comes to accessing the World Wide Web. The usage of the Internet is continuing to move away from the traditional desktop computer to the mobile devices we carry around with us. The basics of responsive web design will also be discussed in relation to the creation of websites that automatically respond to the size of the device viewing the website.

Friday, November 4, 2016

Management

An Empirical Factor Analysis of Efficiency Ratios and Profitability Metrics of the U.S. Retail Industry

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Need: The U.S. retail industry is continuously evolving since the advent of eCommerce. The traditional brick-and-mortar retail model is being challenged by the online retail model. In response, traditional retailers are adopting a hybrid model by strengthening their own online presence. It would be interesting to study how these changes are affecting the operational efficiencies and their impact on the profitability of the U.S. retail sector over the years.

Overview: In this research, we examined historical trends in efficiency and profitability ratios in the U.S. retail industry. The data is collected from annual reports of the last ten years for a selected group of retail companies in the U.S. The key factors calculated and used in the analysis are operating margin, financial leverage, days sales outstanding, days inventory, payable period, cash conversion cycle, receivables turnover, inventory turnover, fixed assets turnover and assets turnover. The three metrics: return on equity (ROE), return on assets (ROA) and return on invested capital (ROIC) are used to assess the profitability of individual companies. Pearson correlation and multiple regression analysis models are used to study the relationship between the efficiency ratios and the profitability metrics for individual companies as well as for the overall retail sector.

Major Points:

- Overview of the U.S. retail industry.
- Data collection for a selected group of retail companies for the last ten years.
- Historic trends in efficiency ratios and profitability metrics.
- Formulation of Pearson correlation and multiple regression analysis models.
- Presentation and analysis of results.

Summary: This research provides an overview of historical trends in efficiency ratios and profitability metrics in the U.S. Retail Industry during the last decade. Further, the relationship between the two is explored using Pearson correlation and a multiple regression models.

Friday, November 4, 2016

Management

Analysis of the New Six Monthly Distribution Strategy for Food Grains: A Study of Public Distribution System of Indian Punjab

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Need: The Indian state of Punjab has introduced a new supply chain strategy to manage the inefficiencies of the Public Distribution System (PDS) for food grains called the "advance six monthly distribution". This system has enabled value stream reforms by overhauling the existing method of procurement and distribution of food grains. The stakeholders of the system such as the farmers (producers), government (buyers, logistics), fair price shops (sellers), and beneficiaries (end customers) have been affected differently by the reforms. The goal of this project is to identify the impact of the reforms on the key stakeholders and analyze factors affecting the adoption of new policy among the beneficiaries.

Overview: PDS is the largest food security program of India in which the food grains are provided to less privileged population on a subsidized price on a monthly basis. With the new policy in Punjab, the grain entitlement is distributed on a six monthly basis against the monthly system to the beneficiaries under the direct supervision of food inspectors instead of fair price shops. While the state claims to provide better quality/quantity of grains with significant cost savings, the beneficiaries feel that the logistic cost has been transferred to them. This study presents results from a qualitative analysis of the exploratory research conducted with key stakeholders during field visit to Punjab. Future research would reveal the factors and the extent to which these factors affect the adoption of the new policy among the beneficiaries.

Major Points:

- Introduction to value stream of PDS and its evolution in Indian Punjab
- Discuss the new six monthly distribution policy, describe its need and importance
- Identify the key stakeholders, their interests and impact from the reforms
- Identify and analyze the factors affecting the adoption of new policy among the beneficiaries

Summary: The audience will get an insight into the value stream of PDS for food grains in Indian Punjab, the key stakeholders of the system, and the impact of the new policy on these stakeholders. Furthermore the factors affecting the adoption of the new policy among the beneficiaries will be discussed.

Friday, November 4, 2016

Management

Application of an Improvement Selection Tool to Diversity Sustainable Outcomes

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Need: Trends in industry are moving to a focus on Sustainability. Looking through company websites it is usually easy to find a page about how that organization is being "Sustainable". While these organizations might be trying to be sustainable, there are aspects of continuous improvement (Lean Six Sigma) where sustainable practices can be interwoven in the changes made for organizational improvement. From that, in order to bridge the gap between "Sustainability" and continuous improvement, methodology for a clear implementation tool seems to be almost non-existent. This proposal has been created in order to show one way in linking together sustainability and lean methods.

Overview: This study tests the applicability of a Lean/Six Sigma/ Sustainability framework used for determining which improvement initiatives are best suited for an organization at any given time. Though the framework has been developed in a generic form, for this study the framework has been tailored in a way that reflect the needs, knowledge base, and current practices in one particular organization. The study was conducted in three relatively distinct phases. From the implementation of the framework into the organization, researchers were able to draw conclusions on impacts made as well as recommendations for future studies

Major Points:

- Tailoring a framework to fit the organization in the study in a way that reflected the organizations current state of operations as well as its strategic mission
- Training individuals within the organization on the purpose of and how to use the framework for making decisions that are related to process improvement initiatives
- Interviewing not only the decision makers, but also the first line and management personnel in the organization to determine in regards to both a perceived and actual usefulness by implementing the framework
- Concluding on how the framework implemented impacted the organization and making a need for further research/ recommendations

Summary: With the focus in Sustainability appearing to gain broader appeal within companies, it seems that tools found within Lean Six Sigma would be ideal for pairing in order for companies to achieve Sustainability metrics. The framework created by the researchers originally was in a generic form that could be applied through multiple organizations. This study served a two-fold purpose for the researchers. First, it allowed the framework to be tailored to a particular organization, and secondly it allowed researches as well as the organization to have a first-hand example of what did and did not work upon implementation. This study is viable for other organizations that are considering implementing a tool to help bridge Sustainability/Lean/Six Sigma initiatives as well as expanding the knowledge on why such a tool will be needed for companies going forward that are focusing on the triple bottom line.

Thursday, November 3, 2016

Management

Application of Quality Tools to Characterize Patterns in a Workers' Compensation Claims Database

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Need: Excessive medical and liability costs are two of the seven deadly diseases outlined by Deming as major barriers organizations must overcome to achieve total quality and continuous improvement goals. The opportunity to apply quality tools to a large database of workers' compensation claims were presented to researchers. Analysis of the claims data allowed researchers to identify root causes and characterize workplace injury patterns. Quality tools and techniques were used to scientifically and systematically analyze claims to detect possible causes and mitigate risks. While analysis of a single event using quality tools have been completed, this work explored the application of quality tools to analyze a large database of incidents to help detect potential safety risks.

Overview: Kaoru Ishikawa suggested that the majority of process-related problems could be resolved using seven basic quality tools. Despite major changes in the nature and volume of process data witnessed in recent times, the basic quality tools and techniques continue to be widely popular methods of analyzing process variation and examining root causes. This presentation will discuss how a large workers' compensation claims database was converted into useful decision-making metrics using basic quality tools and techniques.

Major Points:

- Description of the workers' compensation data-set
- Application of root-cause analysis in the characterization of workplace injuries
- Factors and challenges in the use of quality tools for continuous safety improvement
- Scope of future work

Summary: Attendees will understand and appreciate the wider applicability of quality tools to not just solve technical problems in the manufacturing process but also other challenges across the business, specifically in using a large database to manage and characterize a firm's safety performance.

Thursday, November 3, 2016

Management

Contributions of Lean Based Systems in Sustainability Performance of Supply Chain

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Need: Lean manufacturing and service systems are already established as effective methods for improving business performance. Lean approach makes performance improvement by eliminating waste, creating lean culture in terms of empowering employees of the organization in decision making, and establishing mutual trust based partnering relationship with suppliers and customers. Implementation of Lean Tools and lean approaches would naturally lead to green and sustainable practices as can be seen in the literature. Today business organizations and overall society are imparting highest importance to sustainability, especially environmental and economic sustainability. As such research on the contributions of Lean approaches in green and sustainability of supply chain are crucial for overall improvement of the business performance.

Overview: Lean approaches for minimizing and eliminating wastes are a basic ingredients for sustainability. The research will outline how lean approach based steps and tools that decrease cost, improve productivity, quality, and overall competitiveness of a business, are in fact contributing to environmental, economic and social responsibility (triple bottom line, 3P). As an example consider reducing inventory, which is reducing cost to address the bottom line defined by Profit. By reducing inventory it also strives to eliminate obsolescence, which ultimately addresses environmental bottom line, defined as Planet. To achieve no inventory or reduced inventory, lean goes for Just in Time (JIT), empowers the employees, creates partnering with suppliers, and involves entire organization to ensure fulfillment of customer demand, which is basically bottom line for People. The paper will outline sustainability approaches and factors recommended in the literature for improvement of business performances. Considering the lean system based outcomes and already proved procedures, it will analyze and establish that the lean implementation steps are either integrated or aligned with those approaches and factors. Considering the evidences from much publicized example cases, the research will evaluate the lean tools for sustainability performances. A mathematical model based approach will be included to aid supply chain managers to apply lean tools in their unique business to improve their overall sustainability.

Major Points:

- Importance of sustainability performance of the businesses in the current global market.
- Defining lean based steps and tools that can appropriately address sustainability metrics.
- Methodology to compare sustainability metrics for lean and non-lean approaches
- Integrating lean based sustainability factors in supply chain planning model.
- Carrying out what-if analysis to pinpoint applicable lean tools and their effect

Summary: This research presents a new approach for defining sustainability metrics taking a lean based view. It will then integrate sustainability criteria in a supply chain planning model to improve overall business performance. A numerical example will illustrate applicability of the model. The research will facilitate supply chain managers to implement the planning approach in their unique businesses to achieve desired sustainability performances.

Friday, November 4, 2016

Management

Efficiently Managing Human Resources in an Organization through Lean Six Sigma Techniques

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Need: The success rate of an organization depends on the performance of the employees. Organizations should give more importance to satisfy their employees in order to increase their performance. The challenges in human resource management mainly include recruiting, training, motivating, developing, and retaining the employees. Human resource management impacts the financial situation of the organization. Hence there is a need to develop a structured process to efficiently manage the human resources.

Overview: In this paper we develop strategies to efficiently manage human resources using Lean Six Sigma. Lean Six sigma methods identify the key factors affecting the performance of an organization and control these factors to enhance the performance. DMAIC is one of the most commonly used Lean Six Sigma methods. DMAIC has the ability to substantially help the improvement of human resource management in any business. To our knowledge, there are no comprehensive studies on streamlining the hiring process and measuring employee satisfaction involving lean six sigma concepts. This study is done to identify strategies that can be applied for human resource management overcoming the challenges that are there in this area.

Major Points:

- In this paper we propose effective strategies using DMAIC to:
- Reduce the cost and time for hiring process
- Identify reliable parameters to measure and analyze employee satisfaction
- Devise steps to improve the employee retention rate

Summary: This paper and presentation provides strategies to efficiently manage human resources in an organization by improving the employee recruiting process and increasing the employee satisfaction and retention. We will be utilizing the DMAIC approach related to Lean Six Sigma methodologies. Our strategies can improve, fix and sustain human resource processes in an organization and thereby reduce the costs in everyday human resource functions. Our method is applicable to small, medium and large scale industries.

Friday, November 4, 2016

Management

How To Integrate Big Data And Six Sigma To Improve The DMAIC Projects In Service Industry

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Need: In Six Sigma, one of the critical limitations is the nature of data and collection. Especially in service industry applications, data collection and data analysis are the most common failure factors of Six Sigma. A lack of rich knowledge about customers' needs, the dynamic nature of those changing needs and expectations constitute a major challenge in service sector, resulting in Big Data as a strategy. This model will help organizations implement Six Sigma projects leveraging the customer's voice and creating opportunities for open data sources outside the organization while remaining in the original framework of DMAIC.

Overview: The purpose is to explore the potential synergy of the integration of Big Data and Six Sigma through the exploration and identification of limitations and challenges; the presenter will illustrate the propositions for the change of the original DMAIC model. This new model has a theoretical foundation of the existing Six Sigma and Big Data philosophies, to mitigate limitations of both disciplines, while providing guidance for practitioners through specific propositions identified in an integrated DMAIC approach.

Major Points:

- The development of Six Sigma
- Integration Six Sigma and Big Data-What and Why
- The framework of Integration of Big Data and Six Sigma
- Challenges in the implementation of the new model

Summary: The Attendees will learn the origin of the Six Sigma and the nature, foundation, and current challenges of the Six Sigma and Big Data. Integration of these fields will be described. The authors will also present postulations on the best manner in which to embed Big Data analytics in the DMAIC model in Service Industry.

Thursday, November 3, 2016

Management

Identifying the Gap in Continuous Improvement Maturity and Sustainability Outcomes

Author(s)
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Need: It should be fairly common knowledge that continuous improvement projects have an impact on an organizations sustainability from a triple bottom line approach. While this may be true, research has yet to be shown that the maturity of an organization from a continuous improvement perspective can have an effect on the types of improvements being selected from a sustainability perspective.

Overview: This presentation will provide the audience insight to various continuous improvement maturity (CIM) models along with an overview of the three pillars of sustainability. The presentation will cover the research hypothesis as to how an organizations CIM level could relate to the selection of improvement initiatives in particular as those improvements are related to the three pillars of sustainability.

Major Points:

- Overview of continuous improvement maturity models
- Overview of sustainability's three pillar system
- Potential relationships in continuous improvement maturity and sustainability (in form of hypothesis)
- Current outcomes of research based on the relationships mentioned directly above.

Summary: By the end of this presentation, attendees should be able to start to recognize where their own organizations fall from a continuous improvement maturity perspective. Along with that, participants should start looking at improvements their organization is making and be able to recognize how those improvements can be related to triple bottom line results for the organization. Finally, participants should be able to recognize that pending their organizations CIM level the improvements their organization is making may vary on how much impact they have on any given pillar of sustainability.

Thursday, November 3, 2016

Management

Implementing Lean in Universities: Need, Benefits and Challenges

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Need: Lean thinking is a way of continuous process improvement with a focus on eliminating waste in a system and creating value for the customer. Though lean started in manufacturing, over the past decade it has proliferated into other sectors such as education, government and healthcare. In the United States, states such as Ohio is promoting lean initiatives across all public sectors to improve their efficiencies and provide better services. As ever decreasing governmental support to higher education has become the normal across the nation, it is time that more institutions adopt lean as a means to improve their operational efficiencies and increase their capacities with existing resources.

Overview: One of the key aspects of lean is called value stream identification, where value is produced by an organization to its customer as a product or service. This value stream is created as the end result of a process that includes a series of actions or activities. The ultimate aim is to eliminate any actions that does not add value to the beneficiary. In a university setting several similar value streams exist and identifying them could lead to tremendous waste reduction opportunities and process improvements. Complicating adoption of lean with in a university is that many functional units have variations in their business processes, making value stream mapping complex in nature.

Major Points:

- Why Lean?
- Need for it in universities and benefits
- Implementing lean in non-manufacturing sectors? What is the difference?
- Challenges in implementing lean in a university setting?
- Conclusion

Summary: The presentation attendees could gain knowledge of the topic of lean, its relevance in improving operational efficiencies in service sectors such as education and how differently lean is applied in those sectors.

Thursday, November 3, 2016

Management

Implementing Value Stream Costing Analysis to Support Lean Management & Process Improvement

Author(s)
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Need: Lean manufacturing (LM) technique has been used for improving the overall organizations' performance. Value stream mapping (VSM) analysis is one tool that can be used for implementing the lean manufacturing technique. Value Stream Costing (VSC) is a new technique that can be used to evaluate the efficiency of lean implementation and to calculate the percentage of cost reduction. This research aims to explore the importance of lean costing in lean management. The process of implementing VSM technique will be discussed briefly. Then, the audience will be provided with the factors that are needed to implement VSC analysis such as: productive and non-productive capacity, takt time, production lead time (PLT), and process cycle efficiency (PCE). The process of conducting VSC analysis will be explained. VSC equations and parameters will be shared with the audience. This presentation provides a case study of VSC application in manufacturing environment to show how this analysis can be conducted. Handouts of the presentation will be distributed.

Overview: This research aims to apply the technique of Value Stream Costing (VSC) in an industrial manufacturing company. Lean manufacturing technique is used to minimize the waste and maximize the flow. Value stream mapping (VSM) can identify continued opportunities to enhance value, eliminate waste, and improving flow. Four steps will be followed in order to fulfill the value stream mapping: identifying the product, creating a current state value stream map, creating a future state value stream map, and creating an action plan. After developing the current and future state value maps, VSC will be used to evaluate the improvements that are gained by implementing VSM technique. Parameters such as productive and non-productive capacity, takt time, production lead time (PLT), and process cycle efficiency (PCE) will be used to evaluate the current and future state value stream maps and to conduct the VSC analysis. Graphs will be used to show the improvements and demonstrate some of the ideas.

Major Points: ▪

- Applying the value stream analysis related to product development is essential to reduce costs and eliminate waste.
- Value Stream Costing (VSC) analysis is one of the tools that can be used to measure the efficiency of implementing VSM.
- The cost of current and future state value maps can be calculated to show the percentage of improvements.
- Productive and non-productive capacity, takt time, production lead time (PLT), and process cycle efficiency (PCE) are important parameters for conducting the VSC and creating VSMs.
- Graphical assessments using cycle time and takt time are useful for developing the current and future state value.

Summary: Attendees will be exposed to the concept of Value Stream Costing (VSC). This is a new and contemporary technique that can be used as one of the lean tools to evaluate the efficacy of implementing value stream mapping. Case study of VSC application will be shared to discuss the concept and to show the savings that can be gained by implementing VSM. This technique might be used in any lean environment to support lean efforts and to evaluate process improvements.

Thursday, November 3, 2016

Management

Incentive Systems in Organizations: The Scientific Perspective

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Need: Organizations utilize incentive systems to reward employees for relative performance. However, implementations of incentives and punitive systems (incentive systems) more often lead to degradation and demotivation rather than serving as a platform that encourages contribution for organizational success. Understanding the psychological and organizational constructs behind incentive systems will allow for designing these systems in manner that will deliver the intended and desired results.

Overview: Organizations will quite often indicate that incentive systems are notoriously 'trickier' than the intuitive, straightforward, perception of their relationship with employee motivations. Thus, many incentive systems lead to perverse incentives (i.e., incentives that result in unintended and undesirable outcomes). A common example of incentive systems are manufacturing facilities that provide incentives to encourage quality production or safe behaviors. This presentation will introduce psychological theories and organization characteristics that are defining the effectiveness of incentive systems. Various example of incentives system from private industry, municipal entities, and governmental organizations will be reviewed and reflected upon. Attendees will leave with guiding principles for designing effective incentive systems that provide their intended outcomes.

Major Points:

- Incentives and penalties are more often hurting rather than enhancing performances in organizations.
- The intuitive 'straightforward' perception of the relationship between incentives/penalties and employee motivations in organizations is deceiving.
- Social and psychological aspects should be included in the design of incentive systems.
- Successful incentive systems should be designed based on an understanding of the scientific aspects of the various types of incentives and penalties.

Summary: Organizations use incentive systems to motivate employees to contribute toward organizational success. However, a lack of understanding of how incentives affect employee behaviors lead to implementation of incentive systems that gain undesired outcomes. The presentation will review the psychological and social factors of incentive systems and how to utilize this knowledge in order the structure effective incentive systems.

Friday, November 4, 2016

Management

Maximizing the Benefits of Project Management Techniques in Managing Small Projects

Author(s)
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Need: Due to the uniqueness of small projects, companies easily get tempted to execute them without undertaking the proper planning process. This is most common when these small projects are similar to the previous ones. Many of them often run over budget, over time and out of scope, sometimes even without been realized. Companies must be able to identify and prioritize tasks that should be handled as projects no matter how small they may seem. Proper implementation of project management techniques on small projects could lead to huge savings and enhanced efficiency.

Overview: Small projects have unique features. They have short but uncertain duration, few team members, easy to overlook risks, narrow scope and small budget size. This study reveals why small projects easily get neglected as regards to observing the project life cycle and how to develop a project management framework for managing them. We shall discover how much companies could save by recognizing project management techniques in managing small projects.

Major Points:

- How to identify small projects
- Building a framework for managing small projects
- The implications of managing small Projects without project management techniques
- Managing multiple small projects
- Using the crashing technique to shorten project duration for small projects

Summary: Attendees will gain a better understanding on how to identify small projects. They will also learn the benefits of subjecting projects of all sizes to observe the project life cycle and the implications of ignoring this process.

Friday, November 4, 2016

Management

Process Improvement Software Platform for Lean Management in the Healthcare Sector

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Need: Process improvement software platform strategies are vital for the success of an organization. Properly designed process improvement software platforms can help organizations increase their economic value by learning customer values facilitated by employees' improvement ideas. Analyzing employee acceptance of a software platform strategy through the technology acceptance model; Unified Theory of Acceptance and Use of Technology (UTAUT) helps organizations identify the employee satisfaction with their provided technology.

Overview: Every organization needs to invest their effort to create a culture in which everyone is continuously improving processes and eliminating waste. Lean methodologies in organizations can be implemented through engaged employees. Constantly improving products and services help organizations to remain competitive and keep a strong customer base. Process improvement software platform strategies have developed to strengthen the relationship between employees and their organizations. The employees' ideas of opportunity for improvement enhance the reputation and interests of the organization.

Major Points:

- Describe the culture of employee engagement for the improvement of the organizations
- Importance of process improvement software strategy in the healthcare sector
- Explain the aspects of technology acceptance models on user behavior
- Study the software platform strategy by using the UTAUT model for analyzing the employee behavior

Summary: The audience will gain knowledge on the importance of process improvement software for increasing the efficiency in healthcare sector. Further, information on technology acceptance models on user behavior will be provided. The application of UTAUT model will show the audience, the performance of employee behavior with the process improvement software platform in healthcare sector.

Friday, November 4, 2016

Management

Re-Shoring - And Why it Makes Sense Now!

Author(s)
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Need: The economic and subsequent competitive benefits of outsourcing/offshoring have not materialized in the magnitude expected at its commencement. The promised low-cost labor countries such as China and India once so economically attractive are experiencing steady labor and material costs increases making the manufacturing of products and services less cost effective. Re-shoring presents itself as a viable way to manufacture products in America again and compete in the global market. Re-shoring is worth analyzing because it brings the advantages of producing locally, increasing the wealth of our economy and decreasing the need of ocean transportation and its externalities.

Overview: Although many companies still outsource/offshore, many others in different sectors of the economy are doing the opposite and returning back home. Positive factors, like lower energy cost and favorable business conditions are making the relocation of offshored factories possible again. We need to revert the wheels of becoming a service-oriented economy to a manufacturing oriented economy. Ghost towns are again seeing the renaissance of the manufacturing industry and enjoying the economic, environmental and social gains it provides. In order to assess the total costs of manufacturing the Total Cost of Ownership tool will be presented.

Major Points:

- Offshoring/Outsourcing
- Manufacturing in America
- Relevance of "Made in America"
- Economic independence
- Global Security
- Competitiveness
- The Total Cost of Ownership tool

Summary: This presentation emphasizes the relevance of Re-shoring for the renaissance of the American manufacturing industry with a strong focus on the economic, social and environmental impact it has on our nation.

Thursday, November 3, 2016

Management

Research & Development: Is it Still an Economic Necessity for Industry and Education in the United States?

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Need: The on-shoring of basic and applied research & development activities back to the United States is becoming a hot topic for industry and education. This presentation will discuss if this trend will continue or if there are other mitigating factors which could stymie the re-growth, and economic necessity, of a strong basic and applied research & development infrastructure in the United States. Furthermore, should education institutions prepare themselves to teach the next "big wave" of high-technology scientists and engineers?

Overview: Many Chinese manufacturers aspire to change their manufacturing moniker from "Made in China" to "Created in China." This paradigm shift in Chinese thought is underscored by a need to overcome increasing costs in labor and materials in the Chinese economy. In fact, many countries around the world are undergoing the same labor and economic adjustments. This reality has encouraged international companies to once again view the United States labor market as viable participants in basic and applied research & development. Cutting-edge technologies require top-notch scientists and engineers. Some of these technologies are disruptive, but a good number of them are advanced requiring highly skilled personnel. The presentation will discuss if basic and applied research & development is still considered an economic necessity for industry and education in the United States.

Major Points:

- Basic and applied research & development (BARD) is the backbone of a strong economy.
- BARD has been extensively outsourced from the United States to various countries over the last 35 years.
- A seismic economic shift from China, and Indonesian countries, back to the United States has made the U.S. more economically competitive.
- Key disruptive and advanced technologies have made BARD more attractive to world industries seeking development, and even manufacturing, back in the United States.
- Education institutions must realign themselves to the new United States BARD reality to meet world industry demand of technology scientists and engineers.

Summary: This presentation will provide insight into the challenges of re-integrating basic and applied research & development in the United States in tandem with a discussion of cutting-edge technologies that can turn the tide back to the good old U.S.A.

Thursday, November 3, 2016

Management

Technology Adoption in India's Food Security Program: A Qualitative Management Approach

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Need: Food security continues to be one of the major challenges for India. Public distribution system (PDS) is one of the largest poverty alleviation programs of India. After the implementation of National Food Security Bill (2013), Government of India is bound to provide subsidized food grains to approximately 800 million people. Managing logistics of food distribution in such large scale possess various challenges. State government of Chhattisgarh, in 2012, implemented point-of-sale devices to be used by salesperson at fair price shop (FPS) to distribute PDS commodity. Salespersons are the primary users of these device and faced several challenges in adopting the new technology. The goal of this study is to identify and prioritize the major challenges that affected the adoption of point-of-sale device among the primary users and propose a framework to resolve them using Six Sigma methodology. This will result in smooth adoption of point-of-sale device among salesperson for distribution and management of PDS commodity, which will translate in smooth commodity distribution and less pilferage of food grain.

Overview: PDS is India's largest food security scheme that aims at providing physical and economic access of staple food grains (wheat and rice) and other essential commodities (sugar, salt, kerosene, etc.) to below poverty line (BPL) households. The National Food Security Bill, 2013 is expected to be implemented in all the states by April, 2016. The bill entitles food subsidies under PDS to 75% of the rural population and 50% of the urban population of the nation. Understanding the need of technology interventions, the union budget of 2016-17 aims at computerization of more than 50% of FPS out of a total 535,000 shops in the country by March 2017. A perspective analysis of the FPS salespersons is used to identify the challenges faced by them in new technology adoption. The use of six sigma tools has been demonstrated to propose a framework for effective technology adoption. Six Sigma DMAIC approach will be applied to address the identified challenges.

Major Points:

- Importance of food security and impact of National Food Security Bill
- Importance of Information and Communications Technology (ICT) in e-governance
- Demonstrate the use of six-sigma methodology for technology adoption in food supply chain
- Identify and prioritize major challenges faced by users of new technology in PDS supply chain
- Identifying various possible solutions to these challenges

Summary: The attendees will get an in-depth information of role of ICT in Indian food security system and various challenges it poses to the users of new technology, affecting the performance of PDS. Application of six sigma methodology to improve ICT implementation in e-governance will be discussed. Implications of the work on PDS performance will be shared.

Friday, November 4, 2016

Management

The Revised Certified Technology Manager Exam: The First Year's Results

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Need: In the academic year 2014-2015, the certification board released a revised ATMAE Certified Technology Manager exam. Reasons for the revision were that the old exam was based on 10-year old ATMAE accredited program curricula and accreditation standards. The goal of the new exam was to be congruent with current industry needs and useful for outcomes-based program assessment. As the previous exam was often used as an output measure of program competency, the revised CTM exam needed to focus on technology manager competencies, not just technical competencies. The objectives of the revised exam were to (a) emphasize technical managerial professional skills, (b) align with the Technology Management Body of Knowledge, (c) be competency-based, and (d), incorporated into outcomes assessment, accreditation, and personnel evaluation.

Overview: This presentation discusses the results of the revised exam over the first year of its release. In which sections of the exam did the participants perform well of poorly? In which subjects did participants have the most/least variation in response? Which areas of the exam should be further evaluated or revised?

Major Points:

- Need for the revised exam
- The revised exam architecture
- First year findings
- Discussion and interpretation

Summary: This presentation presents the results of the revised CTM exam during the first year. Attendees will learn how the revised exam was created, it new focus, and the exam participants performed the first year. The presentation will discuss the interpretation of the results and suggest areas for further evaluation and refinement.

Total Quality Case Study of International Student Enrollment at Morehead State University

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Need: Enrollment of international students at various universities across the U.S has become competitive in recent years. Due to the declining share of state appropriations, Morehead State University, like other universities in the region, rely on robust enrollment numbers, including international students, to augment their revenue. It is, thus, pertinent to study the trends in enrollment, so as to make reliable predictions for future years. This work employed Statistical Process Control (SPC) techniques to perform a Quality Assessment of the enrollment of international students from the 2005/2006 to the 2013/2014 academic years.

Overview: The main purpose of this research was to analyze the trends in the yearly enrollment of international students at Morehead State University. A Total Quality analysis of the trends in enrollment was utilized as a benchmark for comparisons in order to improve the quality of the International Student Services.

Major Points:

- Trend Analysis using Run Chart of yearly enrollment.
- Cause and Effect Diagram to identify root causes of shortfalls.
- Correlation from Scatter Diagrams of various demographics.
- Process Capability Analysis of enrollment trends.

Summary: The research revealed that over the period studied, emphasis was placed on enrolling international students from Europe, Asia, and Australasia. It is recommended to extend this emphasis to other areas, such as South America and Africa. It is also recommended that the services available for international students, such as housing, food, and transportation, be improved, while at the same time, communication across cultural barriers be enhanced.

Friday, November 4, 2016

Manufacturing

An Automated Manufacturing Application with a Hydraulic System

Author(s)
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Need: Mechatronics is an integration of Mechanical Engineering, Electrical Engineering, Computer Engineering, and Control Technology. A Mechatronic system combines all these technologies to make simpler, more economical, reliable, and versatile automated manufacturing systems. Hydraulic systems have wide implementations in manufacturing industry. Designing and developing automated and remotely accessible hydraulic applications for manufacturing system integration is becoming a challenge for manufacturing companies in order to improve productivity, efficiency and product quality. The project proposed is to design and develop a fully automated and remotely accessible hydraulic application through the integration of hydraulic circuits, controllers, sensors, and web-based applications through the collaboration with Parker Hannifin Company.

Overview: The purpose of this presentation is to introduce and demonstrate a project for designing developing a fully automated and remotely accessible hydraulic application. The system will utilize Parker Hannifin's hydraulic components, Parker controllers, Parker automation manager, data acquisition software, and web-based programming to realize an integrated manufacturing system. The system will be tested for efficiency and reliability. Also, the system will be used for a hydraulic course for hydraulic circuit design applications. It will also be used as a demonstration for system integration and remote control for a manufacturing automation course.

Major Points:

- Background of mechatronics and hydraulics
- System design and structure
- Programming and database integration
- Development of web-based application
- Discuss of system testing
- Future research and projects

Summary: This presentation will introduce and demonstrate a project for designing and developing a fully automated and remotely accessible hydraulic application. The system components, structure, programming method, data acquisition, and web-based application will be demonstrated and discussed. The system efficiency and reliability will be discussed, as well as future research and projects.

Friday, November 4, 2016

Manufacturing

Design and Fabrication of the Power Transmission System of a Large Scale 3D Printer

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Need: 3D printing has become quite common, where initially being used strictly for prototyping, is also being used for direct digital manufacturing. Additive manufacturing techniques are used in entertainment, medical and even the defense industry, although one major limitation of 3D printers is the build envelope. Large scale 3D printers have been developed, but are experimental and expensive to produce. To overcome size restrictions of 3D printed parts a need to build a large scale 3D printer that is relatively inexpensive (within a $3,000 material budget) is required for larger projects such as residential wind turbine blades or propeller blades made in a single 3D print without needing to join segments together.

Overview: This research project includes the design, manufacturing and integration of the gear drive for facilitating rotary motion of the worktable of an innovative rotary style large scale 3D printer. The 3D printer worktable is a 6ft diameter circular steel plate. The stepper motor drives a 20 degree involute, 3 inch pitch diameter, 24 tooth pinion gear, which rotates the worktable by meshing with an internal ring gear. Based on the pinion gear, the diameter of the worktable and the center distance, a ring gear is designed having a 62.5 inch pitch diameter, 500 teeth and 8 diametral pitch. Internal ring gears having such a large diameter are non-standard and not available for direct purchase. Therefore, the gear design parameters are calculated using the fundamental gear equations for stress based on AGMA standards and the internal ring gear is checked for failure. It is difficult to machine such a large gear in one piece, so the gear is split into 10 parts. Using the NX CAM software, the toolpath for the gear tooth profile is generated, optimized and machined in a Haas machining center. The parts are assembled and the system is tested.

Major Points:

- Design of the ring gear for the chosen pinion gear according to AGMA standards.
- Creating 20 degree involute internal ring gear tooth profile CAD model.
- Suitable manufacturing technique to manufacture a large scale internal gear profile.
- Integration of internal gear segments into the 6 ft. diameter 3D printer worktable.
- Testing and validation of the gear drive to meet the required 3D printer accuracy.

Summary: The use of 3D printing technology is on the increase as a direct manufacturing alternative. However, one of the major limitations in 3D printing is the size which can be printed. Here, an innovative large scale 3D printer design is proposed having a build envelope of 6 x 6 x 5 ft. The main power transmission component for the rotary worktable is a stepper motor turning a spur gear driving an internal ring gear, which is manufactured by machining segments to be integrated together to form the 62.5 inch pitch diameter internal ring gear.

Friday, November 4, 2016

Manufacturing

Developing 3D Antennas for Small Unmanned Aircraft Systems through Fused Deposition Modeling

Author(s)
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Need: Fused deposition modeling (FDM) has been utilized in various industries. With the growing diversity of filament materials, the application focus of FDM has shifted from prototyping to creating functional parts that can be used immediately. In the small unmanned aircraft systems (UAS) field, FDM enables researchers to build three dimensional antennas that provide new functionality. It also opens the possibility to fabricate antennas together with the UAS in a single setup. However the fundamental questions are: How do these FDM antennas perform against those made of conventional materials, how do FDM processes affect antenna design, and what are the best practices of developing FDM antennas?

Overview: We will present a collaborative research project which studies the feasibility of using FDM technology to develop functional 3D antennas for small UASs. The project rationale will be discussed and the design-to-manufacturing process will be illustrated. The performance of antennas printed by both industry- and consumer-grade FDM printers will be compared, and limitations of FDM technology along with alternative solutions will be reported. The influence of FDM process parameters on antenna design will be discussed, and we will conclude this presentation with the outlook of the 3D FDM antennas.

Major Points:

- Overview of UAS antenna and design criteria
- Designing and fabricating 3D FDM antennas
- Performance measurement and analysis
- Limitation and future of FDM antennas

Summary: Attendees will be informed about how various FDM materials contribute to developing 3D UAS antennas, and the challenges and best practices of using FDM to construct functional antennas.

Friday, November 4, 2016

Manufacturing

Development of a Lean Manufacturing Train System

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Need: Currently, the dominant methodologies in teaching the lean manufacturing concepts are theoretical description, case studies, and simulation on software, leading to a lack of realistic perceptions on manufacturing management. Students in industrial management programs are interested in acquiring more hands-on experience with new technologies that enable them to apply these technologies effectively after graduation.

Overview: The lean manufacturing train system simulates a manufacturing line in real life. It is composed of three subsystem: automatic retrieve storage system, Kanban control system and assembling manufacturing system, through which the students can obtain hands-on experience of manufacturing scenes, understand Kanban principle, and learn the lean thinking in manufacturing practice and its applications.

Major Points:

- This project is proposed to meet the educational need of manufacturing management students.
- The system is composed of three sub systems: automatic retrieve storage system, kanban control system and assembling manufacturing system.
- With the modern equipment such as robots, AGV and other logistics aids, the experimental system constructs a real manufacturing scenario where students can be immersed in a modern production environment.
- Communication system such as roulette, workstations and other devices reflects the modern Kanban management. "Kanban" is not in the traditional sense, but rather electronic billboard;
- There are two type of system layout: L-shape and U-shape. The system layout can be changed between the two types.
- For the system, the students are able to select and adjust several parameters such as buffer size, productivity, lead time and other indexes to study the production line performance and to find out the existing problems.

Summary: The lean manufacturing train system is composed of three sub systems to reflect the realistic settings in a manufacturing line; and the system layout can be changed between a "U-shape "and an "L-shape". Students can obtain hands-on experience of modern production management, and learn to improve the key performance indicators through adjustment of the operation modes, facilities layout, production line balance and other means.

Friday, November 4, 2016

Manufacturing

Entering the Future — Nanomanufacturing: Exploiting the Triple Helix for Advanced Manufacturing Workforce Development

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Need: As evidenced by maturing nanomanufacturing industries in New York, Pennsylvania, and other states there is a widening gap between innovative nano products and nano educated workforces required to meet the challenges of making products at the nano, molecular scale. Industry, government relationships as well as industry, academic relationships seem inadequate to embrace the scope of what some describe as a megatrend in manufacturing. The concept of the Triple Helix of the university, industry, and government relationship appears to be the best solution for solving the unprecedented problem of a workforce capable of the scale-up required to move nanomanufacturing from concept to commercialization.

Overview: Innovation for the future of nanomanufacturing is a necessary step to keep American manufacturing strong and at the global forefront of this industry. Other nations are sometimes outspending America and also doing a better job of preparing their citizens for industries that produce at this very tiny scale. The Triple Helix concept was originally designed as a solution to synergize the relationship between university, industry and government, therefore this can be applied to solve a perplexing problem as America now faces with moving nanomanufacturing from the laboratory to commercialization.

Major Points:

- The skills gap of traditional manufacturing workforce and nanomanufacturing workforce.
- Need improved higher education-industry-government collaborative relationships for nanomanufacturing.
- Show how collaborations aid in "industry ready" graduates.
- Show innovative solutions that promote faster workforce development and American jobs creation.

Summary: Today's competitive global nanomanufacturing environments demand more robust workforce education to promote new product fabrication technologies, to maximize the nanomanufacturing megatrend, and to increase nanomanufacturing process efficiencies required for scale-up. The Triple Helix concept of university, industry, and governments must work together to educate graduates who can "hit the ground running" using effective research and innovative development to add more value to themselves and to hiring organizations. Attendees will see that the Triple Helix concept is one solution to increase American manufacturing workforce readiness, innovation and productivity.

Thursday, November 3, 2016

Manufacturing

Florida's K-20 Pathways for Manufacturing Education

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Need: There is a significant skills gap in manufacturing and high demand for technician level professionals across Florida and across the nation. A well defined, industry driven career pathway system is necessary to attract youth into manufacturing education pathways.

Overview: FLATE, the Florida Advanced Technological Education Center, has taken advantage of Florida's statewide infrastructure for career and technical education to develop and implement flexible, robust pathways supporting Florida's growing manufacturing business sectors' workforce needs. The presentation share Florida's CTE infrastructure, details of FLATE's (Florida Advanced Technological Education Center) credential-based manufacturing pathways as well as how its being implemented successfully.

Major Points:

- There are currently a lot of unfilled technician level jobs in manufacturing in Florida and across the US
- Industry credentials can provide a strong component of technician education pathways for manufacturing
- Working with the Department of Education is very important
- The flexible degree plan has made it easy to address emerging industry needs and add new content without full new degree implementation.
- A strong network of colleges offer the degree and work closely together to strengthen their own and each others programs.

Summary: For nearly 10 years, Florida's Department of Education has focused on implementing innovative state policy that defines robust, rigorous, and relevant workforce career pathways. Building on this state infrastructure, FLATE developed a flexible and credential-based career pathway that provides multiple opportunities for individuals to shape their own education-based manufacturing career pathway. Acceleration options, aligned industry credentials and articulations from high school through four-year programs hallmark this growing program in Florida. Continued enrollment growth in secondary and post-secondary institutions across the state endorses its viability. This presentation showcases our career pathway model outlining key components and strategies that have worked for its statewide implementation since 2007.

Thursday, November 3, 2016

Manufacturing

Integrating Sustainability--Lean and Green Secondary Wood Manufacturing Practices in an University Wood Technology Program

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Need: Understanding sustainability—lean and green manufacturing practices-- through material selection, lean engineering and management principles, engineered wood material innovations, hardware developments, emerging finishes and optimization processing, are keys to success in today's secondary wood manufacturing environment and the future of architectural millwork, cabinetry, store fixture and furniture production in the U.S.

Overview: The presentation highlights how this Wood Technology program provides its students with sought-after, unique skill sets through a unique program that addresses state-of-the-art manufacturing materials and processes associated with sustainability--lean and green secondary manufacturing practices, used in leading woodworking industries. It addresses the collaborative efforts of the wood industry—AWI, WMIA, WIC, and Wood Advisory Council, and the university to develop and implement a Wood Technology program that meets the need for qualified wood industry professionals in the U.S..

Major Points:

- Collaborative efforts of the wood industry and PSU in program development
- Materials and supplies associated with sustainability—lean and green manufacturing
- Facilities and equipment associated with sustainability—lean and green secondary wood manufacturing,including panel processing equipment, optimizing equipment, CNC, etc.
- Integrating emerging design, engineering and lean manufacturing practices into program
- The products and results associated with the program

Summary: Attendees will understand the development and implementation of this baccalaureate program, BST in Wood Technology, to reflect today's industry sustainability requirements. Program development and practices presented can be applied to other manufacturing programs.

Thursday, November 3, 2016

Manufacturing

Investigating the Cutting Forces and Temperatures Generated During Machining of Ti-6Al-4V Using Conventional Flood Coolant and Sustainable Dry Machining

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Need: The increased use of titanium alloys in the aerospace and biomedical industries has necessitated the future needs for research in the machining of these exotic materials. Ti-6Al-4V (grade 5 titanium alloy) is used extensively in the aerospace and biomedical industries because of its excellent combination of high specific strength (strength-to-weight ratio) and exceptional corrosion resistance. However, Ti-6Al-4V has been a material that is considered to be difficult to machine. Some of the problems of machining Ti-6Al-4V include poor conductance of heat, strong alloying tendency, low modulus of elasticity, and titanium's work-hardening characteristics. With these added difficulties of machining, the cost of machining titanium increases the overall cost to the machine shop and the final product. The cutting forces generated during the machining and the temperatures at the tool-tip are the two important factors that impact the machining performance. Therefore, it is important to investigate the generation of cutting forces and temperatures at the tool tip and their effect on overall machining performance during machining of titanium alloys.

Overview: This study will be investigating the cutting forces in all three axes and the tool-tip temperature generated during the machining of Ti-6Al-4V under flood coolant and dry machining conditions. The dry machining, also known as sustainable machining, is currently replacing the conventional flood coolant machining because of environmental benefits. However, the tool wear is a serious problem in the machining of titanium alloys in dry conditions. Heat dissipation from the tool-workpiece interface is very difficult in dry machining, which may further increase the temperature at the tool-tip. The effects of multiple variables: feed rate, depth of cut, and cutting speed on the generation of cutting forces and tool-tip temperature will be investigated. In addition, the correlation of cutting forces and temperatures with the machining performance parameters, such as surface finish, machining speed and tool wear will be evaluated.

Major Points:

- Effect of operating parameters on the cutting forces
- Effect of operating parameters on the tool-tip temperature
- Evaluating the machining speed, surface finish and tool wear
- Investigating the correlation of cutting forces, tool-tip temperature and machining performance

Summary: This study will investigate the cutting forces and cutting tool temperature generated during machining of Ti-6Al-4V under both flood coolant and dry conditions. The study will also evaluate the effect of operating parameters on the cutting forces and tool-tip temperatures. Finally, the study will establish correlation between the generation of cutting forces and temperatures with the surface finish and tool wear for machining of Ti-6Al-4V.

Thursday, November 3, 2016

Manufacturing

Leveraging AIDC Technology to Build an Authentic Manufacturing Experience in a Capstone Course

Author(s)
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Need: Students who enrolled in the Engineering Technology and Management (ETM) program at Ohio University are exposed to many different applied technologies. This including no fewer than 12 credit hours of applied computer technology based classes. To assess the competencies from these classes, an inventory control project was developed for their capstone course. The purpose of this project is to provide an authentic learning experience with a relevant and applied engineering project similar to what they would encounter in the workforce.

Overview: This presentation will provide the audience with an overview of the capstone experience within the ETM program at Ohio University. The presenters will discuss the requirements for an automatic identification and data collection (AIDC) system that is implemented as a core component of this class and a live demonstration will be shown. The rational for this project will be presented within the context of the course competencies for the four required applied computer technology courses to justify this component within the capstone course.

Major Points:

- Applied engineering students can build an inventory control system that would work in an industrial setting.
- Access to technologies such as barcode readers extend the functionality of the inventory control system and increase the robustness of the system.
- Applied technology can be included in a manufacturing based capstone course with minimal technology overhead.
- Open ended problem driven projects are an effective way of assessing previous course competencies within a capstone experience

Summary: Attendees will gain an understanding of the inventory control requirements that are built into the manufacturing capstone course within the Engineering Technology and Management program at Ohio University, an ATMAE Accredited program. The capstone course will be reviewed, as well as providing the requirements for the development of the inventory control system. The authors will tie these requirements back to the course competencies within the applied technology courses as well as the capstone course. Additionally, the presenters will provide a live demonstration of one of the solutions developed by the students as it was used in production during their capstone experience.

Thursday, November 3, 2016

Manufacturing

Management Practices to Enhance the Implementation of Process Excellence Using Principles of Lean Six-Sigma

Author(s)
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East Carolina University, Greenville, NC

Need: Many companies are in the course of improving their processes using the principles of Lean Six-sigma that were developed through work at Toyota and Motorola. However, the success potential for improving manufacturing and transactional processes is not fully achieved due to management policies not staying in tune with process improvement tools. Significant number of executives believe that process improvement is a simple case of applying some straightforward tools that are predestined to get them cost savings and productivity increase. Nevertheless, without essential management commitment and understanding of management policies, process improvement initiatives have substantively failed based on the author's consulting and outreach experience.

Overview: In this presentation, a brief introduction of Lean Six-sigma will be done, followed by a treatise on management principles that need to be considered well to gain success in improving processes. These management principles will include leadership principles, information system practices, human resource practices and production planning practices. How an ideal environment can be created in a manufacturing company to lay the foundation for the creation of a continuous improvement culture will also be discussed in this presentation.

Major Points:

- The evolution of Lean Six-sigma and its importance to the manufacturing industry
- Leadership commitments and the identification of process champions
- Information practices to support process improvement initiatives
- Lean Six-sigma tools
- Product design practices
- Human resource practices

Summary: This session will present details on how to position a company in terms of management practices and policies to embark on a path of continuous improvement to become a world-class business through the incorporation of best practices.

Thursday, November 3, 2016

Manufacturing

Modeling and Simulation of Manufacturing Systems for Continuous Improvement – Efficiency Studies

Author(s)
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Need: To keep pace with rapid changes in manufacturing techniques/processes, and to sustain global competition Manufacturing Industry needs continuous improvement (CI) of its existing processes as well as assessment of new manufacturing entities on a continuous basis. This needs complete assessment of the process parameters and carry out optimization studies to adjust for the best alternative strategies in the manufacturing process. For discrete event processes like the manufacturing systems, this is a real challenge as closed form solutions or formulations are not practically feasible to develop. The best option is to assess these processes using simulation and modeling techniques. There are many simulations software tools available today and most of them are quite flexible in terms of modeling specific industries like discrete-event manufacturing processes, continuous flow processes, supply chain management, etc. In order to prepare students to serve the industry equipped with this important tool, manufacturing curriculum need to integrate simulation and modeling techniques in their syllabus

Overview: In this presentation, the authors propose to discuss the CI process with specific emphasis on assessing optimal parameters through a simulated efficiency study, in which different scenarios are simulated with process efficiency degradation. It would also discuss a practical approach to integrate simulation software in the manufacturing curriculum with examples of process from the industry to show various aspects of the simulations techniques. In situations where a full course on simulation and modeling cannot be offered, it could be feasible to add a simulation and modeling module in some relevant courses in manufacturing technology area.

Major Points:

- Continuous improvement needs the PDCA (plan-do-check-act) cycle for evaluating parameters and taking actions on a continuous basis
- Simulation tools are essential for the manufacturing industry to assess process and improve performance on a continuous basis
- Modeling and simulations techniques need to be incorporated in manufacturing programs for students to acquire the knowledge and expertise
- Core manufacturing management areas to integrate simulation techniques
- Example of modeling techniques for efficiency studies using a simulation and modeling software

Summary: The authors propose to present the basic process of using the simulation tools in carrying out the continuous improvement task including assessing process parameters and efficiency studies for the manufacturing industry. This would be of interest to both the manufacturing industry and manufacturing technology curriculum.

Thursday, November 3, 2016

Manufacturing

Simulation of Industrial Facility Layout Using Pro-model Software

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Need: Facility Layout design is an important part of generating a production facility. It maximizes the effectiveness of the production process and provides workers with a safe and desirable working environment. This presentation will provide an opportunity for industrial management and technology educators to observe a demonstration of the latest version of the Pro-model software. The presentation provides a detail discussion of layout principles and how to create a simulation model of an industrial vise production layout.

Overview: The presentation will cover all the major features and the logic used in developing a facility layout model using the Pro-model software. Demonstration of these features will provide better understanding of the software and how it can be applied to the industrial management and technology curriculum.

Major Points:

- Present the principles of industrial facility layout.
- Create a facility layout model using line balancing technique.
- Generate a simulation model of an industrial vise production line.
- Provide results by running and analyzing the model.
- Optimize utilization of workforce and equipment.

Summary: The design of the facility layout should consider overall objectives of the organization and increase the production capacity of the company. A facility layout simulation model provides insight to optimize utilization of the workforce and equipment. Helpful hints and how to implement simulation software into the industrial management and technology curriculum will be provided.

Thursday, November 3, 2016

Manufacturing

Survey of Digital Manufacturing and Simulation Curriculum Effectiveness for Manufacturing Technology Alumni

Author(s)
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Need: How effective is a digital manufacturing and simulation curriculum for graduates of a manufacturing technology program? This survey documents the opinions of graduates who took two classes using advanced 3D CAD modeling and manufacturing simulations in industrial company projects, with the objective to determine the significance and contribution of these specific classes to their careers and professional development. How much value might this add to similar programs?

Overview: A two semester sequence of has been taught at our school for over 16 years. Along with learning the software, teams of students conduct industrial projects with local companies to apply these technologies and formally present the results to the company management. A survey of graduates focuses on the value this curriculum has provided for their professional development.

Major Points:

- Brief description of our digital manufacturing and manufacturing simulation curriculum
- Documentation of the added value digital manufacturing and manufacturing simulation curriculum has provided manufacturing technology graduates
- Comparison with similar curriculum at other institutions
- Comments on the benefits and appropriateness for these technologies and their applications in manufacturing technology and related programs

Summary: Attendees will learn from our experiences and alumni responses to our digital manufacturing and simulation curriculum's contribution to their personal and professional development. They will discover the value alumni placed on these technologies, and in the application of these technologies for industrial projects.

Friday, November 4, 2016

Manufacturing

Sustainable Machining Practices with Metal Working Fluids

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Need: The importance of sustainable manufacturing has grown in recent times because of the realization about the problems associated with the generation of so much waste by the humans due to their industrial activity. Manufacturing has played a major role in the centrality of human existence by creating material wealth for the society. It also contributes a lot to the generation of waste and also consumes a large amount of energy. Metal working fluids are an essential requirement for improving the quality of machining and at the same time contribute to some of the difficulties associated with health and safety of machinists and environmental acceptability. As a result, there is a need by all engineers and technologists involved in machining to get better metal working fluid practices that help the sustainability.

Overview: Sustainability is the need of the hour and it cannot wait any longer because of the ill effects of the human consumption is being seen in various disasters in the past couple of years. It is essential to attempt at sustainability all levels rather than thinking about just electrical energy and emission as is normally understood by many people. Manufacturing as a whole accounts for a large amount of waste generated and the harmful emissions that affect the health of those people involved in manufacturing. Metal working fluids are one such element in manufacturing that typically constitutes about 7 to 17% of the overall cost of manufacturing in addition to the health problems as identified earlier. Unfortunately, not much of emphasis is placed on metal working fluids from the sustainability viewpoint. The authors of this proposal have conducted a survey of the people involved in actual manufacturing as to their understanding of the sustainability and its application to their workplace. This paper will present the results obtained from the survey along with the way this problem can be mitigated without sacrificing the machining quality as well as improving the operating environment for the machinists.

Major Points:

- Principles of sustainability in terms of energy usage and waste reduction
- Metal working fluid problems faced by machinists and environmentalists
- Examples of sustainability practices
- Survey results on the best practices for metal working fluids with sustainability

Summary: Sustainability is a concept that is well understood, but its practice in manufacturing is not all that widespread. Metal working fluids are a necessity in manufacturing, but at the same time contribute a lot towards the health problems of the machine tool operators. Probably the biggest problem is that many of us may not be aware of all that can be done to mitigate that problem. This paper conducted a survey of the industrial personnel with the aim of understanding their awareness. The results of the survey are presented along with the possible solutions.

Thursday, November 3, 2016

Manufacturing

The Effects of Micro-EDM Process Parameters and their Optimal Values to Achieve the Desired Productivity and Surface Integrity

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Need: Ti-6Al-4V has a wide range of applications in automotive and aerospace industries. Manufacturers are looking for the methods to increase the productivity of the micro-EDM process in terms of lessening the machining time and the tool wear, which consequently results in on-time delivery as well as cost reduction. Moreover, the surface integrity of machined area is a critical aspect of a product, such as the biomedical implants. Therefore, it is important to have a holistic approach to the effects of micro-EDM process parameters on the response variables, in order to find out the optimal values of these parameters.

Overview: Titanium alloys are very difficult to machining by conventional methods. Micro-EDM is a non-conventional machining that uses the thermal effect of precisely controlled sparks. Although, there are considerable number of researchers studying different aspects of micro-EDM process, most of them performed one-factor-at-a-time experiments instead of studying all factors simultaneously. This research has been conducted through a series of experiments using the full factorial design. Analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) have been utilized to interpret the findings and determine the significance of each process parameters on the response variables. The first objective of this research was to identify the level of importance and contribution of micro-EDM process parameters on the response variables, including their main effects and interaction effects. The second objective was to identify the optimal values of the micro-EDM process parameters, providing that all response variables have the identical weight and importance.

Major Points:

- The parameters include voltage, capacitance, electrode rotational speed, and Titanium Nitride (TN) coating
- Response variables consist of machining time, tool wear, crater size, surface microhardness, and element characterization
- Voltage and capacitance have been studied separately as well as in combination in terms of discharge energy
- The scanning electron microscopy (SEM) images were used for measuring the crater size

Summary: The findings indicate that the voltage improves the machining time. However, it adversely affects the crater size. The effect of capacitance is beneficial for both tool wear and surface hardness. The effects of TN-coating and electrode rotational speed are not statistically significant. If the importance of all response variables were identical, the optimal process parameters were found to be TN-coated electrode, 60 V, 4700 pF, and 3000 RPM. This study presents the application of factorial design and ANOVA to find out the optimal process parameters for micro-EDM of Ti-6Al-4V. Furthermore, it shows that the effect of capacitance and voltage on response variables are different and they should be studied separately as well as in combination in terms of the discharge energy.

Friday, November 4, 2016

Manufacturing

Using Process Failure Mode Effects Analysis to Improve the Build Quality of Wood Laminate Guitar Bodies

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Need: Attendees will learn about the mechanics of conducting a Process Failure Mode Effects Analysis (PFMEA) project, based on an actual case. They will also gain insights about how font-end work such as accurate problem definition and disciplined identification of failure modes can affect the outcomes of the project.

Overview: Process Failure Mode Effects Analysis (PFMEA) is a tool that can be used to analyze process risks and plan for risk mitigation. Users of this tool methodically delineate process failures that could occur, and identify possible modes of failure. They estimate the severity of these failures and the likelihood that the failures would be detected in a timely manner, and use this information to quantify risk. Finally they prioritize which risks are most in need of mitigation, identify possible corrective actions, and estimate the effects of these actions on risk levels. A PFMEA project was conducted to improve the build quality of wood laminate guitar bodies being produced for the STEM Guitar Project. Guitar body fabrication is carried out as the ongoing core activity of a Production Technology course, which is offered twice per academic year. These fabrication activities also serve as a testbed for projects in the department's Quality Control and Systems Analysis And Simulation courses. The instructors of these courses worked collaboratively with students to carry out this project. The method included process mapping, classifying the problems, creating cause and effect diagrams, employing fault tree analysis, populating the PFMEA matrix, determining risk priority numbers (RPNs), and using process decision program charts (PDPC) to plan for corrective actions.

Major Points:

1. Nature and purpose of PFMEA
2. Context of the problem
3. Work breakdown structure of the project
4. Defining the problem and identifying failure modes
5. Results of PFMEA
6. Analysis and conclusions

Summary: This presentation will provide an overview of a Process Failure Mode Effects Analysis (PFMEA) project, which was conducted to identify and implement process control actions aimed at improving the build quality of wood laminate guitar bodies being produced for the STEM Guitar Project.

Thursday, November 3, 2016

Micro/Nanotechnology

Authentic Asynchronous Microsystems Technician Training Through Distance Learning and Industry Partnerships

Author(s)
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Need: The demand for technicians trained in microsystems and nanotechnologies exceeds the capacity of traditional training programs at two-year schools. Although many schools are interested in provided authentic training, they lack the resources or facilities to deliver the hands-on experience with appropriate tools for fabrication and characterization of micro electro-mechanical systems (MEMS).

Overview: Rio Salado College is developing an introduction to MEMS course for hybrid asynchronous learning through partnerships with the Southwest Center for Microsystems Education and Arizona State University. The course utilizes kits modeled on our Biology classes and 21st century education technology such as virtual field trips to provide authentic learning experiences. This session will introduce the process, curriculum, and prototypes for a truly unique MEMS survey course.

Major Points:

- Arduino based 3D LED display ·
- General information about Rio Salado College, SCME, and ASU
- History of involvement in Nano and MEMS
- Overview of program development process
- Course outline and competencies
- Curriculum process and status
- Summarize existing SCME kits and process to consolidate
- Demonstrate Virtual Field Trip and applicability to a clean room environment
- Next steps

Summary: Attendees will gain insight into the opportunities and technologies available for asynchronous delivery of microsystems training in fabrication and characterization. Discussion will focus on how these technologies can be expanded and adapted to multiple environments within different pedagogical systems.

Thursday, November 3, 2016

Micro/Nanotechnology

Enhance and Evolve Your Tech and Engineering Program with Microsystems – a Rapidly Growing Technology

Author(s)
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Need: MEMS (Microelectromechanical Systems) are found in biotechnology, medicine, transportation, security, and consumer products. Common examples include pacemakers and inertial sensors found in smart phones, wearable health devices, biometrics systems, labs-on-chips, game controllers, automotive control, navigation, and safety. MEMS typically contain an integrated set of otherwise disparate technologies (e.g., mechanics, fluidics, materials, energy, photonics, biology, etc.) that span a large portion of the STEM spectrum. Moreover, MEMS education as a hands-on experience is an inspirational technology that challenges students to join the high-tech workforce. Large numbers of additional technicians are required to advance IoT's (Internet of Things) economic potential as a result in the large-scale integration of micro-scaled devices. Microsystems topics from applications, electronic integration, materials and design to manufacturing, support equipment maintenance and process control, can therefore be integrated into a large variety of current and evolving technician and engineering courses to better prepare students for this growing field.

Overview: The Southwest Center for Microsystems Education (SCME) has been working with industry and partner schools for over twelve years. This has resulted in the development of a wide range of micro-technology related educational materials, topics, and delivery systems available to anyone. Not only does this include written materials but also recorded lectures, animations, online professional development, and hands-on kits. This session will provide participants with an overview and access to these materials. In addition, an industry interactive map system will be demonstrated so that participant educators can ascertain which industries, types of micro-nano related fields, and micro-nano tech job opportunities are available in their immediate area. This data can help support grant intellectual merit requirements as well as job market data for administrators and students.

Major Points:

- The participants of this presentation will be provided access to Microsystems educational materials that will provide additional value to their tech and engineering programs:
- Written Learning Modules – over 50 learning modules each with individual shareable content objects including background reading material, activities (hands-on labs, research assignments, worksheets), assessments (quizzes, cross-word puzzles…), and supplemental resources (presentation slides and notes).
- Hands-on Modules (kits) – there are over a dozen kits that have been developed that can be copied or acquired from the SCME. These include ones to build a working model of a cantilever based chemical sensor array, Gene Chip, and Pressure sensor transducer.
- Lectures, animations and two films on Micro and Nano technology.
- Online distance learning short courses
- Access to SCME Interactive Industry map
- There are over 4000 unique website visitors per month, downloading approximately 8k learning modules.
- There are approximately 12,000 YouTube video views per month and over 1000 subscribers.

Summary: Attendees will learn how to access and acquire the knowledge and skills needed to bring engaging microsystems educational topics to their students. From integrating one or two short hands-on experiences within a STEM course, to creating a Microsystems based course all the way to offering a two-year program, participants will have plenty of resources to access. Consider attending this session if you are interested in evolving your program to include cutting edge MEMS topics to support your regional industry needs.

Thursday, November 3, 2016

Micro/Nanotechnology

SiC/Spinel Nanocomposite A Promising Candidate for Aerospace Industry

Author(s)
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Need: Ceramic composites are of a great interest in aerospace industry; however, they are very sensitive to mechanical and thermal stress. This stress may produce many microcracks which may limit their applications in some cases. To overcome this problem, self-healing approaches have been proposed by many scientists to increase the integrity and the reliability of ceramic structures in service.

Overview: One of the most popular applications of ceramic composites in aerospace industry is thermal barrier coating in turbine blades and exhaust nozzles of jet engines. High pressure turbine blades should sustain a great amount of thermal loads. Cyclic thermal loads may cause thermal fatigue in jet engine coatings, which is a progressive structural damage. Each time jet engines start or shut down, the temperature increases or decreases rapidly, which causes a high thermal gradient both within and between the substrate and coating. Building up of such thermal stress leads to surface microcracking and crack growth, subsequently exposing the metal substrate to high temperature and causing permanent deformation or oxidization. In order to overcome this problem, it is highly desired that the ceramic coating layer has crack self-healing ability. Recent advancements in the understanding of crack-healing mechanism of a novel bio-inspired SiC/spinel nanocomposite will be presented.

Major Points:

- Review of Self healing mechanisms in ceramics
- The importance of spinel ceramic
- Self healing mechanisms in spinel and SiC/spinel nanocomposite
- Glass/ceramic composites with high healing efficiency

Summary: Crack self-healing behavior of SiC/spinel nanocomposite, obtained from talc, aluminum and graphite powders was evaluated as a function of time, temperature and the environment atmosphere. The mechanism that was involved in the crack-healing was investigated and the outcome revealed both physical and chemical phenomena are involved in the healing process. In the presence of oxygen at high temperatures, SiC reacts with oxygen to form SiO2 which is accompanied with about 80% volume expansion. On the other hand, the formed silica reacts with the matrix and produces some transition compounds which can rebond crack walls together. The results showed that cracks can be completely healed after heat treatment at 1545 °C in static air for only 1 min. Attendees will be familiar with self healing phenomena in ceramics and how they can inspire from nature toward their scholarly activities.

Thursday, November 3, 2016

Micro/Nanotechnology

Understanding the Unusual Electronic and Thermal Properties of Graphene - Their Effect on Graphene Transistor Performance

Author(s)
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Need: Graphene is a single, or at most few-layer sheet of carbon atoms. The advent of graphene-based electronic devices since about 2008 requires that, at least at the upper-division level, electronics programs bring knowledge and awareness of this new transistor technology to their students in a form accessible to them. At the present time, graphene-based Field-Effect Transistors (FET) have shown maximum frequencies of operation into the multi-GHz range, thus making them candidates for very high-speed communications/wireless circuits. At the same time, despite these significant advances, it remains the case that it is often hard to predict how as-fabricated devices will perform. Therefore, it is necessary to make the most direct linkage possible between the physical principles governing the electronic and thermal properties of graphene as a material and the resulting operation of electronic devices based on this material. This means that it is necessary to obtain a clear physical picture of the following phenomena in graphene and their effects on transistor performance: (1) the role that non-carbon impurities play in enhancing the scattering of electrons as they transit the graphene material, and thus their effect on the mobility of electrons in the device and the maximum frequency of operation that is a partially dependent on this mobility. (2) the role that vibrations of the graphene layer or layers play in changing the scattering of electrons in the graphene material, again affecting the mobility of electrons. In particular, since graphene is often used in a monolayer or bilayer form, these vibrations have a significant effect on the way devices behave as the temperature changes. (3) the role that a bilayer or trilayer of graphene, used as the channel material in a transistor, plays in altering the mobility of electrons as compared to the mobility in a single layer of graphene. This presentation aims to discuss each of these effects, and how these effects alter the performance of electronic devices based on graphene.

Overview: This presentation will attempt to embody in some simple MATLAB programs the impact on electronic and thermal behavior of graphene-based FET's of various real-world complications that arise when non-carbon impurities are present at some sites of the hexagonal cells that form the graphene crystal structure, and/or when flexural vibrations of the graphene layers lead to enhanced scattering of the electrons in a graphene channel. The aim of this simulation program will be (1) to make predictable links between the concentration of impurities and the resulting mobility of electrons in a graphene FET, and (2) to make similarly predictable connections between the frequency and types of graphene layer vibrations and the scattering and mobility of electrons in the graphene. Finally, as a followup to last year's presentation by the author, an assessment of the difference in performance between single-layer graphene and the bilayer form of graphene will be offered. With regard to this last topic, it should be noted that although more scattering of electrons is expected in a bilayer of graphene, which would then result in a reduced mobility, it has also been noted that the bilayer form of graphene has some advantages for device performance, because bilayer graphene shows a bandgap in energy, which allows for better ON-OFF control of these devices.

Major Points:
The major points of this presentation are:

- To understand and model the role of impurities in a graphene layer in altering the mobility and thus the performance of graphene-based transistors
- To understand and model the role of flexural vibrations of the graphene layer and how these vibrations affect electron mobility and thermal behavior in general.
- To model the effect of bilayer graphene on device performance.

Summary: Those who attend will obtain a better understanding of graphene-based transistor performance, and will have access to some MATLAB programs for performing their own assessments of device performance.

Thursday, November 3, 2016

Micro/Nanotechnology

Using Arduino & LabView for Teaching MEMS Devices

Author(s)
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Need: In product design we can use MEMS devices as sensors to measure physical phenomena. These sensors come in different forms to include accelerometers, pressure and temperature sensors, etc. Typically, electronics is used to transform the MEMS outputs into usable signals that must be conditioned. Teaching how to use these devices requires a method to interface to the devices that is inexpensive, adaptable and maximized opportunities for student learning.

Overview: This presentation will discuss the development of new electronic kit extensions of the SCME MEMS "Modeling a Micro Pressure Sensor" and "Microcantilever Model" kits based on the Arduino Uno microcontrollers and custom LabView software. Arduinos can be used in tandem with shields to provide an inexpensive data acquisition platform that can interface to the MEMS sensors and PCs. NI LabView software can be used to customize the control of the data collection and processing. These new kits can be used in electronic courses while giving students a fundamental understanding of how to use MEMS devices.

Major Points:
This presentation will discuss detail information on how the new kits were developed so that MEMS technology could be integrated into existing engineering courses.

- Initial SCME Kit review for potential addition of electronic kit extensions
- Definition of general requirements for new kits
- Initial design of Arduino Uno interface to MEMS devices
- Initial LabView software code design for data acquisition
- Design and creation of custom Arduino shields
- Design and assembly of inexpensive strain gauges
- LabView code enhancements
- Packaging final product and presentation of kits to customer

Summary: The teaching of how to use and make MEMS devices using technology like Arduino microcontrollers and software like LabView can provide multiple learning opportunities for the student at a small cost for the college. These new kits can be easily integrated into an existing electronics or physics program to provide inexpensive equipment to teach complex concepts.

Thursday, November 3, 2016

Safety

Assessment of the Condition of Power-Take-Off Guarding Systems on Farm Machinery

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Need: Modern agricultural equipment uses state-of-the-art guarding systems that can effectively prevent people from coming into contact with dangerous rotating Power-Take-Off (PTO) shafts. However, as machinery ages the condition of those guarding systems often deteriorates, creating hazards that may lead to disastrous consequences. For various reasons, farmers remove or modify the shielding systems on equipment without restoring them to their original functionality.

Overview: A number of farms will be visited and evaluations of the condition of PTO shielding systems will be conducted. A rubric will be developed to ensure consistency of assessments from location to location. Interviews with farmers will allow them to explain how and why their PTO shielding systems have reached their current state.

Major Points:

- Entanglement with farm machinery is consistently one of the primary causes of serious injury or death on U.S. farms.
- Due to increased prices on modern machinery it is easier for farmers to purchase older equipment, however the older equipment may have ineffective, damaged or missing guarding systems.
- Excuses for poor maintenance of machinery are varied and often creative, but seldom adequate for explaining severe injuries or loss of life.

Summary: This presentation will describe the methodology to be followed throughout the course of the research. This research project will ultimately lead to the production of a farm safety video highlighting the existing problems with PTO guarding systems and encouraging affordable repair/replacement options that many farmers overlook. Attendees will take with them an understanding of the scope of the problem involving the condition of PTO guarding systems on many, if not most, farms.

Friday, November 4, 2016

Safety

Employing Safety Control Measures/Methods to Prevent and Reduce Fall Hazards in Medium-sized and Small Commercial Construction Firms

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Need: In today's complex, high hazard construction work environment, numerous fall hazards are prevalent. Such hazards expose workers to potential dangerous and harmful situations. Many workers are exposed to a variety of hazards daily. Falls in construction represent one of the leading causes of workplace death, injuries, lost work time, and costs to the industry and society alike. Conditions related to fall accidents in the construction work environment frequently involve slippery, cluttered or unstable scaffold working/walking surfaces; unprotected edges; floor holes and wall openings; unsafety positioned ladders; and inappropriate fall prevention/protection means, together with control measures. In addition, persistent unsafe practices and low safety culture across many sectors of construction industries define steady fall injury rates year after year. According to the Bureau of Labor Statistics (BLS), in 2014, falls accounted for one third of the construction fatalities. The overall incidence rate, as reported by the Bureau of Labor Statistics, of nonfatal occupational injury and illness cases requiring days away from work to recuperate was 107.1 cases per 10,000 full-time workers in 2014. As reported, this rate was down from the 2013 rate of work cases in private industry, state government, and local government. The Bureau of Labor Statistics (BLS) reported that in private industry in 2014 the number of days-away-from-work cases (916,440) and the incidence rate (97.8 cases per 10,000 full-time workers) were essentially unchanged from 2013. By contrast, BLS reported that the rate of falls on the same level in private industry increased to 16.6, up from 15.4 in 2013. Furthermore, as reported by BLS, the rate of falls on the same level in construction decreased in 2014, while the rate was higher than the 2011 and 2012 rates. Nevertheless, falls continue to exact a heavy toll on both workers and their employers. Consequently, appropriate reduction of fall injury and fatality rates requires ongoing, concerted safety efforts via industry leaders, safety professionals, employers, and workers alike.

Overview: Fall prevention and/or protection; and control methods together with risk assessment are integral components of proactive safety efforts designed to positively impact safety improvement. This presentation will highlight fall prevention/protection and control approaches appropriate to medium-sized and small commercial construction firms. Relevant issues; fall prevention and protection means; control methods; and examples will be shared in the presentation.

Major Points:

- Rationale for fall prevention, protection, and control methods
- Benefits to employees and employers
- Hazards and descriptions
- Fall prevention, protection, and hazard control measures/methods
- Hazard-risk management

Summary: In today's complex, high-hazard commercial construction industries the safety of workers and other assets is vital for assuring accident and injury reduction and minimal financial loss. This presentation will provide attendees insight regarding the application of fall prevention, protection, and control techniques unique to medium-sized and small commercial construction firms.

Thursday, November 3, 2016

Safety

Nanotechnology Materials: Worker Exposure to Potential Hazards and Risks in the Manufacturing Work Environment

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Need: Nanotechnology has evolved as an important scientific and technological innovation in terms of its application to diverse manufacturing sectors. However, in recent years engineered nanomaterials have attracted a great deal of attention due to some inherent, harmful properties at the nano-scale. Increasingly, workers in various manufacturing industries are exposed to engineered nanomaterials. Such exposure to engineered nanomaterials in the manufacturing work environment poses safety and health risks to workers in both short-term and long-term injury and illness effects. Clearly, there is a need to understand the behavior, effects, and mechanisms of action regarding engineered nanomaterials. There is also an urgent need to evaluate the safety of these diverse materials and to rapidly develop an effective risk management process for known hazards and risks, as well as for those unknown.

Overview: Despite the fact that nanotechnology research is still evolving, numerous workers are currently exposed to engineered nanomaterials in manufacturing operations. This presentation will provide attendees insight on the potential dangers of nanotechnology. It will also incorporate pertinent information on how to protect workers from exposure to potentially harmful nanomaterials. Relevant issues and examples of practical safe practices will likewise be shared in the presentation.

Major Points:

- Nanotechnology hazard-risk definitions
- Trends in nanotechnology and how it is used in manufacturing
- Hazardous nanomaterials and their effects on workers
- OSHA applicable safety standards
- Nanotechnology specific-control branding measures
- Practical safe practices to protect workers from exposure to hazard-risk

Summary: In highly competitive and fast-changing manufacturing industrial sectors, worker safety and health are vital concerns. This presentation will provide attendees insight on some of the potentially harmful effects of various nanotechnology materials and share practical safe practices for protecting workers from exposure to such engineered materials.

Friday, November 4, 2016

Safety

Utilization of Drone Technology to Improve Tower Worker Safety and Productivity

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Need: Tower work requires that workers frequently climb structures for inspections at heights exceed 1000 feet above ground level. The fatality rates of tower workers frequently exceed all other professions in the United States. Some years have been cited as being over 120 deaths per 100,000 workers, more than double the next highest rates. (Much of the specific data is difficult to find since tower work does not have a specific SIC.) Many times tower workers have to make a several hundred foot climb for a simple visual inspection. Eliminating this requirement will keep more boots on the ground and eliminate unnecessary hazards.

Overview: This presentation identifies techniques in using drones to improve the safety of tower worker by eliminating the intrinsic hazard: work at heights. Photographs, videos, and "above ground level" (AGL) data will be examined to determine the feasibility of using drones to in this technique. In addition to the improved safety of the tower workers, more definitive measurements, documentation, and quality can be developed. Recommendations for implementation are included.

Major Points:

- Tower workers make many unnecessary climbs.
- Drone technology can be used to assess if a climb is necessary for a worker
- Improved measurements and documentation increase the quality of the work
- Recommendations for the implementation of drones in the tower worker's toolbox

Summary: Tower workers frequently climb hundreds of feet for their work. They also have one of the statistically most dangerous jobs in the United State; many years frequently exceed the nation's most dangerous jobs' fatality rates. Many climbs are made for a visual inspection. Drone technology can be employed so that a tower worker can reasonably determine if a climb is necessary. In doing this, multiple exposures to fall hazards can be avoided.

Friday, November 4, 2016

Teaching Innovations (TI)

A 3D World – Ideation to Prototype

Author(s)
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Need: Since 1987 when the 3D printing industry was born, there has been a need for creative individuals who understand the process of product development. This process includes many facets from ideation to the construction of a 3D model/prototype. Industry has evolved significantly with the inception of these technologies over the past 25 plus years. As 3D printer prices become more affordable, educational institutions have added many versions of these technologies to their fabrication/lab environments. This technology gives faculty the freedom and ability to be creative in with students in the classroom. Thus, allowing students the opportunity to create and see their 3D vision come to fruition!

Overview: There are many students with creative talents and dreams of how to make the world a better place to live. This could involve a multitude of innovative products. As faculty it is our job to challenge students to test their imagination and creativity to its fullest. One way to achieve that goal is to introduce students to the vast array of 3D printing technology. This is achieved with several related courses, their content will include an introduction to the multitude of printers available, how they work and types of materials required to construct an array of products. Also there will be an introduction to the product development process, from ideation including detailed 3D prototype model. They are the future of the consumer market and new product concepts can and will be their legacy.

Major Points:

- Introduce students to 3D printing technologies and the support structure related to the industry
- Create courses that will infuse multiple facets of ideation (creativity and innovation)
- Apply the process of creating new products Understand ideation and its application to constructing consumer products
- Reinforce the need for creative employees and new ideas in industry

Summary: Attendees will be introduced to the creative process and how it generates excitement, collaboration and competition amongst students in a classroom setting. The ultimate goal of the 3D program is to create the best student possible and upon graduation leave our institution with the tools needed to be competitive and successful in a global market!

Thursday, November 3, 2016

Teaching Innovations (TI)

A Comparative Study of Motivation and Learning Strategies between Public and Private High School Students of India and US

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Need: Study strategies of high school students and their relationship to the real world problems needs investigation. Previous studies show that students in higher education could revise their study strategies in order to become more successful in their STEM disciplines (Dakeev, 2015). The authors of this study are investigating how high school students could be prepared in order to choose the right career. The investigators will report findings on how the students could benefit from study strategies in order to be motivated in their studies.

Overview: A comparative study of the motivation levels of the High school students of public and the private institutions is conducted in India and the US. 240 students have participated in the survey with a response rate of 97.5%. The statistical t-test on SPSS reveals that there is a significant difference between the public and private school students in categories of Test Anxiety, Help Seeking, and Peer Learning. Additionally, gender comparisons reveal that various study strategies for males work better compared to females and vice versa. The results of the study might be beneficial for the high school institutions in revising their teaching methodologies.

Major Points:

- Conduct an MSLQ survey for private and public institutions in India
- Conduct an MSLQ survey for high school students in the US
- Compare public and private student study strategies in India
- Compare high school students in India and the US to investigate cultural differences
- Compare male and female students for motivational differences
- Develop recommendations on the instructional approach for educators

Summary: The audience may benefit from the cultural differences of study strategies between Indian and the US based students. The authors will report how and in which categories the various groups need more attention in order to relate the subject to the real world. Additionally, the attendees will learn how gender differences influence the study strategies of high school students in both countries.

Friday, November 4, 2016

Teaching Innovations (TI)

A Teachable Communication Model for Technical People

Author(s)
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Need: "Young people lack workplace skills such as communication and team work." (BBC News, October, 2015). "With small businesses scrambling to find qualified employees, a recent national survey of employers found that young people are increasingly ill-prepared for today's workforce, lacking basic skills in communications and critical thinking." (Inc. October 6, 2006). For over a decade, employers have been disappointed in how students communicate when they enter the workforce. Although this may not be an entirely new issue, the increasing collaboration required in the workplace, the increasing use of technology for communication, and the rapid pace of business and innovation may be exasperating the effects of a college graduates lack of communication skills. According to Sponcil in the Journal of Technology (2014), "When internet technology has surged in popularity, it is reasonable to be curious about its impact on human face-to-face communication. " As educators in technical disciplines, a way to distinguish your graduates might be to equip them to excel in communications—not only how they write and speak, but how they show up.

Overview: According to Forbes (May 2014), what you may find surprising is that employers are looking for skills that aren't taught in college. The number one weakness Corporate America said they faced with incoming talent was the "inability to effectively communicate" on a professional level. The research indicated that the collegiate environment did not afford many opportunities for the development of this most critical skill. As educators, how might we not only prepare our students in their respective technical fields but also as communicators? This is much broader and deeper than just a couple of speech and English classes. With limited resources, this presentation shares some fundamental practices on how to improve the communication skills of technical managers and technical experts.

Major Points: Major Points:

- Overview of the Communication Crisis with College Graduates and Technical Faculty
- The Side Effects of Technology on Communication
- Communication Model for Technical People
- Program Practices

Summary: Communication competence with students is not a new issue. Is it time for technical educators, not only to address the issue, but lead other disciplines who are also struggling with the issue? Attendees will gain information on the disparate communication gap between education and industry, a balanced perspective on the side effects of technology on communication, a technical communication model, program practices to improve graduates communications competence, including indirect and direct pre and post-test options. Enhance the future by tackling an issue that continues to be ignored—students ability to communicate.

Friday, November 4, 2016

Teaching Innovations (TI)

Addressing Competency-Based Education in the Applied Sciences and Technologies

Author(s)
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Need: The cost of higher education continues to outpace the rate of inflation. These increases in cost have prompted legislators to ask colleges and universities to both account for those high costs and to find ways in which to lower them. Given the funding structures through state and federal governments, institutions of higher learning will have to respond to these demands. Some states have started investigating the use of competency-based education as a means to address these issues. Competency-based education presents both challenges and opportunities. For many disciplines, competency-based education could significantly impact the logistics, funding model, and pedagogy of delivering their academic programs. For academic degrees in the realm of the applied sciences and technologies, the impact of competency-based education may not be as significant. At issue is how educators and administrators will respond if state and federal funding agencies start to push the adoption of competency-based education.

Overview: State legislatures and the public are holding higher education accountable for the high cost of attending college. One way in which to address the concerns of the legislators is through the use of competency-based education. Competency-base education is a model in which students must prove that they have mastered an academic competency before proceeding to the next competency. It is also based on the belief that students should be able to progress through the competencies at their own rate. This includes the opportunity to prove their competencies as a result of previous learning. This presentation will address the issue of competency-based education in the applied sciences and technologies that include the many disciplines within ATMAE. Included will be a discussion of the educational model and its challenges. The presentation will also provide the outcomes of a recent study into how competency-based education may be incorporated into an information technology and a graphic arts management programs.

Major Points:
This presentation will:

- Provide an overview of competency-based education
- Identify the challenges associated with competency-based education
- Offer a framework of how competency-based education can be addressed in applied sciences programs such as information technology and graphics arts management.

Summary: There is concern among legislators, employers, and the public with the increasing cost of higher education. In light of these high costs, the aforementioned parties are also demanding greater accountability. One of the recent trends in this movement has been competency-based education. Competency-based education is centered on the idea that higher education should identify and validate that students are attaining defined levels of competencies in their academic programs. The details on how implementing competency-based education in higher education provides some logistical and pedagogical challenges. This presentation will discuss the challenges, opportunities, and strategies for implementing a degree curriculum based on a competency-based education model.

Friday, November 4, 2016

Teaching Innovations (TI)

Alternatives: Utilizing Visual Communications in the Classroom

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Need: Visuals stimulate. They hold ones attention. Visuals sell. Visual communication and information engage viewers in ways that go beyond traditional text. Opening dialog between students, their peers and instructors may help to develop student learning outcomes. Ultimately students may be better able to make decisions about how to present their point of view via integration of technology with incorporation of visual cues.

Overview: This presentation will focus on one approach to engaging students in the classroom through development of a visual approach in promoting dialog and aesthetic insight through technology based options. This approach is aimed at better communication of information and will focus on how one technology program has incorporated a visual dialog in student engagement.

Major Points:

- Combining aesthetics and technology into viable tools for communicating
- Utilizing visual thinking for problem solving
- Capitalizing on visuals for dispensing and retrieval of information

Summary: Attendees of this presentation will learn about one technology program's approach to teaching with visual strategies to engage students and aid in development of their visual tools. This approach is aimed at dovetailing information into a more cohesive synthesis and dispensing of information.

Thursday, November 3, 2016

Teaching Innovations (TI)

An Evaluation of an Interactive Learning Program for Freshman Students in an Electronics Engineering Technology Program

Author(s)
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Need: Hybrid technology courses using internet supplied interactive learning materials actively engage students struggling with coursework beyond the traditional classroom lecture and laboratory paradigm by allowing students to supplement learning through creation of an individual learning experience geared to their specific needs. Students can selectively move through complex learning materials, and activities focusing on their weaknesses, and receive real-time evaluation feedback on their progress. Research shows that for some programs, when effectively integrated into a traditional classroom structure, interactive learning models can assist students in strengthening their problem solving and critical thinking skills to increase learning, student success in the course, and program retention. As with all teaching methods it is necessary for faculty to regularly evaluate the effectiveness of a newly introduced methodology to ensure that the desired results in student learning are occurring, and to provide continuous improvement.

Overview: In the Spring of 2015 the faculty of the Department of Electronics & Computer Engineering Technology (ECET) at ISU made a decision to use the Connect Interactive Learning Tool System developed by McGraw-Hill Publishers to supplement instruction of fundamental electronics principles in DC and AC courses for freshman majors; and in a survey of electronics course for non-majors. The Connect system allowed students enrolled in these courses to login to the system via the internet and view supplemental learning materials. These materials can be viewed repeatedly and at the student's pace with student progress towards course objectives tracked. Formative evaluations are made of the student by the system to require student mastery of the materials before progressing. Reports of student success are created to guide the instructor. This presentation will provide the attendees with a first year evaluation of the success and limitations of the program during the Fall 2015 and Spring 2016 semesters.

Major Points:

- Challenges experienced in the program development and setup process.
- The effects of the usage of the program on student learning and student success.
- Limitations of the system and opportunities for improvement.
- Implications for technology education instructors teaching and suggestions for use.

Summary: Attendees will hear the first year evaluation of using an internet supplied interactive learning system for first year students in an electronics technology program. Program successes and limitations will be shared as well as implications for technology educators.

Friday, November 4, 2016

Teaching Innovations (TI)

An Examination of the Internship Course in the Graphics Field

Author(s)
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Need: Students take various courses ranging from general education courses to major related courses throughout their program. All courses are important, but one course stands out the most is the internship course. The internship course provides students the real life experience. It is a gateway for students to enter in the future job market. As a result, it is very essential to examine the internship course on various criteria, such as, who is hiring, what students learn, how much students earn, and what students' future plans are.

Overview: Students in the Department of Graphic Design Technology at North Carolina A&T State University have to take the internship course in their Junior year. Students from three track areas, namely, CADD, Graphic Design, and Media Design register for the course. The course was investigated on different criteria in order to serve students better, find out their needs, and discover what they learn. The data were collected from students and analyzed.

Major Points:

- Introduction: Demography of students, preparedness, success rate of finding the internship
- Internship Details: Company's info, job title, job duties, compensations
- Discoveries of Students: what students discovered at the company, like, company's culture, company's policies, and resources.
- Accomplishments of Students: what types of designs students created.
- Sociological Lessons Learned by Students: what types of soft and hard skills students learned.
- Areas of Improvements for Students: what types of competencies that students need to improve on.
- Future Goal of Students: what students want to pursue upon graduation.
- Recommendations to Strengthen the Internship Experience: what the campus career services, the department, an instructor, students, advisory board members, and employers can do to make the internship process better and smoother for students.

Summary: The internship course in the graphics discipline was examined on various criteria, such as, who is hiring, what students learn, how much students earn, and what students' future plans are. The purpose is to serve students better, find out their needs, and discover what they learn. This presentation will be beneficial to attendees to help students prepare for the future career related jobs.

Thursday, November 3, 2016

Teaching Innovations (TI)

An Invitation to Success

Author(s)
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Mr. Lyle Meulebroeck
Bemidji State University, Bemidji, MN

Need: Many of us need to submit Professional Development Plans followed up by Professional Development Reports (PDRs) to substantiate our work. According to our contract, teaching is the first of five areas of our responsibilities. It is followed by Criterion 2. Scholarly or creative achievement or research. That is the area most often cited for lack of presentations and publications. Often overlooked in this area are presenting invited lectures, which are not as weighted as a conference presentation, but still support our PDRs and our resumes in Criterion 2. The last area of responsibility for our contract is Criterion 5. Service to the university and community, which includes providing community presentations and outreach, and also mentoring colleagues and students. We seldom take the time to acknowledge our colleagues expertise and invite them as speakers in our classes. A simple invitation could be professionally, mutually beneficial to both colleagues.

Overview: All of our colleagues are experts in their own right in many different areas, but how often do we acknowledge them and take advantage of their expertise? As we teach our semester-long courses based on our expertise, we continue to teach our colleague's chapter-long topics in our courses. Have you ever thought of the benefits of inviting your colleagues to lecture on a topic in one of your courses? We acknowledge that many of our subjects are related and the repetition of topics re-enforces the learning and the importance of the material in today's corporate environment. But can we acknowledge the expertise of our colleagues and invite them to lecture on their expertise in our courses? Can we give up business as usual in our classroom and recognize the benefits brought by a simple invitation to speak on a topic? Learn how occasionally sharing your classroom's learning environment with your colleagues can be mutually beneficial.

Major Points:

- Professional development/resume builder Meets scholarly presentation requirement
- Engages colleagues in your area of expertise Create mentoring opportunities
- Acknowledges the expertise of your colleagues
- Builds team respect, trust and unity among colleagues
- Creates the potential for open, positive, professional dialogue
- Models professional behavior for students Re-enforces the material being presented

Summary: Attendees will learn the benefits of sharing their classroom environment with their colleagues by inviting colleagues as guest lectures to cover areas of their expertise. An example will be given to demonstrate a simple format to use in the classroom to lead an open discussion, while building both instructors' Professional Development Reports and resumes.

Thursday, November 3, 2016

Teaching Innovations (TI)

Analyzing the Effect of Industry Engagement Activities on Student Learning in the Undergraduate Program

Author(s)
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Need: Industry engagement activities are being used as teaching tools across the various undergraduate classrooms to enhance student learning. Previous research shows that engagement activities enhance student learning but lacks the ability to measure the impact each of the activities has on student learning. This research provides a way to systematically measure multiple industry engagement activities and their effect on student learning.

Overview: Students experience industry engagement through various activities such as guest speakers, facility tours, industry videos, professional organization involvement, and industry-focused final projects. For this research, a questionnaire based survey is disseminated to the classroom to measure student perception of the engagement activities. The data is then analyzed using structural equation modeling to compare the activities to each other to see which impacts students the most. Analyzing the data provides a foundation for allowing classes to include the more effective industry engagement activities.

Major Points:

- Provide a systematic way to collect and analyze student perception of industry engagement activities and the impact on their learning.
- Compare different types of industry engagement activities using structural equation modeling (SEM) to see impact of various activities on student learning.
- Report results to lecturers in order to guide them in incorporating effective industry engagement activities.

Summary: The audience will obtain a better understanding of which activities are found to enhance student learning the most. The results from the research are shared with lecturers to assist them in incorporating industry engagement activities that strongly enhance student learning.

Thursday, November 3, 2016

Teaching Innovations (TI)

Applied Project Management Methodology for College Degree Program Success

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Need: The National Center for Education Statistics reports that "the 2013 6 year graduation rate for first time, fulltime undergraduate students who began their pursuit of a bachelor's degree at a 4-year degree-granting institution in fall 2007 was 59 percent" overall but was only 58 percent for public institutions. In addition to the actual time that it takes for students to complete their college degree program, the costs associated with their education also often grow beyond their initial expectation as a result. As a college degree program is by definition a project, applying project management methodology to the selection, planning and performance phases of the college degree program can provide the undergraduate with a clear and detailed plan that will serve to support the student's successful achievement of their degree in terms of its schedule, budget and quality outcome for the deliverable.

Overview: As a result of witnessing Juniors, who may be 50 percent through the required courses for their degree but who were 'over-budget' due to being behind in their original schedule of coursework, a new course was developed, Introduction to Project Management. This course is aimed at incoming Freshmen and Sophomores and is designed to introduce these students to project management methodology that they will then learn to apply in selecting and planning their college degree program. Included in the planning phase is budget development, resource requirements planning, risk and constraint analysis and management, development of a plan for quality checks as well as a project control, review and management process. While this course is currently in its second year since implementation, feedback from students who have completed the course is that they have a much clearer understanding of how to approach the performance phase of their college degree 'project'.

Major Points:

- Designed for incoming college students
- Provides guidance in course scheduling and structured planning
- Provides guidance in total cost/budget development and control
- Provides guidance in planning for quality outcomes in the deliverable
- Provides methods for measuring performance to plan, budget and quality of the deliverable
- Provides guidance in constraint and risk analysis and management
- Potential to improve on-time, on-budget graduation with superior quality outcomes in the major deliverable
- Provides a foundation of understanding of project management methodology that may be applied to all project based learning throughout the student's academic career

Summary: Attendees will be introduced to a strategy that has the potential to improve the success of their student population in terms of student retention, graduation rates, and overall satisfaction.

Thursday, November 3, 2016

Teaching Innovations (TI)

By Moving Interior Design Students into a Complete Digital Drafting Environment, Are They Better Prepared for the Needs of the Industry?

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Mr. Norman Philipp
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Need: Current practice includes ideation manually as well as digitally, but is it necessary to ideate in the traditional medium of pencil and paper or could the application of technology produce equivalent outcomes? If industry moves completely to technology based mediums, will our students understand the mechanics of design? Is it imperative for comprehension that students learn manual drawing via traditional mediums before transitioning to technology based mediums and digital input?

Overview: This panel brings together educators and professionals with experience in Interior Design, Engineering and Architecture to discuss the advantages and disadvantages of replacing manual drawing in the interior design curriculum via total submersion in digital technical drawing and design communication. The current mission of the majority of AEC programs is to provide quality design/construction education while developing professional leaders for industry through authentic education and experiences with emerging technologies in the AEC industry. Exposure to emerging technologies allows the students to be better prepared to excel in the industry as technological advancements are being continuously integrated into practice.

Major Points:

- Can the creative ideation process be achieved through computer generated sketches?
- What should be the balance if both manual and technological techniques are employed?
- How does technology affect the studio space?
- Does going through a digital format impede the transient nature of preliminary design ideation?
- Are we academic or industry driven?
- How can interior design embrace the advantages in a BIM methodology?
- Should interior design programs be totally immersed in digital representation?
- What are the implications with NCIDQ?

Summary: Industry trends within the AEC industry are moving into digital implementation and utilization in design and construction, while a large portion of academia are still teaching and emphasizing manual methods. The communication process within a project will be limited when one entity cannot integrate itself with the others. Shouldn't the pedagogy of an Interior Design program emulate a practicing design studio in order to provide the skills necessary for professional practice? The student's education should be in alignment with the highest industry standards. Design programs that engage in strategic foresight will position themselves to take full advantage of emerging opportunities. This panel will explore where the balance should be or if there should be a balance between a manual or digital format.

Thursday, November 3, 2016

Teaching Innovations (TI)

CAD/Prototyping Development through Design Centered Education

Author(s)
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Need: The need for a wider range of proficiencies beyond standard skill sets has seen an unprecedented growth in industry over the past few years. Driven by global demands for skilled workers with an understanding of design and design processes; design became an essential part of a technology related program. We will present a curriculum development model and explain how it was used to update course content related to understanding and applying design in a traditional CAD course. These changes are anticipated to better prepare students for immediate entry into the workforce and for the benefit of industry.

Overview: In order to develop understandings related to the design process, key concepts, content, and interaction must be incorporated throughout the curriculum. Varied levels of interactions strategically placed can assist in moving the learner from a level of awareness to one of applying design principals for specific applications. Challenges include keeping up to date with the changes in technology, developing meaningful learning opportunities, and providing relevant context while maintaining required skill development. This presentation will discuss how design and design processes have been integrated throughout the curriculum, particularly in an introductory CAD-based courses for further development throughout the program.

Major Points:

- History of Program and Expectations
- Need for Change/Development Design Development without Losing Critical Skills
- Design to Production – Spanning the Gap
- Looking Forward

Summary: Attendees will understand the curriculum development process and see current activities and interactions used to develop CAD, Parametric Modeling, Additive Manufacture, and Prototyping abilities through design based projects and curriculum. This model has been successful in the fostering of student abilities with regard to the application of the design process and production for the benefit of the students and industry alike.

Friday, November 4, 2016

Teaching Innovations (TI)

CM Industry Experts in the Classroom: Requiring Mentors for a Senior CM Capstone Class?

Author(s)
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Ms. Jennifer Warrner
Ball State University, Muncie, IN
Mr. Garry Rollins
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Need: Experience in any industry or business is invaluable, but it does take time. Many companies, regardless of specialty, have Mentorship programs as part of their learning procedures for new or recent hires. These new hires are assigned an experienced leader or mentor to help guide the new hire through the rigors of learning what to do, how to do it, and when to do it, in their early days on the job. And our senior CM Capstone class is no different!

Overview: At Ball State University, senior CM students are required to complete the TCST 460: Capstone for Construction class. Students are required to form a team (or company) of approximately 4 students, and will be assigned a variety of CM activities relative to a selected project on the BSU campus. Capstone student teams are strongly encouraged to select and engage a Mentor(s), as part of their learning process in this class. Likewise, one CM faculty is assigned for the class leadership, but all CM faculty partake in this course……..from providing leadership, knowledge and other learning experiences, to the grading of both Written Deliverables & Presentations. When Capstone class students properly and regularly engage their Mentors, their class learning outcomes are typically greater than student teams that do not engage with CM industry experts.

Major Points:

1. What is the process for creating the Capstone class and Mentor requirements.
2. How does your program engage interest for possible Mentorship participation.
3. Encourage student team members to use a member from their Internship employer.
4. Encourage students to select 2 or 3 or 4 Mentors, as Mentors are very busy, and time is money!
5. Encourage students to select Mentors with varying strengths and expertise, similar to what will be expected in the Capstone class.

Summary: Attendees will gain an understanding of a senior Capstone (or thesis) class, and the true value of teaming with the use of all CM faculty, and students involvement with experienced CM Mentors & Leaders. Also, attendees will learn some of the Good, the Bad and the Ugly of a Capstone class, plus advantages of working with others outside of their immediate university network and world!

Thursday, November 3, 2016

Teaching Innovations (TI)

Constructing a Virtual Cross-Institution Design Collaboration with a Multi-national Focus

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Need: There is keen interest in the promotion of virtual undergraduate cross-institutional design projects, particularly those opportunities with a multi-national focus.

Overview: This paper outlines a framework we are now developing to foster a virtual undergraduate cross-institutional design project with a multi-national focus. In this presentation, we will share a comprehensive model for operating a credit-bearing course populated by students from SUNY/Buffalo State and from Jiaxing University in China. Each institution will sponsor its own separate technical design course, to be offered simultaneously and collaboratively. Virtual communication will be the highlight of the course, since a unified 'whole team' project outcome is the principal objective. Under close faculty supervision, students from the combined virtual design team will be challenged to identify a novel, mutually agreed design problem and then to create and propose a joint solution using principles of electro-mechanical design. Laboratories at each institution will be used to develop prototypes. Preparation of a detailed written manufacturing proposal will be the final deliverable jointly prepared by the cross-institutional student group. As a culminating activity, student travel will be encouraged to each collaborating institution, to jointly present the proposal for review and critique by a board of external professionals assembled specifically for this review task.

Major Points:

- Share the journey we took to conceive and develop this multi-national project.
- Present anticipated benefits and challenges.
- Discuss implications for the future - potential industry sponsorship in future years, establish competition with other cross-institution multi-national teams.

Summary: Attendees will be presented with the model we have developed for this virtual cross-institution multi-national design collaboration, with ample time for dialogue and discussion.

Friday, November 4, 2016

Teaching Innovations (TI)

Control Problem for the Manufacturing/Mechatronics Curriculum

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Need: There is a continuing need to attract students to, retain students in, and raise the awareness of, manufacturing/mechatronics programs. The subject matter may be perceived to be dry and the theoretical modeling and the hands on laboratory application are often separated. Commercial equipment may be priced beyond the reach of many programs. Many laboratory setups fail to capture the interest of junior and senior students already in these programs let alone potential new recruits and their families.

Overview: We bring an interesting, highly visual, easy to explain, control problem of a ping-pong ball in a tube to the manufacturing/mechatronics curriculum. Our set up is simple, low cost, and constructed from readily available components. It has the added ability to easily introduce an external disturbance to the control problem. It ties together the theoretical and the hands on components of automatic control in our manufacturing and mechatronics curricula. It not only can be used to attract attention to, and create interest in, automatic control but is an interesting control problem in its own right.

Major Points:

- Highly visual, interesting, easy to explain
- Ties together the theoretical and the hands on aspects of the curricula
- Problem requires closed loop control
- Low cost
- Readily available components

Summary: Attendees will learn how to bring a highly visual control problem to their manufacturing/mechatronics programs.

Thursday, November 3, 2016

Teaching Innovations (TI)

Evaluating the Productivity of eLearning Combined with 3D Printed Models in Hybrid Drafting Courses

Author(s)
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Need: For many years, higher education design and drafting technology (CADD) courses have mostly been taught using the traditional educational methods. Although many universities have gradually been including eLearning to facilitate students' learning, some freshmen students still find it difficult to understand some of the basic technical concepts. According to the Cognitive Constructivist Learning Theory and based on the recent studies, active learning and experiencing can help in better understanding the concepts and their practical applications. Therefore, implementing multimedia and providing tangible models for students enrolled in blended courses can help to create an engaging educational environment in which learners can actively and independently learn and visualize objects while making connection to their life experiences. Understanding students' learning needs and how to facilitate and stimulate effective learning can enable higher institutions to provide an optimal educational environment valuable not only for maximizing students' learning and success but also for future academic and institutional innovations.

Overview: The purpose of this quantitative study is to investigate whether a hybrid instructional approach supplemented with multimedia and 3D printed models would be an effective option to accommodate the learning styles of the students enrolled in two introductory Design and Drafting Technology (CADD) courses at the University of Central Missouri. To evaluate the effectiveness of implementing 3D printed models, the project scores of 44 freshman students currently enrolled in two introductory drafting courses with tangible 3D prototypes will be compared with the scores of 44 students enrolled in the same courses last semester without the 3D models. In our presentation, we will display the results of our study and additional effective eLearning instructional strategies.

Major Points:

- Design and Drafting Technology eLearning Procedures
- Results of our study
- Effective implementation of new eLearning methods
- Recommendations and conclusions

Summary: Attendees will learn innovative and effective methods of Design and Drafting Technology instructional approaches to engage students in their learning process and accommodate their learning needs. The practical activities addressed in this presentation can be incorporated into any drafting course to achieve positive outcomes.

Friday, November 4, 2016

Teaching Innovations (TI)

Examining Students' Perceptions of Helpfulness from Asynchronous Supplemental Video Modules in a Hybrid Technology Course

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Need: Implementation of online asynchronous supplemental video modules (ASVMs), or videos that are available to students outside of class periods, in hybrid and online courses is well documented in the literature. The reasons for the usage of these ASVMs is to augment access, reduce costs, provide schedule flexibility, and increase curricular offerings. However, the relationship between how many ASVMs students watch and how strongly they agreed/disagreed that the ASVMs help them 1) understand a course's content, 2) illustrate the relevance of a course's content to the real world, and 3) consistently explain and clarify confusing course content is unclear. Examining these associations can help to clarify the impact that these ASVMs can have on students.

Overview: This presentation will extend previous research related to how helpful students perceive ASVMs and link it to current results that illustrate the relationship between how many modules students view and how helpful they are perceived to be. A Statistical Process Control (SPC) module within a junior level total quality improvement course will serve as the focus of this research, with a sampling frame comprised of over 200 students in technology, engineering, and business degree tracks.

Major Points:
Examine the relationship between how many ASVMs students watch and how strongly they agreed/disagreed that ASVMs help them:

1. Understand a course's content
2. Illustrate the relevance of a course's content to the real world
3. Consistently explain and clarify confusing course content

Link these results to past findings to clarify the impact that asynchronous online course modules can have on students.

Summary: While ASVMs are a common pedagogical instrument used to extend learning beyond the classroom, it is unclear how helpful students perceive these to be. Analyzing these perceptions and relating them to the quantity of ASVMs watched by students can clarify the impact of this type of course content. Ultimately, this information can be used to determine the value of investing in the development of ASVMs for a course to increase student learning, satisfaction, and achievement.

Thursday, November 3, 2016

Teaching Innovations (TI)

Experiential Learning in Quality: Setup of a Thin Film Temperature Sensor Processing Line

Author(s)
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Need: It is often difficult for students to transition from concept to application in quality control courses, particularly when the concepts involve variation and the application of statistical techniques to understand, characterize, and control variation. In order to meet industry needs, applied engineering and other technology management students must have an understanding of the nature of variation in manufacturing and how to control it. The more realistic the activities that can be provided to students, the more ready they will be to immediately enter the workforce and contribute to these organizations.

Overview: The presentation will provide an overview of recent activities at Eastern Kentucky University to set up and integrate a thin film resistance temperature sensor line to demonstrate quality concepts in manufacturing. The processing line provides an excellent learning opportunity for students in several quality classes, including Introduction to Quality, Control Charts, Design of Experiments, and Reliability.

Major Points:

- Knowledge about quality concepts and statistical techniques and the ability to apply them in a process environment are important components of the skill set of Applied Engineering Management graduates
- Realistic application activities enhance the ability of students to immediately contribute to organizations as they enter the workforce
- Students benefit when technical problem-solving activities are key elements of the learning experience.

Summary: Attendees will be given an overview of the processing line stations and flow, along with examples of application of quality tools and statistical techniques to meet student learning objectives.

Thursday, November 3, 2016

Teaching Innovations (TI)

Experiential Learning: Service Learning Used to Enrich Learning, Training, and Civic Responsibility for Technology Students

Author(s)
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Need: It is essential for students to engage in meaningful classroom experiences that cultivates them in preparing for career pursuits. Successfully passing a class and obtaining a degree is a tremendous asset. Nevertheless; students need more opportunities to develop transferable job-related skills, collaborate with workforce professionals, and establish civic responsibility. Promoting this aids in developing well-rounded students; thus, making students deemed more favorably by potential employers. In developing experience, a form of experiential learning (i.e. service learning) provides the opportunity to effectively learn through the practical experience of serving the community based on specific learning objectives and overall direction of the instructor.

Overview: As Experiential learning, Service learning is an educational method that connects formal instruction with an opportunity to serve the community in order to provide a progressive learning experience. With academic coursework merged with civic engagement, Service learning benefits both students and community through a "hands-on" and interactive approach to learning. In the Emergency Management Technology (EMT) program a Jackson State University (JSU), EMT students have collaborated with Emergency Management (EM) professionals in the fields of meteorology, law enforcement, fire, and medicine to address local community needs. Service learning projects with EMT students and EM professionals have afforded the opportunity for students to assist pertinent emergency and disaster mitigation and preparedness issues.

Major Points:

- Define Service leaning and explain how it is a form of Experiential Learning
- Define Emergency Management and describe the Emergency Management Technology Program at Jackson State University Example the key components of Service learning
- Provide examples of successful Service learning projects with JSU EMT students
- Describe how such Service learning projects promoted creativity, accelerated learning, improved attitudes toward learning, and etc.
- Explain the benefits of Service learning and how it helps students prepare for careers

Summary: Service learning is described in the following ways: curricular connections, student voice, reflection, community partnerships, authentic community needs, and assessment. Curricular connection is integrating learning into a service project, which is essential in gaining experience. Student voice is beyond being actively engaged in the project itself; students have the opportunity to select, design, implement, and evaluate their service activity. Reflection is structured opportunities are created to think, talk, and write about the service experience. However, Service learning projects for EMT students encourage collaboration with Emergency Management professionals and enable students to develop the exceptional skills needed to obtain and maintain successful Emergency Management careers.

Thursday, November 3, 2016

Teaching Innovations (TI)

Filling the Gap Between Industry and Academia: Teaching Critical Skills in Automation and Control Using Developed, Open-Source Programmable Logic Controller Software

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Need: With current advancements and re-configurability of manufacturing, the Programmable Logic Controllers (PLCs) become an integral part of nearly all today's industrial processes. The high demand in engineering professionals equipped with relevant and up-to-date PLCs skills, drives the engineering education to develop the alternative to the standard in-class instruction approaches.

Overview: Collaborative initiative of Electrical Engineering Technology (EET) and Computer Science (CS) Department at Michigan Technological University is to develop a PLC curriculum to help solve the current shortage and future expected growth in control engineering professionals required to have relevant and up-to-date PLC skills.

Major Points:

- This project develops and implements the open source, multi-level, interactive PLC software to be used in high schools, two and four year colleges, as well as to training the displaced workers wishing to improve their knowledge and expertise in the subject matter and to meet the changing needs of the industry.
- The developed software represent different levels of difficulty and students can select the most appropriate version of the module for their knowledge base. Each learning module includes multimedia materials including video, audio, and/or electronic documents which provide an introduction to the content presented in the module.
- The learning system hosted by Michigan Tech is freely available for anybody around the world to use over the Internet. When the system is used in conjunction with a class, instructors will be able to connect with their students and monitor their progress.
- The learner competency can also be tested by structuring some of the learning modules as games where students can work collaboratively or competitively to solve PLC programming challenges.

Summary: In this paper we present the techniques and approaches used for the PLC system development and implementation.

Friday, November 4, 2016

Teaching Innovations (TI)

Flipping the Design and Drafting Technology (CADD) Courses: Students' Perceptions of Blended Learning

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Need: Since the emergence of electronic learning (eLearning) in the1990s, instructional concepts and interactive course tools have also been transformed and advanced to not only provide accessible, engaging, inclusive, and self-paced education for the modern age learners, but also utilize innovative technologies to facilitate learning and stimulate learners' motivation. Due to the issues associated with the conventional teacher-centered classrooms in higher education and the incompatibility with diverse learning styles, transforming educational practices is crucial to maximize students' involvement, learning, and success. As flipped classrooms have become more attractive to the higher education institutions, effective educational strategies are needed to achieve a productive flipped classroom and provide a positive learning environment. In our presentation, we will display students' perspectives of a flipped educational approach and how to efficiently design a flipped CADD course to accommodate the learning needs of today's learners.

Overview: The purpose of this study will be to explore CADD students' perceptions of blended learning, which will include interactive multimedia and self-paced learning. Information pertaining students' opinions and experiences of blended learning will be collected using an online survey involving CADD students enrolled in two flipped drafting courses at the University of Central Missouri. The results of this investigation will be analyzed to discover how to enhance the drafting curriculum in order to improve students' learning and achievement. The findings of this study will be valuable not only for advancing individualized educational practices, but also for future academic and institutional innovations.

Major Points:

- Students' perceptions of flipped classroom
- How to make a flipped classroom work
- Effective implementation of new eLearning methods
- Recommendations and conclusions

Summary: Attendees will learn innovative and effective methods of Design and Drafting Technology instructional approaches to accommodate the modern age students' learning needs. The practical activities addressed in this presentation can be incorporated into any technical course to achieve positive outcomes.

Thursday, November 3, 2016
Teaching Innovations (TI)

Identifying the Causes and Remedies for Skill Gaps in Manufacturing Technology Education

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Need: Manufacturing industry is the backbone of our nation's economic prosperity. Over the past century, manufacturing has been a major stakeholder leading to better standards of living through increased employment. However, current economic conditions hint towards low to moderate growth in the nation/global economies over the next couple of years. A growth rate of about 2.2 to 3.1% is indicated for the US, with the global rate being projected as 3.3 to 3.8. This discrepancy seriously points towards the challenges faced by the US manufacturing industry. Among the many challenges faced by the industry, finding the right talent is prominent. Though this is not something new, the issue is exacerbating and the causes keep changing. Hence there is a need to assess the existing skill gaps and accordingly modify the manufacturing curriculum. SME has been undertaking this task on a regular basis nationally.

Overview: Manufacturing sector is a major stakeholder in the US economy. However, the success of the industry greatly depends on the skills of the working professionals. SME on their web site claim that 2 million jobs will be unfulfilled in the next decade. The manufacturing companies are having a hard time finding right candidates to fill up the vacant positions, despite the high levels of unemployment. This situation hints towards a growing gap between the academics and the expectations of the industry. With the intent of contributing towards better employability of the students, thus a better economy and a better society, our research group at Dept. of Technology, University of Northern Iowa, has taken up a survey on Skill gaps in Manufacturing Technology Education. A survey instrument was sent out to various personnel from industry and engineering consultants that typically employ manufacturing graduates. The questions are based on the usual attainable objectives of a standard manufacturing technology curriculum to verify whether the objectives are really achieved and manifested through the skills of the student. This paper will present the results obtained from the survey along with the possible remedial steps.

Major Points:

- Skills expected from a work
- Observed deficiencies in the skills
- Survey results indicating the critical areas
- Possible causes for skill gaps
- Remedial measures

Summary: Though manufacturing industry contributes significantly to the economy of the nation, unfilled vacancies due to non-availability of suitable candidates is a major challenge for expanding the manufacturing productivity. This severely affects the growth and sustenance of the industry. This paper presents the results from a survey conducted to identify the major skill gaps and understand the possible causes. These results will be useful in designing and fine-tuning the curriculum of manufacturing courses and making the students more employable.

Friday, November 4, 2016

Teaching Innovations (TI)

Impact of Preventing Cheating Strategies in the Classroom

Author(s)
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Need: Preventing cheating strategies are needed in helping preserve the integrity of test questions and also improve the quality of education. The presentation aims to critically discuss the strategies the author employs in his classes to prevent cheating and how they impact his students.

Overview: Students must understand, analyze, apply, create, and be able to practice concepts, tools, and techniques they are taught without any form of cheating. The presentation discusses techniques that the author uses in his classes to impact his students on cheating.

Major Points:

- Importance of preventing cheating techniques to students' understanding
- Benefits of preventing cheating techniques
- Discussion of categories of preventing cheating techniques
- Impact of preventing cheating techniques

Summary: Attendees will understand how preventing cheating techniques impact students. The findings may help attendees appreciate and see the relevance of preventing cheating techniques in helping promote the quality of education for students.

Friday, November 4, 2016

Teaching Innovations (TI)

Improving Teaching Effectiveness of Automotive Sensing and Communication using Virtual Instruments and Customized Signal Conditioning Circuits

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Need: Due to the advance in electrical, electronics, controls and software technologies for developing better automobiles, there is an increasing need for automotive engineering technology programs to enhance the components of application of computers in analysis, design, manufacturing, and operation of facilities in major courses, particularly in labs, to better prepare graduates for the workforce.

Overview: The presentation introduces the latest progress we have made in developing shield circuit boards to work in conjunction with Ardruino microcontroller board. These boards serve as the signal conditioning units for selected engine sensors that provide important input to engine computers. More importantly, the sensor readings and their communication with the engine computers can be monitored and revised through LabVIEW virtual instruments. The user friendly graphical interface helps students visualize engine working status and internal communication mechanism, so that they gain fundamental understanding of vehicle electronics and computer systems.

Major Points:

We will demonstrate:

1. Signal conditional units for major engine sensors developed Arduino shield boards.
2. CAN bus shield to handle communication between sensors and engine control units.
3. LabVIEW virtual instruments to allow students to monitor and change sensor readings and CAN bus messages in real time.

Summary: We provide practical examples of using mature, inexpensive yet effective computer hardware and software to augment traditional automotive labs to offer better learning experience for students.

Thursday, November 3, 2016

Teaching Innovations (TI)

Integrating Open Source Resources in Robotics Education

Author(s)
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Need: The open-source movement has already revolutionized a number of industries by empowering end-users to contribute to the products that they need and want, and fueling grass-roots development of projects in completely new areas, as well as their continual improvement. Robotics is the branch of mechanical engineering, electrical engineering and computer science that deals with the design, construction, operation, and application of robots as well as computer systems for their control, sensory feedback, and information processing. The nature of collaborative works in Robotics over multiple engineering and science disciplines makes it perfect for open source, which not only leverage minds much greater than ours on specific fields, but also connect college students, industrial developers, hobbyists, educators and researchers.

Overview: This presentation is about how to integrate open-source resources into engineering technology teaching. The case study is an embedded system course that benefited from open-source software and hardware resources. The course project was to target a robot competition at a national student conference. The students use collaborative platforms such as GitHub, Webex, etc. to communicate with and get help from experts in navigation, programming, circuits design, CAD modeling, etc. They also use many open source resources such as grabCAD, ROS, Github, etc. so that they design and develop their robots on predeveloped and tested work that are made available by others. This greatly reduced the development time and improved project quality. This also got them familiar with what industries are doing in project developments.

Major Points:

- Open source software
- Open source hardware
- Open source mechanical systems
- Collaborative design
- Out of the box thinking, teaching, and learning

Summary: This presentation is about a real robotics class that benefits from open-source resources and collaborative design. The results show that it greatly improves students leaning by providing much bigger resources and communities for supports, providing environment where students centered learning truly happens, providing learning experience that is similar to industrial setup.

Friday, November 4, 2016

Teaching Innovations (TI)

Integration of Project Management into a Senior Capstone Sequence

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Need: The technology degree programs at Iowa State University (ISU) have seen a dramatic increase in the undergraduate enrollment over the past several years. Feedback from industrial stakeholders has indicated that project management is a highly desirable skill for technology graduates. These two driving factors have prompted a significant change in the instructional model for the senior capstone course, a required two-course sequence taken by graduating seniors. The challenge was to develop a course sequence that meets the needs of industry while still delivering a high-quality senior capstone experience to an increasing number of students.

Overview: The senior-level Technology Capstone experience requires students to work on teams of 3-5 and utilize their cumulative skills towards an open-ended project. Students have shown a propensity to lean on their technical skills to work through problems, yet the value of softer skills such as conflict resolution and communication have historically had a stronger influence on the success of teams. Students have also struggled to develop a framework for working together to complete their tasks and structuring their approach to problem-solving. This presentation will discuss the transition from a two-semester capstone experience to a capstone incorporating the principles of project management beginning with a sophomore-level course and ending with the senior capstone course. Implications for learning, outcomes assessment, and sustainability will also be shared.

Major Points:

- Current state of ABE's Technology Capstone course
- Explanation of the process to implement project management skills into the Technology curriculum
- Detail the expected outcomes of implementation of project management

Summary: Graduates from Technology programs are not only being asked to utilize their technical expertise, but also to manage personnel. By introducing project management in a sophomore-level course, students will be able to utilize these skills as the progress through their education and be better suited to succeed in their professions after graduation.

Thursday, November 3, 2016
Teaching Innovations (TI)

Internet Accessible Remote Laboratory

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Need: The internet accessible remote laboratory can grant the online/distance learning students' access to laboratory equipment. This can increase the type of courses that can be offered through online/distance learning. Student can proceed with their own pace with more flexibility.

Overview: LabVIEW can be adopted to implement instrument control. LabVIEW programs are called virtual instruments (VIs). LabVIEW possesses a very convenient web interface. The Web Publishing Tool can publish the front panel of a VI as a HTML document to the web. With the LabVIEW built-in Web Server, it is possible to view and control a VI remotely from a Web browser. Students can actually access the experiments with web browser in the same way a conventional website is accessed. LAN extensions for Instrumentation (LXI) is a new test instrumentation standard which defines the communication protocols for instrumentation and data acquisition systems using Ethernet. The connection with the LXI instruments is over an Ethernet connection. National Instruments (NI) Educational Laboratory Virtual Instrumentation Suite (ELVIS) integrates several most commonly used instruments into a compact form factor. This platform has made it easy to interface those instruments remotely. Microsoft Remote Desktop Connection can connect two computers over the Internet. Many instruments (such as NI ELVIS) can be accessed remotely via this direct connection.

Major Points:

- Review the different online delivery methods for remote laboratory development
- Use emerging technologies to bring a radical change in delivering laboratory courses
- Allow remote groups to conduct experiments with real equipment placed online.

Summary: This project studies the feasibility of several potential approaches for developing a remote laboratory: LabVIEW, LXI, NI ELVIS, and Remote Desktop Connection. It is necessary for an online/distance program to provide the same learning environment as traditional learning process. Online technology education presents a challenge for institutions to convert real to online labs. This study provides a deeper understanding of the current technology for remote laboratory development.

Friday, November 4, 2016

Teaching Innovations (TI)

It's Elementary: Promoting STEM Fields to Children

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Need: In 2013, 5.7 million job openings were available in STEM (science, technology, engineering, and math) fields. With such a great demand in these fields, nearly three jobs are available for every one student graduating with a STEM degree. Colleges and universities must work to recruit students into STEM degree fields.

Overview: College and university recruitment generally focuses on middle and high school students. However, research shows that students' career decisions are influenced at a much earlier age. This presentation highlights a new outreach initiative developed by the construction management program at Ball State University to introduce elementary school children to construction. The primary goal of this program is to make younger children aware and excited about career opportunities in the construction industry. This outreach initiative utilizes innovative teaching strategies and hands-on activities to teach elementary students about the construction industry, what skills are required to work in construction, and what types of jobs are available in the construction industry. Students from the Ball State construction management program assist with these presentations to share their knowledge and experiences with the children. Hopefully some of the children involved in this initiative will be part of the next generation of successful construction professionals.

Major Points:

- How to establish relationships with elementary schools and community organizations
- Strategies for recruiting college students to volunteer
- Development of elementary school presentation curriculum
- Innovative strategies and activities to teach construction to children
- Plans for future presentations and involvement

Summary: Attendees will understand the value of outreach to elementary schools and other community organizations. Attendees will learn about innovative presentation strategies and activities that could be incorporated into similar programs at other institutions. Attendees will learn how to incorporate current students into outreach initiatives.

Thursday, November 3, 2016

Teaching Innovations (TI)

Make Way for Generation Z: Strategies for Reaching Out to the Next Generation of Students

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Need: It is commonly thought that each generation is more complex and challenging than the previous. Gen-Y and Millennials have been widely studied, yet more than a quarter of the current population in the United States belongs to what is now known as Generation Z. Generation Z consists of the latest wave of students that were born between the mid-90's and the early 2000's. These students, aged between 16 and 19, are seen as being entrepreneurial, pluralistic, and determined to take charge of their futures. Generation Z students are technologically savvy and depend on technology for day-to-day activities. This latest generation is now reaching our college classrooms so it is essential educators are aware of the differences between Gen-Y, Millennial, and Generation Z students and how we as educators can take advantage of technology and best strategies to better reach them.

Overview: This presentation will examine the elements that make Generation Z students different from other students and explore various ways to reach these students.

Major Points:

- Generation Z students, who are they?
- What makes Generation Z students tick?
- How can technology be used to enhance classroom learning
- How to keep Generation Z students focused

Summary: Attendees will learn of best practices and strategies from academic professionals and resources for engaging and advising for the next generation of students.

Thursday, November 3, 2016
Teaching Innovations (TI)

Managing Industry-Based Projects In a Senior Project Course

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Need: Managing industry-based senior capstone projects in an efficient and productive manner may require a pre-enrollment planning and deploying various course management tools. The proposed course management scheme is designed to provide a learning environment for the students to integrate their knowledge of management, technology and applied engineering with creative problem solving, critical thinking, team working, ethics and technical writing.

Overview: The Senior Project course in Industrial Technology and Packaging (ITP) program of California Polytechnic State University culminates students' coursework by applying the gained skills and knowledge to solve a real-world problem. Students acquire research, organizational and presentation skills through project works and development of a formal report. This paper presents some background on the author's experiences in managing industry-based senior projects in ITP program. In addition to applications of operations management, product development, and packaging design/testing to solve a real-life business/industrial problem, students develop the soft skills such as, team work, written and oral communications, and ethics. The administrative management and monitoring of projects including pre-enrollment planning, project selection, orientation meetings, and assessment tools will be discussed. Several examples of industry-sponsored projects will be described.

Major Points:

- Background of related work
- Pre-enrollment planning
- Project selection criteria
- Project progress monitoring/feedback
- Challenges of assessing team projects
- Application of decision making/critical thinking skills
- Presentations of project results
- Evaluation rubrics
- Examples of projects

Summary: It is expected that the process and tools described in this paper to assist other educators and students in managing their industry-based senior projects in a more efficient and effective manner.

Thursday, November 3, 2016

Teaching Innovations (TI)

Outcome Assessment, Assessment of Students' Learning: Their Implications for Departmental & Institutional Effectiveness

Author(s)
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Need: Outcome assessment and the Continuous Assessment of Students' Learning, developing the culture of Evidence and documenting results continue to be a major challenge to many institutions. There is ample evidence that this is the case as once read about sanctions, "show cause" stipulations that are issued to institutions by numerous regional accrediting agencies. On-going professional development is necessary on the topics of Outcome Assessment, Institutional Effectiveness.

Overview: Accreditation and Re accreditation processes require the continuous assessment of students' learning at the course level, program level and at the institutional level. Student learning outcome- what student will know, be able to do and value at the end of their academic program is what constitute education. They are designed and approved by the curriculum process, assessed through the outcome assessment process and reflect as well as enhanced in the review process. Each programs offered by an institution must have an assessment process with documented results. Evidence must be presented that the results of assessment are applied to the further development and improvement of programs. The Assessment processes must demonstrate that the outcomes important to the mission of the institutions and the objectives of the programs are being measured. It is an imperative that institutions develop the culture of evidence to document that assessment is taking place and that the results are being used for continuous improvement of programs, and the college mission.

Major Points:

- An Overview of the Assessment Processes
- How successful have faculty in programs worked together to develop and implement a plan for assessment and collecting data focused on students learning out come at the course level, program level and institutional level?
- Review of Courses Student Learning Outcomes
- Discussion of how to measure program Success, department's and Institutional Effectiveness
- How to use program Student Learning Outcome to improve Programs and institutional effectiveness
- The relationship of Program Outcome Assessment to Institutional Effectiveness.

Summary: Attendees will understand Outcome Assessment Processes, assessment of students' learning their importance and relationship to department and institutional effectiveness and how to develop a culture of assessment based on Evidence.

Thursday, November 3, 2016

Teaching Innovations (TI)

Phidgets: A Practical Aid in Teaching Student's Computer Programming

Author(s)
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Need: Engineering technology and management professionals agree that all technology students should know at least one programming language. The presenter has introduced the use of Phidgets, a simple USB hardware device, to aid in teaching computer programming. The goal of this presentation is to share the successes of such an approach.

Overview: Courses in computer programming should introduce all the basic constructs (Control flow, Data types, Methods, and Variables) that are common in all high level programming languages like C, C++, Java, VB.NET and ASP.NET. To some students learning these constructs is challenging because they view them as abstract. It has been found that inclusion of hardware devices help the students visualize these programming constructs. This presentation will discuss the use of Phidget boards to supplement an introductory level VB.NET and APE.NET programming classes taught by the presenter. By introducing this hardware device the presenter has been able to better communicate the subject matter while making programming more enjoyable and less abstract. The presentation will discuss some typical programming projects that were successful and the costs involved.

Major Points:

- The engineering technology student Interfacing with the Phidget Software and hardware event handling
- Samples of activities/programs conducted

Summary: Attendees will understand the challenges involved in teaching engineering technology students event driven application programming. This presentation will share a teaching method to better engage the students making the learning process simpler. The learning process of the presenter will be shared and where the presenter plans to take the class in the future

Friday, November 4, 2016

Teaching Innovations (TI)

Preparing Students for Careers via Project Based Learning Supported by Industry Partnership

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Need: In an effort to meet industry's demand for students that have practical/hands-on experiences, educators must begin identifying new methods of integrating projects into the classroom that provide such opportunities. The authors have found that through simple collaborations with industry, they are able to ensure that students will graduate with the knowledge and skills necessary to be successful for today's careers. By allowing students to work on real world problems and getting critical feedback from professional practitioners, these projects benefit both the industry partner and the students.

Overview: Our presentation will discuss how industry partnerships have provided for practical, project based learning in computer aided drafting and quality control courses. The presenters will provide an overview of the types of projects implemented, the anticipated learning outcomes from the projects and how these are relevant for today's industries, and plans on how the projects will evolve in the future based on the input from the industry partners and reflections of the professor on meeting the course goals and objectives.

Major Points:

- Industry partnerships lead to hands-on/project based learning
- Industry partnerships can be implemented into a variety of courses
- Project based learning allow students to actively apply theories and concepts, thus honing technical skills
- Industry driven projects provide a holistic perspective of how concepts relate in an industrial environment
- Projects aid in successfully implementing a flipped classroom model
- Industry partnerships help provide projects that fill gaps for students that cannot secure internships
- Industry partnerships help students practice professional communication in verbal and written formats

Summary: Attendees will learn how the industry partnerships developed by the two presenters have assisted in effectively implementing the flipped classroom model in a manner that better prepares students for careers in today's industry. Discussion will include an overview of the projects, goals and objectives, how the authors evaluate student learning, and lessons learned going forward. The projects discussed can be easily integrated into both undergraduate and graduate level courses.

Friday, November 4, 2016

Teaching Innovations (TI)

Program Specific Career Events Provide Increased Benefits for Industry and Students

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Need: Companies benefit from opportunities to network beyond a typical career fair especially when industry focused. Students need a network of industry connections to ensure career success following graduation and beyond.

Overview: Program specific career events develop long term relationships with companies leading to continued internships and career opportunities as well as financial contributions to the university. Company representatives travel hundreds of miles to reach our university so capitalizing on their time commitment and providing numerous opportunities to connect with students is essential. The UNK Industrial Distribution Career Event held in the Fall and the Spring includes our advisory council meeting, information sessions, career fair, onsite interviewing, and networking opportunities with seniors, interns, and underclassmen. This focused approach benefits companies and students with a less intimidating environment and many opportunities to network over several days.

Major Points:

- Career events are part of the culture of the program and critical for developing soft skills sought by companies.
- All students from freshman to senior participate to develop a network of contacts and learn from industry professionals.
- Process to prepare students and provide clear expectations is needed.
- In hard to fill, technical positions, companies benefit from industry specific events.
- Additional networking and information sessions provide opportunities to showcase student talent.
- Deeper relationships create a stronger commitment from companies leading to financial and academic contributions.

Summary: Program specific career events with long term and new company relationships result in sustained program success and near 100% placement of graduates. Industry needs for qualified candidates are met and students have access to companies who are looking for candidates with their skill set. The university benefits through program partnerships and industry involvement.

Thursday, November 3, 2016
Teaching Innovations (TI)

Quantitative Analysis of Mechatronics and Student Motivation in a First-Year Applied Engineering Course: Preliminary Results

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Need: Mechatronic experiences have been reported to positively motivate students in first-year engineering and technology courses. However, limited empirical evidence has been found in the literature to support this notion. Furthermore, the impact of contextual, demographic, or experiential factors on student motivation is unknown. Therefore, analyzing how mechatronic experiences motivate students, and how different students report different levels of motivation, can advance understanding of this topic.

Overview: This paper will analyze the level of students' motivation in the classroom after engaging in a half-semester mechatronic project. A sample of more than 70 students will be surveyed using the self-reporting Motivated Strategies for Learning Questionnaire to understand the level of student motivation when participating in a mechatronics project and how different students are motivated differently. A description of the mechatronic experience, implemented in a large first-year applied engineering course at a mid-west university, will also be presented.

Major Points:

- Mechatronics can motivate applied engineering students in first-year courses
- Different student subpopulations exhibit different levels of motivation related to mechatronic experiences
- Results lay an empirical foundation for understanding how this technology impacts student motivation

Summary: Limited empirical evidence has been found in current literature to support the use of mechatronics in first-year engineering and technology courses to motivate students. In response, this study lays a quantitative evidence base for the use of mechatronic projects in first-year courses and how they impact student motivation, albeit to different degrees for different students.

Teaching Innovations (TI)

SCME's Hands-online Academy – A Remote Approach to Hands-on Instruction

Author(s)
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Need: STEM (Science, Technology, Engineering, & Mathematics) is a vital foundation to education at all levels. Today's workforce is faced with more and bigger problems and an even greater number of solutions. Hands-on learning helps to foster problem solving skills and increase interest and understanding in all STEM fields. The Southwest Center for Microsystems Education (SCME) has been developing and supporting STEM education at the secondary, 2 year, and 4 year college level for 12 years. Our education materials and workshops help to enhance STEM curricula with hands-on kits and real life problems involving Microsystems Technology. To facilitate the incorporation of MEMS into STEM classrooms, SCME has provided training, support, and educational materials to this community via SCME online material libraries, SCME YouTube channel, webinars, hands-on workshops, multi-day clean room workshops at several sites, and professional development and training via distant learning platforms.

Overview: In 2016, SCME has taken an innovative approach to providing training and access to curriculum materials. The Hands-online Academy is designed to remotely support and facilitate microsystems education by providing online, easy access to a variety of courses, supporting classroom materials, and personalized coaching. In 2016, SCME is offering a series of six asynchronous online courses, all free of charge. Our series of hands-online courses for high school, community college, and university educators gives instructors one-on-one, hands-on instruction of our course materials and kits using the online venue. The course utilizes the Moodle Platform. This presentation will discuss how SCME has designed the Hands-online Academy, its interface with Moodle, its experiences with global participants, what worked, and what didn't. Each course provides the educational materials (reading materials, videos, and hands-on activities) needed to teach fundamental STEM concepts using microsystems applications. Many of the activities are supported with a SCME kit. The course utilizes the Moodle Open-source Learning Platform. If a course requires a SCME kit, the participant may request a free kit. In order to receive a free kit, the participant must complete the course, agree to integrate at least one of the kit/course activities into a class, and provide SCME with detailed feedback on their experience and those of their students. Participants are given 24/7 access to the online course for asynchronous study, reference, and use in the classroom. After going through the course and corresponding kit, instructors can request a hands-online session with a SCME coach. During the online session, they receive one-on-one coaching to answer questions and to ensure that participants are ready and comfortable before introducing the course/activity to their students. SCME has conducted in person workshops and training sessions in the past on the use of its materials, but the intent is that the Online Academy approach will enable SCME to reach a broader audience, increase exposure and opportunities for instructors to understand and use our materials, and reduce cost by eliminating the classroom setting. The asynchronous setting makes learning our materials convenient for everyone and the online coaching sessions also ensure that there is still the personal connection. As of February, 2016 there are over 100 participants from 24 states and 9 different countries. The online venue gives the microtechnology community the opportunity to share and learn from other participants from many locations worldwide.

Major Points: · SCME is using the distance learning platform to conduct hands-on professional development. · This venue enables SCME to reach a broader audience and increases exposure and opportunities opportunities for instructors to understand and use our materials. · Distance learning facilitates a community of practice among our users and allows them to share and learn best teaching practices. · We share our experiences with global participants. · We explore how hands-on concepts and methods are handled in a distance learning platform. · We explore how SCME designed its Hands-online Academy · We offer tips on how to develop distance learning courses with Moodle.

Summary: This presentation discusses how the Southwest Center for Microsystems Education has created a distance learning academy, how we have transferred our live hands-on workshops to online hands-on instruction, and how this has expanded our Community of Practice. The workshop audience will be provided with access to all of SCME's hands-online courses, and the opportunity to receive a free kit corresponding to each course. The kits allow participants to experience first hand the remote hands-online instruction that SCME's Hands-online Academy offers.

Thursday, November 3, 2016
Teaching Innovations (TI)

Self Regulated Learning Pedagogy for Teaching Applied Engineering and Technology Class

Author(s)
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Need: Metacognitive strategies are the intrinsic parts of a student's self-regulated learning (SRL) activities such as awareness of planning (setting learning goals), monitoring (self-testing), and regulating (determining the best way to learn). If learners know and apply these strategies in their learning, and are able to generate information about the efficiency of application of these strategies and successfully implement their findings in their ongoing and future learning processes, they are able to control and regulate their cognitive activities.

Overview: The SRL skills can be developed with various tactics, including activities that provoke the self-assessment or reflection of learning. Studies reported that when an instructor supports students to construct their SRL skills rather than predefined strategies, it bestow them better knowledge of course content. The four-phase SRL model has been implemented in computer aided drafting, a course of applied engineering and technology curriculum. Four phases are: 1) planning and designing, 2) identifying priorities and allocating resources, 3) self-monitoring, and 4) evaluating and controlling.

Major Points:

- Students were informed in advance to prepare for the coming quiz.
- They were asked to make self-efficacy assessments; measure confidence in correctly completing the quiz; plan for preparation for the quiz; identify learning priorities and resources.
- After finishing the quiz, students were asked immediately to make self-evaluative judgment on correctly completing the quiz again. Instructor graded the quiz and hinted correct answers as feedback.
- Additionally, students were promoted to think what strategy(s) did work well and to revise unsuccessful strategies.
- Students were informed again for next quiz where they should apply successful strategies, priorities and adopt learning resources. Instructor graded this quiz again and returned to students to reflect their SRL skills.
- Results of this study showed that the SRL can double the increase of students' quiz scores.

Summary: This paper reports implementation of the self-regulated learning (SRL), a teaching innovation pedagogy where test subjects and embedded prompts were designed to simulate the iterative cyclical progression of self-regulated learning processes. Findings of this study demonstrated the innovative method's positive impacts to student learning. It is intended to provide students with training and experience to efficiently practice and develop metacognitive strategies for a successful completion of an applied engineering and technology class.

Thursday, November 3, 2016

Teaching Innovations (TI)

Show and Tell: Making the Case for Competency Based Learning in a Networking Technologies Course

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Need: Competency-based education (CBE) has elicited strong interest among educators and education stakeholders due to its potential to meet students where they are in their education journey and provide a more personalized path to completion (Lebua, 2015). A typical CBE program has a curriculum structured to demonstrate learning in clearly articulated competencies, is often self-paced and has an emphasis on authentic assessment, which evaluates what the learner knows and can do through real-life demonstrations and projects.

Overview: The presentation will discuss the developmental process of creating competency based course material for a networking course. Factors considered in the development of course material will be presented, particularly as they relate to program outcomes and learning objectives. Implications for the traditional, virtual, and hybrid higher education classroom will also be shared.

Major Points: Pressure on education institutions from Department of Education and/or other government entities to offer more accessible and shorter education pathways (to a credential) to accommodate non-traditional learners. The non-traditional segment is a new and growing market of adult learners with prior skills and experience Expanding non-traditional student population who seek open, flexible learning Skills gap identified by employers High cost associated with higher education

Summary: The presentation will discuss the development of CBE modules for an undergraduate-level networking course. Also, the presentation will discuss the integration of the CBE modules for University of Central Missouri systems engineering and networking technology courses. Students' perceptions and learning experiences from the modules will be illustrated. Reference: Lebua, Mark. (2015, October 12). Competency-Based Education: Technology Challenges and Opportunities. Retrieved from http://er.educause.edu/articles/2015/10/competency-based-education-technology-challenges-and-opportunities

Thursday, November 3, 2016

Teaching Innovations (TI)

Student Certification of a Campus Building through the USGBC LEED® Lab™ Program

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Need: Technology programs are known for their applied learning approaches that develop solutions for real-world problems. The LEED® Lab™ program provides an opportunity for students to learn about sustainability while certifying an existing building on campus, providing actual project experience while simultaneously benefiting the institution.

Overview: The United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) certification program recognizes energy efficiency and sustainability in the built environment. Its new LEED® Lab™ program promotes sustainability at the student level through their participation in certifying a campus building through the LEED for Existing Buildings: Operations and Maintenance (LEED-EBOM) program. This program has been expanding and is now offered at 19 institutions worldwide. There are several approaches that have been used in implementing the LEED® Lab™ program on campus, and this presentation examines that developed by one institution that recently became the third LEED® Lab™ program to submit a building for certification.

Major Points:

- USGBC LEED® Lab™ overview
- Different approaches to implementation
- Course structure and process
- Certification process
- Planning and scheduling
- Challenges and lessons learned
- Conclusions and recommendations

Summary: Attendees of this presentation will understand how the one technology program successfully implemented the USGBC LEED® Lab™ initiative on campus, from course development through building submission.

Friday, November 4, 2016
Teaching Innovations (TI)

Teaching Industry Relevant and Application Oriented Skills in Automation and Control by Developing an Integrated Robotic Work Cell Using 6-Axis Robots, PLC, Conveyor and Sensory Vision System

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Need: There is an increasing demand for automation in the industry due to expensive manual labor and faster manufacturing processes. Therefore there is a need to educate future engineers in relevant to current industry needs automated systems which generally consist of Programmable Logic Controllers (PLCs), 6-axis Robots, Conveyors, pneumatic, sensors and vision systems.

Overview: Objective of this project is to develop an integrated work cell using 6-axis robots, PLCs, Conveyor, Sensors, pneumatics and vision systems for academic curriculum bridging the gap between industry and educational institution by teaching rapidly emerging technologies.

Major Points: This project develops and implements a robotic work cell to be used at Michigan Technological University to educate the engineering students in the field of industrial automation. The robotic work cell will be used to create hands-on activities based on different applications similar to the industry using PLC and FANUC programming, and train the students to improve their skills and knowledge in industrial automation. This system would provide the students with an opportunity to develop real time scenarios in material handling applications similar pick and place parts moving on a conveyor using sensors and vision systems, end-effector tools, hand shaking of two 6-axis robots and controlled by PLC. Training engineering professionals and testing them on different applications using a single work cell will help them to develop a holistic approach towards solving real time solutions in the automation industry.

Summary: In this paper we present the methods used to develop and implement a robotic work cell, and design techniques for pick and place application.

Friday, November 4, 2016

Teaching Innovations (TI)

Teaching STEM Using Electric Guitars

Author(s)
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Need: There appears to be no argument that our nation's students are deficient in the STEM skills needed to support a robust economy. Gender, socioeconomic, and racial inequality are especially visible when looking at the STEM skills gap. The STEM Guitar Project is focused on preparing teachers to teach the math and science using the guitar as a "hook". Why guitars? Because guitars are cool and students can easily make the connection with the iconic instrument. The enthusiasm for learning and relevance of STEM concepts are built in. Ideally, students fabricate guitars as part of a course but there are many levels of integration that can occur based on available funds, time, and facilities. The project has focused on preparing teachers of traditionally under-served students populations. Guitarbuilding.org is the home of the project where you can find more information, curriculum, and week-long training opportunities.

Overview: The National STEM Guitar Project, in partnership with NSF Advanced Technological Education (ATE) Centers with funding provided through a grant from The National Science Foundation (#1304405), hosts innovative Guitar Building Institutes around the United States. The 5-day institutes, combined with additional instructional activities comprising 80 hours, provide faculty training on science, technology, engineering and math (STEM) for middle, high school, and post-secondary faculty. The institutes present and teach participants hands-on, applied learning techniques to help engage students and spark excitement for learning STEM subject matter. The project is connected to industry through an advisory committee of industry professionals who ensure relevance of curriculum and STEM activities to industry demand.

Major Points:

- Project history and overview.
- Examples of STEM applications related to the guitar.
- Examples of project implementation.
- Resources on the Guitarbuilding.org website
- How schools can get involved in the project.

Summary: The STEM Guitar project is being implemented throughout the country and we're looking for more rock star teachers who want to connect their students to STEM. Consider attending a free summer workshop to get started.

Friday, November 4, 2016

Teaching Innovations (TI)

Transforming Technology Education for the Digital Age

Author(s)
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Need: Curriculum innovation is being driven by the needs of industry and delivered through curriculum and learning transformation that prepares a T-shaped professional. T-shaped professionals are characterized by their deep disciplinary knowledge in at least one area, an understanding of systems, and their ability to function as "adaptive innovators" and cross the boundaries between disciplines. The vertical bar of the "T" represents the disciplinary specialization and the deep understanding of one system. Systems describe major industry sectors, such as transportation, energy, design and manufacturing, food, and healthcare, that impact quality of life. The defining characteristic of the "T-shaped professional" is the horizontal stroke, which represents one's ability to collaborate across a variety of different disciplines.

Overview: The Purdue Polytechnic Institute is a bold initiative to address many of the pressing challenges facing higher education in this digital age and provide a better prepared STEM workforce for our nation through the transformation of traditional teaching and learning practices. It is attempting to transform higher education from within by changing an entire academic college with a total of 5000 students in West Lafayette and its 10 locations around the State of Indiana with about 250 faculty and 200 staff. We are guided especially by the works and research of the Association of American Colleges & Universities (AAUC) on "essential learning outcomes" which are best developed by a liberal education and their Key Findings from 2013 Employees. These essential learning outcomes are delivered through high impact teaching practices.

Major Points:
The college's transformation plan focuses on six intersecting areas with a goal to have most of our work completed by Fall 2017:

1. Curriculum Innovation
2. Teaching and Learning Method Innovation
3. Use-Inspired Research
4. K-12 STEM Education & URM Opportunities
5. Faculty Professional Development
6. Modernization of Learning Spaces

Summary: The overall goal is to prepare graduates as T-shaped professionals. T-shaped professionals are characterized by their deep disciplinary knowledge in at least one area, an understanding of systems, and their ability to function as "adaptive innovators" and cross the boundaries between disciplines.

Friday, November 4, 2016

Teaching Innovations (TI)

Transitioning to the Future: What Students and Employers have Taught Me About the Value of Co-ops and Internships

Author(s)
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Need: Even when schools do have the laboratory settings to simulate "real world" conditions, they can only approximate the working world so closely. There are workplace norms and nuances that can only be learned in a workplace setting. Furthermore is the added issue of employers expecting new hires to have years of experience in their field. Another difficulty that students face is making the necessary connections to professionals in the working world. Finally, the financial reality is that students have to work anyway to support themselves with the rising costs of college. Taken as a whole, this adds up to co-ops and internships being a good solution for college programs. This includes what Lester and Costley (2010) refer to as "learning that takes place at work as a normal part of development and problem-solving, in response to specific work issues, as a result of workplace training or coaching, or to further work-related aspirations and interests."

Overview: College programs are designed to help students transition from academia into their careers. While a good portion of those programs include foundational concepts and theories, as well as higher order thinking skills, the preparation can only extend so far in the classroom. Students can learn a great deal, and still maintain the support of their instructors, through internship and co-op experiences. From school to school, and even within the same school, there are great variations between these experiences. The fact remains; studies have shown that there is a real value to the co-ops. The students gain not only career experience during that time, but are often hired into full time jobs upon graduation or have an offer prior to graduate. In addition, employers have given the co-op coordinator a much better awareness of the skills and competencies they need in college graduates.

Major Points:

- College internships and co-ops have definite value from a variety of viewpoints, including students and employers.
- Being the co-op coordinator has value such as staying in touch with employers and the competencies they are looking for in our graduates.
- Students often get hired full time and/or receive beneficial references from their positions.
- Students can use the work they would already be doing as college credit to decrease the overall time they need to be in college.

Summary: This presentation will reveal an overview of the challenges and benefits of internships and/or co-op experiences in college programs. A student's perspective, and how the co-op/internship experience can help with career clarification and specialization will be included. In addition, how it enhances the knowledge of the co-op coordinator for curriculum development will be discussed.

Friday, November 4, 2016

Teaching Innovations (TI)

Using Video and Voice to Enhance Assessment in a Flipped Introductory Manufacturing Processes Class

Author(s)
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Need: Challenges introduced in an online assessment can degrade from the assessment of subject matter competency. Creating alternative techniques that will accurately assess competency while minimizing academic dishonesty requires thoughtful planning and innovative solutions. This study addresses online assessment challenges through the use of audio and video assessment techniques that will provide verification of competency, engage the learner, and reduce the "collaborative assessment" issue using tools that are available at most institutions.

Overview: The entire purpose for flipping a course is to create more opportunity for students to receive experiential learning by increasing time in the labs, and minimizing lecture and assessment time in the classroom. Difficulties arise any time that assessments go online due to the loss of control in the assessment environment. Developing strong assessment techniques that will measure learning outcomes, balance examination weighting across the entire class while creating randomized response solutions is improved by using video questioning and audio response techniques. While the process to convert exams to this format is laborious it enhances the assessment process, makes assessment more interactive for the student, and provides a valuable tool that does not drastically burden the instructor's time associated to grading competency assessments. This study will introduce how the use of innovative technologies Voicethread, Camtasia, and similar tools were used to create online quizzes and assessments in an introductory manufacturing processes course to move PowerPoint presentations, prior knowledge assessments, and competency examinations into a course management program to maximize laboratory activity time. Student's response to this change is showing a positive reception early in the study, and assessment grading time has been reduced.

Major Points:
The major impact for instructors wishing to move course-work online includes:

- Improving the assessment experience for students
- Increasing assessment options for the instructor
- Utilizing voice-over and video in the assessment process
- Enhancing the assessment process without increasing the grading burden
- Providing online assessment methods that address some of the problems relative to online assessments.

Summary: The online assessment experience can be enhanced through the use of audio and video tools like Voicethread and Camtasia and reduce some of the issues commonly associated with online assessments. Students and instructors can both benefit from this technique through increased time for lab activities while providing a strong assessment tool that works to minimize compromising the quality and security of the assessment.

Teaching Innovations (TI)

Virtual Production Line Development

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Need: The incorporation of new technologies and technological developments in automation and control demand constant education and/or training of personnel in this area. In either of these cases, the aim of personnel involved is to learn and/or bring their knowledge up to date in one or several of the following topics: PLCs - Ladder Language. - Learn and program in commercial programming environments (AB: RsLogix, Siemens: Stp7, etc.). Communication Protocols. - OPC - Modbus - DLLs - Commercial protocols (DeviceNet, ControlNet, Profibus, etc.). SCADAS - Commercial Brands (RSview32, Simatic, etc.) - Desarrollar SCADAS mediante lenguajes de alto nivel(C#, VB.NET)

Overview: This training in automation is currently offered in laboratories at educational institutions and centers for personnel training. Unfortunately, these places are limited in infrastructure and thus restricted to the use of only a few actuators and sensors and in the best of cases, test sets where certain mechanisms are involved in practice. This results in knowledge that is limited to the equipment installed in the labs, which translates to a lack of experience when faced with complete lines of industrial processes. Another source of training is that which is offered by the company itself lead by specialists in the area. This is done usually when a new member joins the team or to update internal personnel. It is a practice in which those involved already know the real process and its sequences. Unfortunately, in this type of training, the active participation of the trainee is restricted due to the fact that errors in programming could result in economic losses and in the worst cases, disasters that compromise the security of the personnel involved. In response to these disadvantages software has been developed to simulate environments where elements such as mechanism, actuators and sensors are all incorporated yet the majority of these software don't take into account the physics of the environment and its components (gravity, moment and momentum of inertia, mass, etc.), including the real sounds of the process that would allow the programmer to really submerse themselves in the virtual environment.

Major Points: In response to these needs encountered in training in the area of automation and control, the Engineering and Technology Management Department of Morehead State University presents the development of virtual laboratory of industrial scenarios; a laboratory in which the components possess the physical and electrical characteristics of industry thus also behaving similarly to real life situations.

Summary: Automation is an area that is in need of constant update with the development of new technology. In order to keep up with these changes, constant training both in the class room as well as on the industrial environment are needed. For this reasons, institutions, schools and training facilities must do a better job at providing adequate training. There are several factors that have hindered good development and training, like the shortage of sensors, actuators and prototypes. Without these, the students are limited in their development of new processes and ideas that could further development in the industrial sector. The Engineering and Technology Management Department of Morehead State University has developed virtual laboratories with industrial scenarios specifically designed for application in the teaching of subjects related to automation and control. With this development educational institutions will have the ability to impart knowledge without needing to acquire the hardware and actuators needed to implement it. Furthermore, the participants will be able to automate real lines and processes with scenarios that can vary the complexity of the sequences depending on the knowledge level of the trainee. Another advantage of this tool is the ability to operate a process while at the same time eliminating the financial and safety risks that inevitably present themselves when the parameters of control are altered. This laboratory can interact with any brand of PLCs that has communication by OPC and DLLs. This offers flexibility in the teaching of courses in control and industrial automation. This environment is based on the simulation of processes where the physical aspects and dynamic behaviors of the real models such as objects, actuators, sensors and the environment, are represented. With this development the hope is that the educational institutions and centers are able to adjust to the types of controllers that currently exist in the market. The PLCs can also use their I/O to interact with the virtual process that serves as a training scenario. These flexibilities allow the learning process to more closely resemble reality.

Thursday, November 3, 2016

Teaching Innovations (TI)

What Factors Influence the Decision-Making Process of Undergraduate Students?

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Need: The National Science Foundation and others have reported on the importance of critical thinking in STEM fields. One important aspect of critical thinking is the ability to defend and justify a decision choice. An analysis of decision-making data collected in 2015 found no significant relationship between professional work experience and the decision-making process of undergraduate students in a quality management course. This study is a continuation of the 2015 study, but the analysis will focus more on how well students can explain and justify their decision choice. Little is known about the effects of professional work experience on how students seek information when making a decision or how well they can justify their choice. The goal of this continuing research is to understand how work experience influences the decision-making process and critical thinking on that process in undergraduate students.

Overview: This presentation will discuss the use of a decision analysis methodology to identify differences in the decision-making process of students who have had an internship experience and those students who have not. Results from qualitative data such as which information was most important to the students' decision choice will also be shared. Finally, implications for further use of the data will be shared.

Major Points:

- Role of internship experience in knowledge creation
- Defining internship experience in this research
- Influence of internship experience on the decision-making process
- Measuring post-decision justification and reflection
- Implications for future use of internship and decision-making knowledge

Summary: The audience will learn about how internship experience influences the student decision-making process. Measurement of internship experience and decision-making components will be discussed. Implications of use for educators and industry will also be shared.

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Entering the Future

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TEACHING INNOVATIONS (TI)

Filling the Gap between Industry and Academia: Teaching Critical Skills in Automation and Control using Developed, Open-Source Programmable Logic Controller Software

Dr. Aleksandr Sergeyev, Michigan Technological University, Houghton, MI
Dr. Nasser Alaraje, Michigan Technological University, Houghton, MI
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Introduction

With current advancements and re-configurability of manufacturing, the Programmable Logic Controllers (PLCs) become an integral part of nearly all today's industrial processes. There are few major PLC makers such as Allen Bradley (AB), Siemens, Modicon, ABB, Mitsubishi, GE, Omron, Bosch, Fuji and Toshiba, but AB pertains about 80 % of the market share in the United States. For the past 30 years, the AB PLC solutions have significantly evolved from PLC-2 all the way to PLC 5000 series with several configurations being in between. The most up-to-date AB PLC has endless functionality including, programming with functional blocks, multitasking, and communication capabilities. It is also very common that PLC systems are integrated with robotic solutions to enhance automation processes. As a result, the skills of newly employed industrial workers must include the knowledge of PLC and Robotic systems, as well as how to integrate these two systems together in one efficient automated process suiting the requirements of modern industrial environment.

In recent years, there have been significant changes in engineering education, especially in electrical and computer engineering fields, both in terms of the content and its delivery. With the advent of computers, learning through computer-based environments has dramatically increased(Aydogmus & Aydogmus, 2009) and (Toral, Barrero & Martínez-Torres, 2007). Web- based presentations of introductory PLC concepts are relatively easy to find(Hsieh & Hsieh, 2005), ("Siemens Basics of PLCs course", n.d.), and ("Forum.MrPLC.com", n.d.). There are several web sites that provide free PLC information such as book chapters, programs for download, and online Q&A (Hsieh & Hsieh, 2005) and ("Forum.MrPLC.com", n.d.). The Grand Valley State Michigan Tech has a free downloadable e-book ("PLC Book", n.d.). However, tutorials that provide opportunities for practice with feedback are harder to find, and tutorials that adapt practice and feedback to the needs of individual learners appear to be non-existent. Some web sites provide ladder logic editors free downloads ("Global Controls", n.d.) however, not all of these editors simulate program execution. A non-web-based commercial software LogixPro, available for low cost, provides a good PLC simulation environment and comes with various animations for various processes, such as traffic control and batch mixing, I/O configuration. This well design software demonstrates how a ladder logic diagram relates to an automated process (Hsieh & Hsieh, 2005) and ("TheLearningPit - PLC Simulators and Resources for Training.", 2016), however LogixPro does not provide the basics on fundamental knowledge, such as Boolean algebra, digital gates, ladder notation, wiring, and syntax of individual instructions.

Blakley and Irvine report development of PLCSIM, a PLC simulator designed to assist in teaching ladder diagram programming, and PLCTUT, a multimedia teaching package that uses audio, video, and animations to teach about PLC hardware and programming (Blakley & Irvine, 2000) and (Hsieh & Hsieh, 2005). However, their systems are tightly linked to a particular brand of PLC, the Toshiba EX20PLUS.

The Electrical Engineering Technology (EET) and Computer Science (CS) Department at **University** collaborate with **Community College** to develop and implement the open source, multi-level, interactive PLC software to be used at various educational levels spanning from high schools to four year colleges and displaced workers wishing to improve their knowledge in PLC. The main objective of this project is developing multlevel PLC simulation software so students can select the most appropriate level of difficulty that fits his/her knowledge. For example, it needs be flexible enough to be used to get high school students interested in programming PLCs, could be used to train displaced workers seeking a certificate or two-year degree, or be used in more advanced courses that are part of a four-year degree. Each level of the learning module includes multimedia materials, including video, audio, and/or electronic documents, which introduce the content presented in the module. Considering common utilization of Allen Bradley PLCs in industry, it has been chosen as a base platform for the developing simulation software. However, the basic skills that the students learn while completing the learning modules would be easily transferable to other systems.

Open-Source Software Development Model

This project aims to develop a free and open-source web-based simulation software that introduces students to PLCs and SCADA systems. The software can be used by both, the general public wishing to improve their PLC knowledge and by instructors who wish to use the website in conjunction with a course at a university or community college. Highly customizable software allows course instructors to use it in various ways: to log in and adapt specific curriculum modules and make them available to the students; monitor the progress of the individual students through the course; and use the system in course labs where students can cooperate to quickly and accurately complete problems and modules.

A team consisting of faculty members from both departments, graduate and undergraduate students develops the software that powers the website. The multidisciplinary nature of the overall project involves giving computer science and engineering students the opportunity to work together. One of the goals of this project is to make the website flexible enough to run on a variety of computers without the need to install any software. Authors selected using the HTML5 standard recommended by the World Wide Web Consortium. The JavaScript programming language has been used to allow users for interaction with the software. To speed up the development process, authors use open source libraries. For simple web component like dialog, tab, button, drag & drop and widgets, the popular and well-documented jQuery library has been chosen for implementation, and utilization of jsPlumb provides the ability to connect web components with style lines. The last capability is useful when drawing a logic diagram or using ladder logic to program a PLC.

The developed PLC software consists of nine main curriculum modulus and three supplementary modules as shown in Figure 1. The main modulus 1-9 are devoted to general concepts that every student needs to know to become proficient in programming PLCs. Module 10 teach students additional skills of PLC installation, troubleshooting and safety. In module 11, concept of Supervisory Control and Data Acquisition (SCADA) with implementation of Human Machine Interface (HMI) is presented. Lastly, in module 12, students have an opportunity to test their knowledge working with fully simulated water treatment facility and conduct programming of its components and also run and troubleshoot its operation directly from the system HMI. Next, authors provide brief description of the content covered in each module.

Module 1 focuses on the binary number system and memory. The interactive aspects of this module focuses on teaching the user how to manipulate this number system. This module teaches concepts of the number system and codes using gaming approach designed to help the user become familiar with converting base ten numbers into base two, binary numbers. Sample screen shoot of Module 1 layout is shown in Figure 2.

Module 2 interactive portion consists of two portions: "test your knowledge" and a logic circuit simulator. The "test your knowledge" portion displays logic circuits to the user and ask them to input the truth table. The circuits are ranked in difficulty and the overall difficulty is weighted as well. The program randomly selects circuits from a pool of circuits and populates the quiz with the circuits selected. The difficulty weight keeps the program from selecting too many easy or hard circuits for the selected difficulty. The second portion of Module 2 is a logic circuit simulator. This simulator has two modes: problem solving and sandbox. In problems solving mode the user has to construct logic circuits from pre-determined toolbox to perform certain tasks.

Figure (1): Layout of the PLC Web-Based Simulation Software Main Page

These tasks are determined by "user requirements," essentially word problems. The user has to interpret the description, wire the circuit, test it, and submit it for approval. If the circuit is correct, then they move on to the next problem. The sandbox mode allows the user to create logic circuits of their own choosing. This model encourages learning through experimentation. This also allows any instructor utilizing the program a basic program to perform a logic circuits lab.

Figure (2): Sample Screen Shot of Module (1) Layout

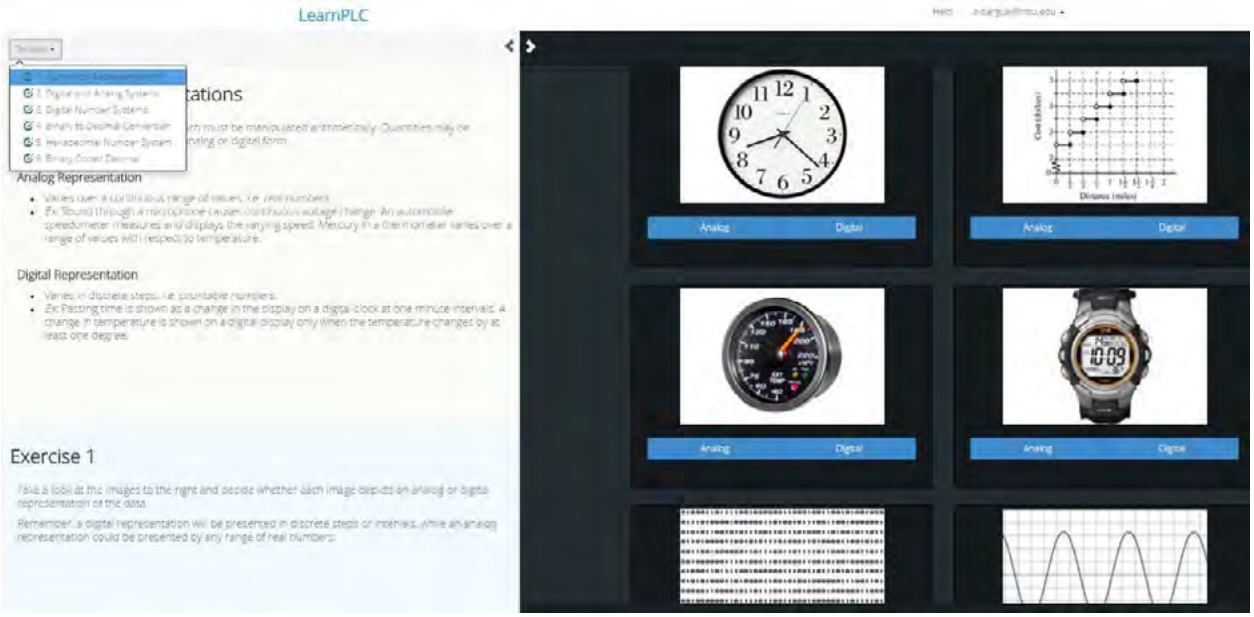
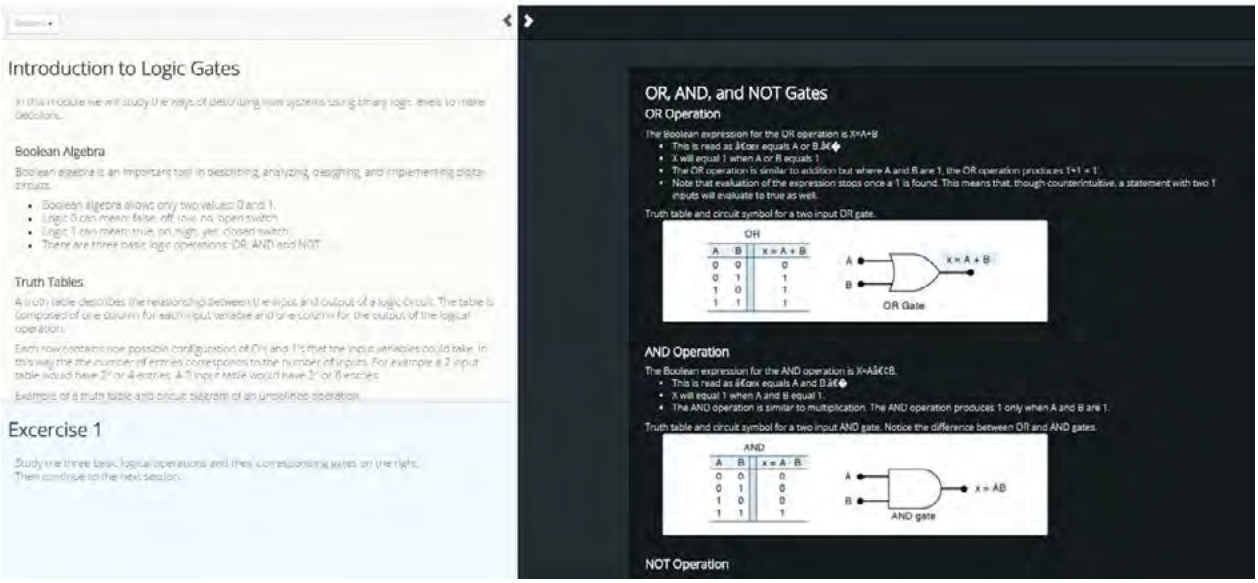
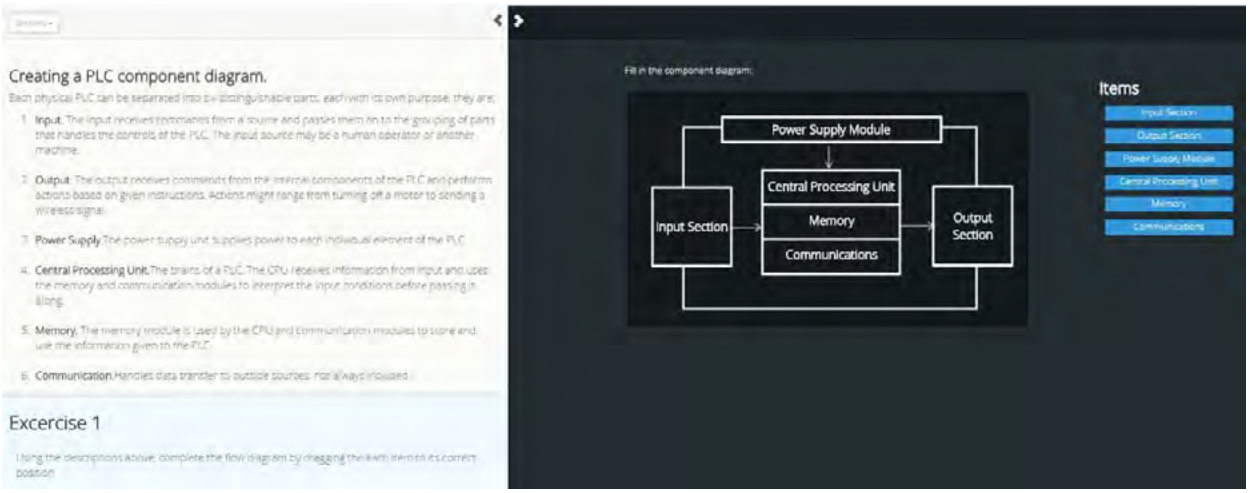


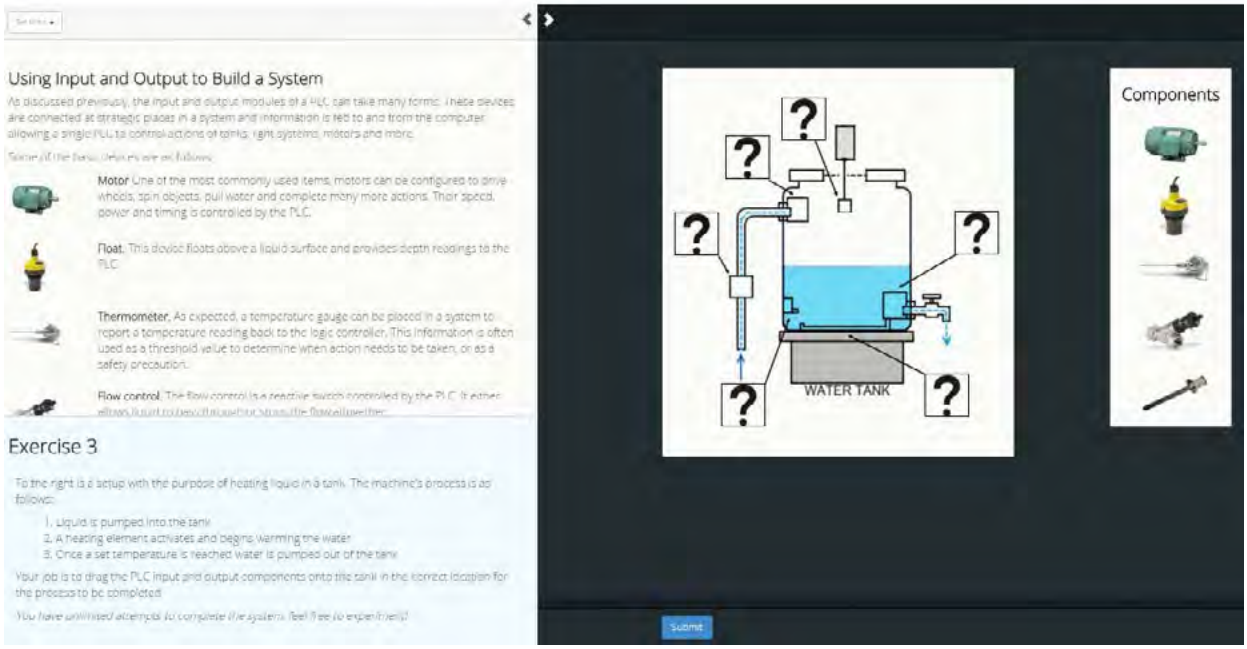
Figure (3): Sample Screen Shoots of Module (2) Learning Materials



Module 3 revolves around the physical parts of the PLC and input/output devices that are typically used with PLCs. Users have to identify the various parts of a PLC, sensors, and output devices. There is also an assignment where the user has to select the proper device based on a description provided. Figure 4 shows learning modules of Module 3. The upper picture shows PLC components design and the one below demonstrate the physical systems of tank filling application and how the PLC can be used to control it.

Figure (4): Sample Screen Shoots of Module (3) Learning Materials





Module 4 introduces the virtual PLC system where the scenarios focus on programming in ladder logic. The module starts by asking the user to build programs in ladder logic to mimic logic gates and circuits. Once they have mastered converting logic circuits into ladder logic, they are assigned to solve word problems. All these problems focus on the "examine if open" input, "examine if closed" input, and general outputs. The user learns how to use branches and latch an output on. A very simple sandbox mode is implemented as well.

Module 5 Teaches concepts related to Timers. In this module, the user starts with timer basics learning how to configure PLC timer instruction and further continues with On-Delay, Off-Delay, Retentive and Cascading timers. Each section of this module is accompanied with few exercises.

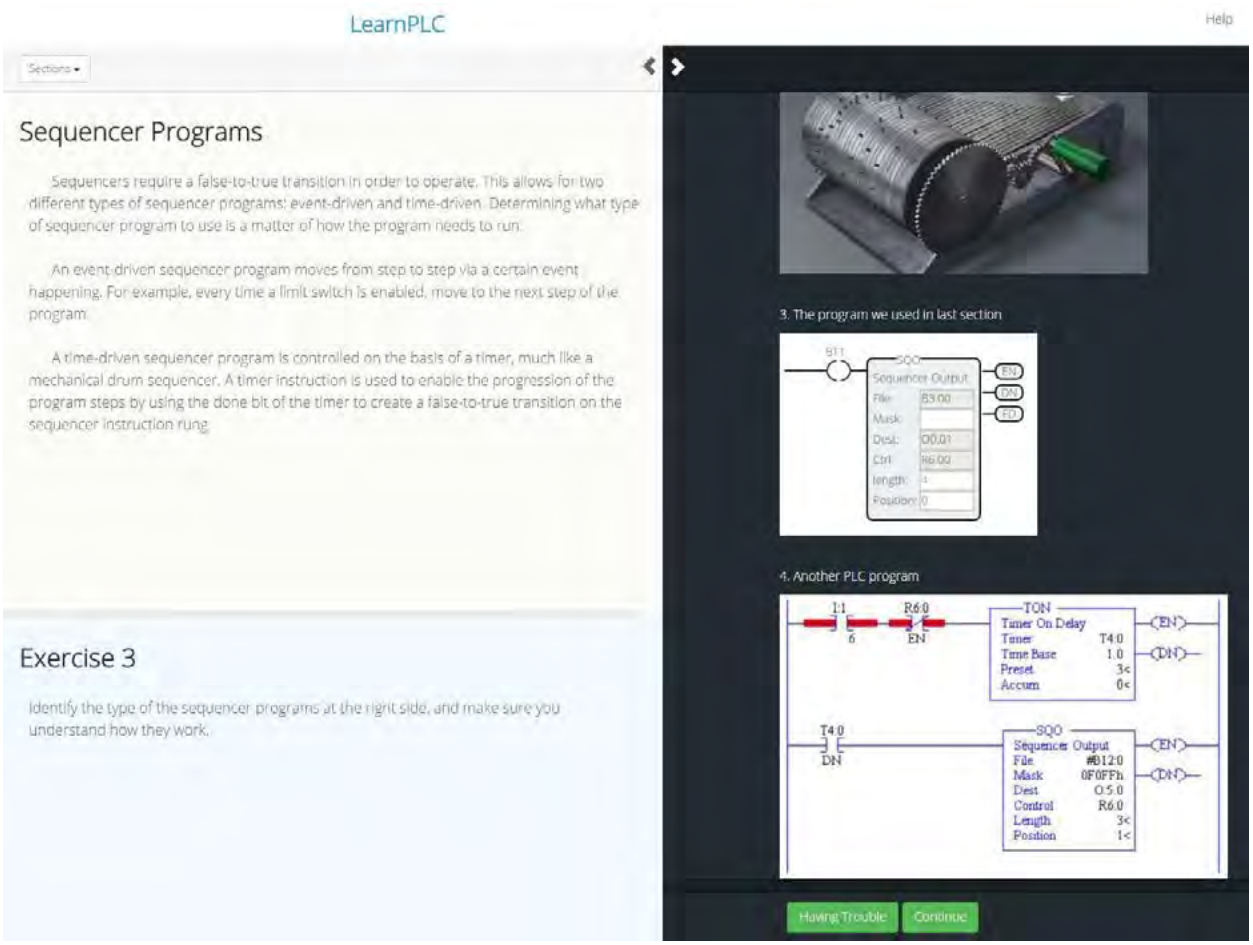
Module 6 Introduces concept of Counter PLC instruction and its syntaxes followed by specialized Up- and Down-Counter instructions. Concept of cascading counters to achieve higher count limits is also presented in this module. Module culminates with exercises requiring combining Timer and Counter instructions for proper execution of presented to the user scenario.

Module 7 is devoted to the Sequencer and Shift Register instructions. To provide an easy understanding of a subject matter a mechanical sequencer analogy is introduced first. Once concept is comprehended, the PLC Sequencer instruction is introduced along with detailed instructions on how it should be properly configured to use with Ladder Logic. Considering that concepts of Timers and Counters were covered in the previous modulus, exercises that are more comprehensive and require more in-depth understanding of various PLC instructions are introduced to the user.

Module 8 consists of 5 sections covering the following program control PLC instructions: Master Control Relay (MCR), Jump, Subroutine, Immediate Input (IIN), Immediate Output (IOT), Selectable Timed Interrupt, Fault Routine, Temporary End, and Suspend. The rationale behind each instruction is explained first, followed by various application scenarios and exercises for the user to practice and reinforce priory received theoretical knowledge.

Module 9 teaches commonly used in PLC programming mathematical instructions such as addition, subtraction, multiplication, and division. A word-level instructions including square root (SQR), negative (NEG), clear (CLR), binary coded decimals (BCD), and scale data (SCL) are introduced as well. As in previous modulus, the concept of reinforcing theoretical knowledge by means of exercises and case scenarios is extensively used in this module.

Figure (5): Sample Screen Shoots of Module (7) Learning Materials



Module 10 covers important concepts of PLC installation, troubleshooting and safety. It starts off explaining requirements and proper codes to follow while installing the PLC in industrial environment. Considering universal nature of the PLC in terms of receiving and sending various AC and DC signals, which may be susceptible to electromagnetic interference, models of electrical noise and leaky inputs and outputs, are explained and followed by proper grounding, voltage variations and surges. Also, concepts of program editing, monitoring, as well as necessary steps to properly commission the system are explained. The module culminates by outlining preventive maintenance and troubleshooting procedures commonly employed in PLC industry.

Module 11 is devoted to the following subjects: human machine interface (HMI), supervisory control and data acquisition (SCADA), data communication, and networking schemes. The last discusses the following: Data Highway, Serial Communication, DeviceNet, ControlNet, EnterNet/IP, Modbus, Fieldbus, and Profibus. Even though this module is more on the theoretical side, the user is still required to complete several exercises and check the subject comprehension by answering several question.

Module 12 is a specialized module devoted to the water treatment facility and how PLC and SCADA is used for its proper operation. In the introductory part of this module, the user studies a basic water treatment system and its parts before presenting an interactive HMI simulator with scenarios that simulates the water treatment process. The basic water treatment system shown in Figure 6 has three parts: a Pump House, Filter Tanks, and a Water Tower. The pump house is the first stage. It draws water from a river and passes it to the filter tanks. A filter tank receives the water from the pump house and uses a filtering system to clean the water. There are always at least two filter tanks in a water treatment system. This is so that filtration can continue even if one of the tanks is malfunctioning. After the water is cleaned, it is pumped out to the water main with some being diverted to a water tower. The water tower stores the clean water to maintain water pressure in the water main. This pressure should run about 50 to 100 psi with about 600 gpm, gallons per minute. Upon studying the structure of the water treatment facility, the user is required to match the names of the three parts of a water treatment system to the diagrams and provided descriptions. Once this introductory task is successfully completed, the user is introduced to details of the system components and their operation. The system components are: Pump House, Filter Tank, Backwash, Water Tower. While studying the system components, the user is tasked to correctly answer sort test questions and complete some short simulation assignments. After the comfortable level of operating these system components is achieved, the user is provide with two exercises: Backwash with HMI and Backwash with Error HMI. In the first assignment, the user is asked to complete to complete water tank backwash procedure using HMI according to the following instructions:

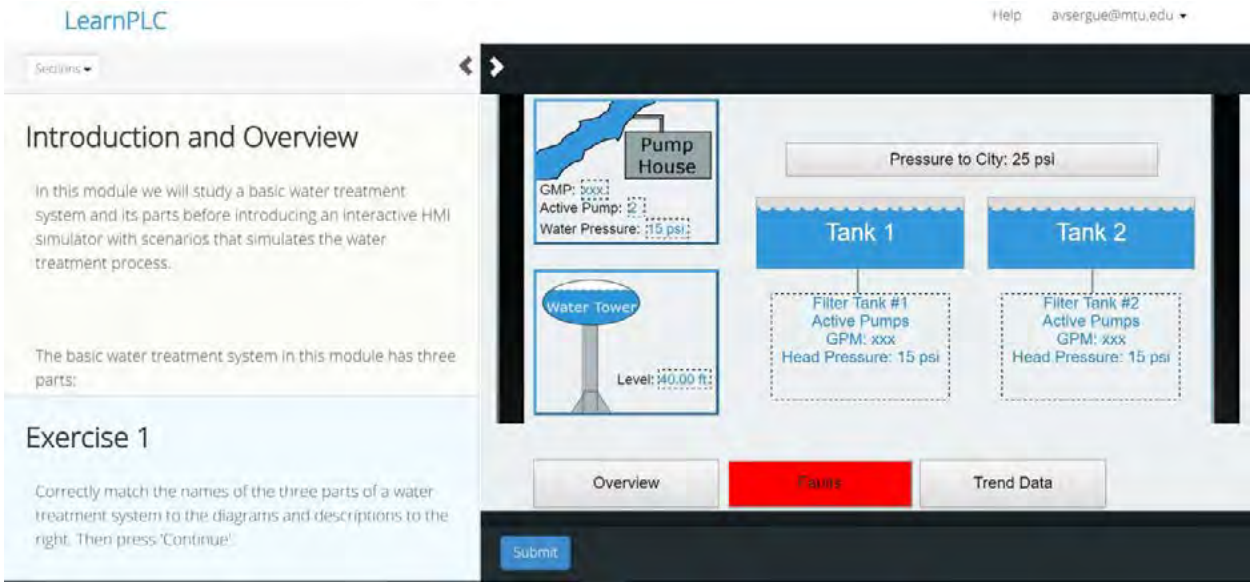
"During your duty at the water treatment plant you notice the outflow pressure is low. You must perform a baskwash on the system and return it to normal. Turn on and off the pumps and valves in the correct order to begin the backwash. Once the backwash animation begins, wait a few moments and then click on the dirty water drain pipe to 'clear' the debris. Turn on and off the pumps and valves again until water is filtering through the system normally again. If a step is missed or performed in the wrong order, the system will reset and you must begin again. When you have accomplished this simulation, press 'Submit' and then 'Continue'"

During the second exercise, the user needs to perform the same backwash procedure but the HMI being in the faulty state which must be analyzed and fixed. The faults can be related to two causes: the physical part is broken or an HMI encountered. In each case must be repaired before use of HMI and backwash procedure can be performed. Below is the task received by the user:

"During your duty at the water treatment plant you notice the outflow pressure is low. You must perform a backwash on the system and return it to normal; however, during the process, a fault occurs. During this simulation, either the HMI or a random physical part will break and turn red to indicate that it is not working. In order to correct this can continue, you can press either the red "Send an Engineer" button or the dark blue "Refresh the HMI" button. If you refresh the HMI and the corresponding button is not green, then you must send the engineer to fix it.

If you send the engineer and the corresponding button is not green, then you must refresh the HMI to fix it. Once the buttons light green, you can continue as normal.

Figure (6): Exercise for Water Treatment System



Website Registration

The developed software represent different levels of difficulty and students can select the most appropriate version of the module for their knowledge base. Each learning module includes multimedia materials including video, audio, and/or electronic documents that introduce the content presented in the module. While progressing through each module, students can assess their comprehension of the presented material using computerized tests testing.

The learning system hosted by ***University*** is freely available for anybody around the world to use over the Internet. Below, are the steps needed to successfully register and use this software package:

URL: https://plc.csl.mtu.edu

1. Create a user account
   - Click on Register Here
   - Use your Email to register a student account with Course Code left blank, there is no benefit to register as an instructor.
   - Go to your Email, and click on the link of the confirmation email to activate your account.
   - Go back to the website https://plc.csl.mtu.edu. Login to your account.

2. Learning Modules
   - To access each module, simply click on the module blocks.
   - A module is divided into multiple sections. Each section page consists three areas.
   - You can click on the small arrows to expand either reading area or the exercise space.

3. Go through modules and learn PLC
   - If you are using this for a course, please follow the instruction of your course instructor.
   - Recommended learning steps are:
     - ◊ Follow modules and sections. For each section, do the reading first, and then read the exercise description and complete the exercise at the right side.
     - ◊ If you encounter any trouble, click "Having Trouble" buttons for hints.

Conclusion

Academic programs at **University** are designed to prepare technical and/or management-oriented professionals for employment in industry, education, government, and business. The Electrical Engineering Technology (EET) and Computer Science (CS) Department at the **University** are collaborating with **Community College** to develop a PLC curriculum to help solve the current shortage and future expected growth in control engineering professionals required to have relevant and up-to-date PLC skills within the State and beyond. This project develops and implements the open source, multi-level, interactive PLC software to be used in high schools, two and four year colleges, as well as to training the displaced workers wishing to improve their knowledge and expertise in the subject matter and to meet the changing needs of the industry. The developed PLC learning system has been tested at **University** during two introductory PLC class offerings in Fall of 2014 and 2015. The collected feedback revealed that the software is very friendly and very easy to use. In addition to these features, students also emphasized that it serves as a good complement to the theoretical and hands-on parts of the course. In addition to the collected feedback, the designers were able to troubleshoot few software related issues and clean up few "bugs".

The learning system is hosted by **University** and made freely available for anybody around the world to use over the Internet. At **University**, we plan to integrate the materials into high school outreach programs and into PLC courses. College and other interested instructors or students will be able to use the material independently or in conjunction with a class. When the system is used in conjunction with a class, instructors will be able to connect with their students and monitor their progress. Given the remote location of **University**, this online PLC education system will allow us to reach a much larger audience. We will solicit feedback from the people who use the system and make improvements based on that feedback. Besides the benefits to the students who use the proposed PLC learning system, the project will also give undergraduate and graduate students hands-on experience working on a large-scale project with multiple people that span different disciplines. We hope that these hands-on experiences will encourage students to think about how they can use their own skills in an entrepreneurial way to improve the lives of others. We also plan to build student competency by structuring some of the learning modules as games where students can work collaboratively or competitively to solve PLC programming challenges. We plan to use metrics such as the time it takes to solve a particular problem as well as the complexity or efficiency of their solution as game metrics.

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ADMINISTRATION

Creating a Cyber Security Major in a Liberal Arts Institution

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Introduction

In 2014, it was reported that the Pentagon repels over ten million hacking attempts per day (Bender, 2014). In the same year, the state of Utah repelled up to a reported three hundred million hacking attempts per day (Davidson, 2015), up from twenty million hacking attempts per day in 2013 (Park and Cawley, 2013), likely due to the new NSA computer center in that state. The field of cyber security has been growing rapidly over the past two decades as is the need to have qualified, educated and properly trained cyber security analysts who can use the most current technology to reduce breaches and apprehend perpetrators is crucial. Lau and Davis (2011) assert that experts agree that the challenges of cyber security must be met with formal educational training in the field. As a result, college degree programs in some type of cyber or network security have increased dramatically in number.

In colleges and universities, curriculum development always has its challenges and creating a technology-based major at a traditional liberal arts undergraduate institution brings unique circumstances that must be addressed. These challenges include the program's disciplinary focus, contextual interdisciplinary learning, connections with local industry, considerations of college policies and politics, a non-technical seminar, and delivery options. This paper will address the current state of undergraduate level cyber programs before speaking primarily to the challenges that may arise in liberal arts institutions.

Current State of Undergraduate Level Programs

The primary goal of curricular development in higher education is to meet the needs of that specific discipline and as important, the job market. This holds true regardless of whether the discipline is in the humanities, social sciences and hard sciences, or the technologies. Along with the well-rounded nature of a liberal arts curriculum, graduating students must possess the knowledge and skills to succeed in their chosen field. Higher education curricula must fulfill this goal.

Cyber security programs in higher education are no exception. Fourteen years ago, Myers and Myers (2002) suggested that criminal justice majors include components in computer training of some kind, even before the meteoric rise of cyber security majors across the country. Now those skills are more valuable than ever, as evidenced by the rapid proliferation of college- level cyber programs, the relative inadequacy of current workforce, and strong employment projections over the next five years.

Security and privacy have become the one of the most complex and pressing subjects of information technology. From the demands of government to the nature of the information age itself, employers, including the government, are faced with serious challenges of how to obtain a reasonable balance (security versus the cost of security) with dwindling resources. Experts agree that obtaining this balance will be found in education as information technology now plays a crucial important role in modern education (Lau and Davis, 2011).

When examining the broad spectrum of cyber degree programs in existence, there seems to be more differences than similarities. Even in name, programs diverge. Information assurance, information security, cyber security and network security are among the more popular program names. In relation to courses in majors, all have a requisite amount of technical courses but they differ substantially in total (and technical) number and in disciplinary focus. For example, many have a broad range of fundamental technical courses while others move directly into the courses that allow a student to become technically proficient in specific cyber-investigatory processes (see Lau and Davis, 2011 for a review).

One of the major differences revolves around the inclusion of interdisciplinary content and courses in the curriculum. Many undergraduate programs are solely technical while others have ethical and writing components. Fewer programs are truly interdisciplinary and do not have required or elective courses in criminal justice, political science, or accounting. This even after scholars have suggested that the legal, ethical, political and geographical issues that arise with cyberspace must be addressed in undergraduate programs (see Higgins, 2014, Smethers, 1998).

Considerations for Curriculums in Liberal Arts Institutions

Computer Forensics Versus Network Security

In the realm of cyber security, there are two distinct areas of study. The first area focuses on computer forensics. Computer forensics includes the gathering, processing, and analysis of digital evidence and the analysis of digital devices. Digital evidence includes electronic documents, call logs, cloud data, GPS tracking data, digital photographs and more. Digital devices include desktop and laptop computers, USB drives, cell phones, GPS devices, digital cameras, servers, video game consoles, and portable media players. Any of these devices could hold evidence germane to a criminal case or corporate investigation and analysts must be prepared to collect and analyze digital evidence, regardless of form. In short, the goal of computer forensics is to find evidence left behind on digital devices of any kind.

The second area focuses on network security. Rather than collecting evidence left on digital devices, network security is the process of detecting and preventing unauthorized use of networks and computers on networks. Prevention measures help stop unauthorized users from accessing any part of a network for malicious purposes and detection helps to determine whether or not someone attempted to break into a network, if they were successful, and what they may have done.

Of these two distinct subfields, the latter is where job candidates are most sought out and where curriculum formation should focus. While a network security analyst must have a computer forensic background, the interconnected nature of technology will only continue to grow and those educated in cyber and network analysis will have stronger employment opportunities. For example, in 2015, Cisco reported that there were approximately one million unfilled security jobs worldwide (Cisco Security Advisory Services, 2015) and the demand shortfall by 2019 is estimated at one point five million jobs (Morgan, 2016). Morgan (2016) also predicted that the job market for cybersecurity is expected to grow to $170 billion by 2020. When designing a curriculum this arena, the primary consideration should be which direction the major will take within the two realms of high technology crime investigation. While having courses in computer forensics can balance out a strong curriculum, the primary focus should be on network security.

Interdisciplinary Nature

Formation and delivery of a primarily technical-based major while maintaining an interdisciplinary nature is crucial but requires communication and collaboration with faculty from other departments, including philosophy, business, criminal justice, accounting and political science (Curtis, 2008). Myers and Myers (2003) stated that someone who investigates high technology crimes should have the background and a baseline knowledge in criminal justice and criminology, principles of accounting and auditing, and computer operations and technology. Even as far back as 1999, forensic accounting and economic crime undergraduate programs have included ethical components and have focused on the importance of interdisciplinary curriculum (Curtis, 2008).

The fact that high technology crime has grown in prevalence and complexity coupled with the fact that the ramification for breaches could have significant impact (i.e. critical infrastructures), the need to have a broad base of knowledge is crucial. In other words, it is not only important to have the technical skills, one also needs investigatory skills and the ability to put the crime into context culturally, criminologically, and politically. An understanding of why a cyber crime may have been committed can be germane when examining the available digital evidence. This could be gained from courses in criminal justice, political science, philosophy and accounting, among others.

The education that undergraduates in technical majors receive must adequately prepare them for the workforce in a more inclusive manner than simply conveying technical skill sets. Soft skills (such as teamwork, verbal and written communication, time management, problem solving, and flexibility), personal attributes (such as risk tolerance, collegiality, patience, work ethic, identification of opportunity, sense of social responsibility, and appreciation for diversity) (see The Joint Task Force on Computing Curricula Association for Computing Machinery IEEE Computer Society, 2013) and a knowledge of the criminal justice system play a critical role in the cybersecurity workplace. A cyber curriculum in a liberal arts institution should follow the principles of being well-rounded, especially in liberal arts institutions, which actively seek to produce well-balanced graduates.

Connections with Local Industry

For this type of major where technical skills are of paramount importance, it is crucial that the college and faculty actively promote and sustain connections with local industry to facilitate paid or unpaid internship opportunities for the students. There has been wide support in the literature for student internships in their major field of study (see for example George et. al, 2015, Ralevich and Martinovic 2012). They provide students with experiential learning and allow for real life application of content specific knowledge from their coursework. Moreover, they allow students the opportunity to understand what the job environment consists of and give a strong advantage when seeking employment since an employer has already experienced what the student has to offer. In short, internship experiences augment the resumes of students by giving them actual, relevant experience, while enhancing their professional network (Burke and Carton, 2013).

For those already involved with experiential learning opportunities for students, the benefits of internships for those students are not surprising. For colleges and universities, the commitment must be present not only in the institutions internship/career office, but with the relevant faculty as well. Both must work to develop strong connections with employers who can provide opportunities with students. With this type of major, the possibilities are wide ranging. Focusing on only cybersecurity firms would be short sighted and instead, college representatives should make connections with organizations that have a network to protect. While this may exclude the smaller businesses with no IT department, organizations with an IT department could find a substantial need for strong interns. On a final note, the search for potential internship sites should be an ongoing process since sites will begin to be over-utilized.

The Environment at the Institution

Challenges arise when new majors are being proposed in smaller, faculty governed liberal arts institutions, especially when those new majors are more technical or vocational. It is difficult for many faculty, especially senior faculty, to support this type of major because concerns exist that it may change the directions for the college itself. First, it may be a move away from the humanities and more toward a technical major, even one whose future employment possibilities are strong. Second, most cybersecurity programs are either online or have a strong hybrid component and this may be even more difficult to accept.

To combat this type of dissent, it must be predicted prior to the formation of the major itself. It would be advisable to approach the faculty who might dissent and ask for advice from their senior faculty about the formation of the cyber major. If the faculty are in departments that might contribute to the major (via interdisciplinary electives), it would be wise to approach them, regardless of whether they might dissent. Having an interdisciplinary cybersecurity major not only benefits the students by putting technical skills into context, it also allows for support to be gained from several departments who might otherwise not.

The Non-Technical Seminar

A seminar is a sound way to bring the technical and non-technical coursework together. It also allows for topics to be addressed that may not warrant a required course in the major. At the very least, three distinct sections should be addressed. These include ethics, where cybersecurity falls in the larger world stage and profession preparation. The former two will likely be addressed in an informal ongoing manner in other major courses but a full exploration should occur in this class (unless the college requires enough major coursework to include distinct required courses in these areas).

The skills being taught in a cybersecurity curriculum are ones that would clearly allow a user to commit unethical or even criminal acts. Ethics is important not only because it's often a precursor to crime (perhaps lack of ethics) but also because having an ethical foundation is crucial to both the qualifications and integrity of the cyber analyst (see Curtis, 2008). Curriculums presently in place even have ethical hacking within their list of required courses and many corporations require ethics training and in service training for their cyber analyst employees. The goal revolves around having students/employees handling sensitive information make ethical and right decisions with the information they access and how to avoid information misbehavior (Brooks, 2010). Education in this realm must start in the classroom to allow it to translate to the work environment.

Education in cybercrime and terrorism as global issues are lacking in undergraduate programs (Long and White, 2010) and in an era where cybercrime is inherently global, this shortcoming is one that must be addressed. With Stuxnet, the attacks on Estonia or the constant DOD and NSA hacking attempts from other countries, the landscape is one that must be included in college curriculums because it is clear that cybercriminals do not respect international boundaries. This extension of interdisciplinary learning can give students a solid understanding of the international nature of cyber attacks and how to approach investigations with this context in mind.

Lastly, preparation for entry into this field must be addressed. This should include resume preparation and interview skills, and information about what the job of cyber or network analyst entails. Moreover, using members of the local or national industry as guest speakers is crucial and must be included.

Number of Courses (technical and non technical), Mode of Instructional Delivery, Technological Advancement, Sequencing

The number of courses a major should have will vary by institution and currently, the number of courses required for most cyber majors in place varies from eight to even over twenty. It is important to consider how many technical skills based courses a major should have compared to the number contextual courses, or ones that are not inherently technical. This statement necessarily presumes that cyber-security majors should include those contextual courses.

Most cyber or network security programs are online and this includes both undergraduate and graduate programs. That being said, of the top cybersecurity undergraduate programs in the country (see Ponemon Institute, 2014), all but two were face-to-face, one was online, and one had both options. While an online degree may be desirable for some students based on flexibility, convenience, and time efficiency, research suggests that the method of instruction is more important than the learning platform (see Jaggers, 2015). Colleges must also explore the efficacy of having an on campus program (or blended format) given the differences in communication, immediate technical assistance and questioning that occurs in a face-to-face environment.

The world of cybersecurity offers one constant and that is 'change' but when teaching subjects such as the languages or writing/composition, the courses may not need to be modified as time passes. With majors such as criminal justice and cybersecurity, however, courses must necessarily change to be up to date with changes in law and technology. Formation of a cyber major must leave room for new courses and must be flexible enough to allow the major to grow and change as the technology changes, since the methods used by cyber-criminals change as does the software used to apprehend cyber-criminals.

The structure and sequencing of a cyber major must allow the students to gain the foundational, technological, and investigative knowledge in a way that starts with the building blocks and increases in complexity as they progress. As they do progress within a cyber major, the material will become extremely technical and complicated, and without that base knowledge, success would be difficult. The major's introductory course should be a prerequisite for all the technical courses that follow and advanced courses should have the relevant prerequisites to allow for success in those courses (i.e. a network basics course before a network security course).

Conclusion

The practice of cyber security must be founded upon established technological scientific knowledge, principles, and practices, which are best learned through formal education, training and research. A relevant and thought out formal bachelor's level program is crucial since more and more employers are seeking those with secondary degrees and as most fields, the salaries increase as the level of education increases. Additionally, most who are currently in the field may be required to engage in continuing training and education.

Not addressed above but worthy of mention, a cybersecurity program would be a significant recruitment tool, especially for a small liberal arts college. Such a program would attract incoming traditional-aged students who have interests in computers and criminal justice, adult students who are returning to school to advance in their current position or start a new career, and those from community colleges, more of which are starting cyber degree programs of some kind. Moreover, a program that was based on a traditional face-to-face teaching scheme with strong faculty interaction would be attractive given the relative lack of in-house programs across the country.

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ADMINISTRATION

The Internet of Things (IoT): What should ATMAE Program Undergraduate Students know?

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Abstract

The Internet of Things (IoT) has been a key activity for leading companies for the last few years but little information has made its way into the general knowledge stream. This paper provides an overview about the Internet of Things, its enabling technologies, its applications within key business sectors, and an evaluation on 'what', 'where', and 'how' such knowledge and content can be incorporated in existing technology, management, and applied engineering baccalaureate-level programs. The paper justifies the need to include IoT-related content within ATMAE programs to better prepare the students for the upcoming digital workplace.

Internet of Things Background

The term 'Internet of Things' was first coined by Kevin Ashton in 1999 in the context of supply chain management (Gubbi, Buyya, Marusic, and Palaniswami, 2013). At the Massachusetts Institute of Technology's (MIT) AutoID lab, Ashton was searching for ways that the Proctor & Gamble Company could improve its business by linking Radio Frequency Identification Technology (RFID) information to the Internet. While the term Internet of Things is now more and more broadly used, arguably there is no common definition or understanding today of what the IoT actually encompasses (Wortmann and Flüchter, 2015). All the different definitions of the term "Internet of Things" suggest that the IoT somehow involves the integration of the physical world with the virtual world of the Internet (Haller, 2010). While there is no universal definition for the IoT, the core concept is that everyday objects can be equipped with identifying, sensing, networking and processing capabilities that will allow them to communicate with one another and with other devices and services over the Internet to achieve some useful objective (Whitmore, Agarwal, and Da Xu, 2014). Botta, de Donato, Persico, and Pescap (2016, p.2) defined the Internet of Things (IoT) as an "intelligent and self-configuring nodes (things) interconnected in a dynamic and global network infrastructure. It represents one of the most disruptive technologies, enabling ubiquitous and pervasive computing scenarios". Radio frequency identification (RFID), sensor technology, and other smart technologies will be embedded into a variety of applications (Chen, 2014).

The Internet of Things (IoT) is still at an early stage in its development and with further development it is expected to have an enormous impact on consumers, businesses and society as a whole. "The IoT is a technological revolution that represents the future of computing and communications, and its development depends on dynamic technical innovation in a number of important fields" (Madakam, Ramaswamy, and Tripathi, 2015, p.164). In a press release, Gartner, Inc. (2016) stated that more than half of major new business processes and systems will incorporate some element of the Internet of Things (IoT) by 2020. The consulting firm IDC expected the worldwide market for IoT solutions to grow at a 20% compound annual growth rate (CAGR) from $1.9 trillion in 2013 to $7.1 trillion in 2020. The same firm expected the installed base of IoT units to grow at a 17.5% CAGR over the forecast period to 28.1 billion in 2020 (Lund MacGillivray, Turner, and Morales, 2014, p. 21). Table 1 below shows the worldwide expected IoT installed base units from 2013 to 2020.

Table (1): Worldwide IoT Installed Base Units From 2013 to 2020 (B)

	2013	2014	2015	2016	2017	2018	2019	2020	2013-2020 CAGR (%)
Internet of Things (number of installed base units in billions)	9.1	11.4	13.7	16.3	19.2	22.2	25.2	28.1	17.5
Growth (%)	25.4	24.8	20.8	19.1	17.5	15.8	13.5	11.5	

Desjardins (2014), in an article on the Visual Capitalist website, wrote that the internet of things global revenues are estimated to be $180 billion in 2014 and could reach $1,003 billion by 2020, i.e. $959 billion for services and $44 billion for hardware. Globally the Internet of things could create as much as $11.1 trillion a year in economic value (Bughin, Chui, and Manyika, 2015). Cisco analysts estimate that the IoT will create $14.4 trillion in net profit between 2013 and 2022, which amounts to an increase in global corporate profits of roughly 21 percent. The total global impact of IoT technologies could generate anywhere from $2.7 trillion to $14.4 trillion in value by 2025 (Castillo and Thierer, 2015). Gartner estimates that IoT product and service suppliers will generate incremental revenue exceeding $300 billion in 2020 (Press, 2014). Lund et al. (2014, p. 22) stated that the IDC consulting firm expects the worldwide revenues generated by the internet of things will grow dramatically by year 2020. Table 2 below shows the expected worldwide IoT revenue from 2013 to 2020.

Table (2): Worldwide IoT Revenue, 2013 to 2020 ($B)

	2013	2014	2015	2016	2017	2018	2019	2020	2013-2020 CAGR (%)
Revenue (in billions of USD)	1,927.5	2,292.3	2,711.5	3,179.7	3,782.4	4,592.3	5,648.6	7,065.3	20.4
Growth (%)	25.7	18.9	18.3	17.3	19.0	21.4	23.0	25.1	

IoT Enabling Technologies (Basic Devices and Technologies)

As educators attempt to prepare graduates who are sought by employers, it is important to understand that all IoT technologies involve two basic data related activities: collection and analytics. The output of this data manipulation can range from presentations/visualizations of information to physical actions. Several technologies enable the successful deployment of the IoT. These include, but are not limited to; RFID, smart sensors, communication technologies, and Internet protocols (Al-Fuqaha Guizani, Mohammadi, Aledhari, and Ayyash, 2015). IoT-focused conference papers were presented at conferences held in Asia and Europe, with very limited representation in North America and Africa, and literally none in South America (Whitmore et al., 2014). The following sections provide a better understanding of those key IoT technologies.

Radio Frequency Identification Technology (RFID)

Haddud, Dugger, and Lee (2015) stated that RFID technology can be utilized within manufacturing control, asset tracking, and asset maintenance to minimize certain manufacturing wastes. A foundational technology for IoT is the RFID technology, which allows microchips to transmit the identification information to a reader through wireless communication (Da Xu, He, and Li, 2014, p. 2233). The distinct feature of RFID technology is item traceability and addressability (Nivash, Babu, Raj, Nirmala, and Moses et al., 2014). RFID technology offers improved capabilities, including the identification of irrelevant line-of-sight, unique item-level product identification, multiple-tag product reading, enhanced data storage capability, and data read-and-write capabilities (Wamba and Ngai, 2013).

Sensors

Another foundational technology for the IoT is the wireless sensor networks (WSNs), which mainly use interconnected intelligent sensors to sense and monitoring (Da Xu et al., 2014). Market research has shown a significant growth in sensor deployments over the past decade and has predicted a substantial acceleration of the growth rate in the foreseeable future (Perera, Zaslavsky, Christen, Compton, & Georgakopoulos, 2013). Due to advances in sensor technology, sensors are getting more powerful, cheaper and smaller in size, which has stimulated large scale deployments (Perera, Zaslavsky, Christen, & Georgakopoulos, 2014).

Networks and Cloud Computing

The IoT creates an intelligent, invisible network fabric that can be sensed, controlled and programmed. IoT-enabled products employ embedded technology that allows them to communicate, directly or indirectly, with each other or the Internet (Chase, 2013). The collected data through RFID tags and smart sensors will require a robust and high performance wired or wireless network infrastructure as a transport medium. The IoT paradigm can be built using wireless sensor networks (WSNs) as the leading technology to acquire and manage data (Castillejo, Martínez, López, and Rubio, 2013). Smart connectivity with existing networks and context-aware computation using network resources is an indispensable part of IoT (Gubbi et al. 2013). Many IoT applications will be based on a deployed sensing, actuation, and communication platform (connecting a network of things). In these deployments, it is common for the devices to know their locations, have synchronized clocks, know their neighbor devices when cooperating, and have a coherent set of parameter settings such as consistent sleep/wake-up schedules, appropriate power levels for communication, and pair-wise security keys (Stankovic, 2014). Wireless Sensor Networks (WSN) has moved from an early research topic to the point where the number of implemented WSNs is growing rapidly. Cloud Computing is principally designed and promoted to be data center centric and efficient interaction with the outside world is an area where improved solutions are being sought (Ahmed and Gregory, 2011).

Standards

The IoT is a radical evolution of the current Internet into a network of interconnected objects that not only harvests information from the environment (sensing) and interacts with the physical world (actuation/command/control), but also uses existing Internet standards to provide services for information transfer, analytics, applications, and communications (Gubbi et al. 2013). To facilitate communication and

cooperation within the IoT, common practices and standards are required. This is particularly important with regard to object addresses. These should comply with a standardized schema if at all possible, along the lines of the IP standards used in the conventional Internet domain (Mattern and Flörkemeier, 2010). The majority of the IoT standards are being developed in Europe (Whitmore et al., 2014).

Internet of Things Applications

IoT technologies are instrumental in making data collection and analysis ubiquitous. The IoT has hence, is influencing many areas, and there have been many IoT applications implemented within industries such as healthcare, transportation, logistics, and manufacturing (Gubbi et al. 2013). Implementations associated with the IoT are projected to provide dramatic improvements in manufacturing, health care, energy, transportation, retail services, government, and general economic growth. The cost savings and productivity gains generated through "smart" device monitoring and adaptation are projected to create $1.1 trillion to $2.5 trillion in value in the healthcare sector, $2.3 trillion to $11.6 trillion in global manufacturing, and $500 billion to $757 billion in municipal energy and service provision over the next decade (Castillo and Thierer, 2015).

Retail

The Internet of Things is expected to transform the retail industry, virtually eliminating the choice/customization trade-off and redefining sources of competitive advantage (Kambies, Raynor, Pankratz, and Wadekar, 2016). The IoT movement offers retailers opportunities in three critical areas: customer experience, the supply chain, and new channels and revenue streams (Gregory, 2015). Big retail chains will take advantage of their dominant position to enforce the future IoT retail market, as was the case with RFID adoption (Kramp, van Kranenburg, and Lange, 2013). Radio Frequency Identification (RFID) is being widely used as a sensing platform for item identification, as such, this represents a common Internet of Things (IoT) technology in retail (Melià-Seguí and Pous, 2014). Examples of IoT applications within retail include: Walmart heavily uses big data for consumer insights and store-level merchandising. Nordstrom tracks pins on Pinterest to see what products are trending. Disney has RFID-enabled MagicBand wristbands that provide theme park access, entry access for guest hotel rooms, and cash and card-free payment for food and merchandise. Amazon.com introduced Dash buttons, a WiFi enabled device that is mapped to specific consumer packaged goods products. When the current supply of a specified product is running low, tap the button which generates an order, transaction and delivery of the specified product, (perhaps a fresh supply of detergent) (ComQi, 2015). As a result of using more IoT applications within retail, retailers are learning more about customer preferences, allowing them to provide personalized and immersive experiences that keep shoppers coming back (Intel, 2014).

Industrial/Manufacturing

McKinsey (2015) defines the IoT as the digitization of the manufacturing sector, with embedded sensors in virtually all product components and manufacturing equipment, ubiquitous cyberphysical systems, and an analysis of all relevant data. IoT in manufacturing is driven by four clusters of disruptive technologies. The first technology consists of data, computational power, and connectivity. Analytics and intelligence is the second while human-machine interaction is the third. The fourth is digital-to-physical conversion. Accenture consulting

(2015) stated that manufacturers can leverage the Industrial Internet of Things (IIoT) to achieve "smart" intelligent and connected production processes. In manufacturing settings, the IoT will allow facilities to create networks of connected production facilities along entire value chains that can autonomously communicate with each other and direct changes in response to unexpected developments. Devices will provide constant, accurate measurements of output, resource depletion, and capital depreciation to isolate sources of waste and maximize productivity (Castillo and Thierer, 2015). Specific examples of IoT applications within operations/manufacturing include; asset material tracking, connected operations intelligence, unified key performance indicators, real-time asset health monitoring, and operations management improvement (PTC, 2015).

Healthcare

A growing number of research efforts have been conducted over the last decade to explore the use of IoT technology to acquire data ubiquitously, process data timely, and distribute data wirelessly in the healthcare field (Natarajan, Prasath, and Kokila, 2016). IoT has provided a promising opportunity to build intelligent healthcare system and smart wearable applications (Heo, Noh, Moon, Kim, 2015). The emerging paradigm of Internet of Things (IoT) and a wide variety of increasingly cheap sensors (wearable, implanted, and environmental) have the potential to put in place personal Smart-Health systems hosting new interconnections between the natural habitat of the person, his body, and the Internet at the purpose to produce and manage "participatory" medical knowledge (Amendola, Lodato, Manzari, Occhiuzzi, and Marrocco, 2014, p. 144). There are two technologies that might promote a more proactive approach to sharing health information, perhaps anonymously: mobile health technologies and the Internet of Things (IoT) (Blacke, 2015). The IoT-powered e-health solutions provide a great wealth of information that when analyzed can be used to make actionable decisions. By connecting information, people, devices, processes and context, IoT powered e-health creates many opportunities to improve outcomes (Maksimovic, Vujovic, and Perisic, 2015, p. 1).

Energy and Utilities

Buildings, both residential and commercial, represent one of the highest energy consumption fields in the world (Moreno, Úbeda, Skarmeta, and Zamora, 2014). The Internet of Things (IoT) is causing a significant change in the utilities industry and is leading a big transformation trend. It connects assets, people, products, and services to streamline the flow of information, enable real-time decisions, heighten asset performance, mitigate supply chain risks, empower people, and help ensure product quality and consistency (SAP Corporation, 2014). With the global focus on energy and water management and conservation, the IoT will extend the connected benefits of the smart grid beyond the distribution, automation and monitoring being done by utility providers (Monnier, 2013). IoT technology offers the possibility to transform the energy production and distribution by increasing the availability of information along the value chain of production using networked sensors. A major application area is heat and energy management utilizing different resources (such as heat and electricity meters) in order to optimize the use of energy in commercial and residential areas (Kyriazis, Varvarigou, Rossi, White and Cooper, 2013). For example, smart thermostats have saved consumers as much as 10 -15 percent of the cost of heat and cooling (Zheng and Carter, 2015).

Education

Cisco predicts that worldwide, the IoE in education has a 10-year net present value of US$175 billion (Bandara and Ioras, 2016). The IoE creates a need for an education system that empowers a new generation of digital citizens who understand the technologies that underpin the IoE applications, the societal impact of widespread adoption, and the right application of the information that is captured (Selinger, Sepulveda, and Buchan, 2013). Actions are urgently needed to refocus attention on education, adapting the current educational systems and approaches to better prepare younger generations for the upcoming digital workplace (World Economic Forum, 2015). Kortuem, Bandara, Smith, Richards, and Petre, (2013) indicate that the Open University in the United Kingdom started offering an introductory course, My Digital Life, designed around IoT concepts for its undergraduate computer science program. My Digital Life places IoT at the core of the first-year computing curriculum and primes students from the beginning for the coming changes in society and technology. Drawing upon their experience with almost 2,000 students, they highlight the technology's pros and cons for collaborative and collective distance learning, especially for modules with real-world sensing applications (Feki, Kawsar, Boussard, and Trappeniers, 2013). The current state of education involves physical interactions between students and teachers, singular moments of one-time instruction in one location, static content with minimal student control, and costly one-size-fits-all instructional resources. By 2017, the IoT will change instruction in all these categories (Agrawal and Mazumdar, 2015).

Incorporating IoT Content in University Programs

Technological advances and breakthroughs are bringing about a paradigm shift in contemporary education. The modes of learning and teaching are becoming more open and flexible in terms of time, space, curriculum contents, organization, pedagogical methods, infrastructure and requirements (Yuen and Li, 2015). Cunjiang, Liying, and Dawei (2014) stated that the IoT relates with many technologies, such as computer networking, computing technology, embedded technology, sensor technology, wireless communication technology, etc. and it is an emerging national strategic industry. A large number of high-level talents with strong theoretical knowledge and practical skills are badly needed (Luo and Wang, 2015). Business, engineering, computer science, and cyber security departments must plan to address student awareness through revamped departmental curricula and interdisciplinary opportunities across departments (Trivedi, 2016). Lin, Ren, and Cerritos, (2013, p. 563) wrote that "with the emergence of IoT/M2M, it is time for the university to closely watch the development of this area and create a suitable IoT/M2M curriculum for our students." Colleges and universities are challenged to educate students across the curriculum to understand the underlying technologies and the application of the Internet of Things (Trivedi, 2016). The following section will include a discussion about what IoT content can be included within ATMAE programs.

Incorporating IoT into ATMAE Baccalaureate Programs

Management and Technical components within ATMAE

ATMAE programs that address IoT should consist of IoT management-based content along with IoT technical content. Management content would provide an awareness of the capabilities of a fully integrated IoT system along with information about the changing role of humans in an increasingly information-rich business environment. More specifically, management topics can include; a) how to deal

with the creations and sustainability of new emerging business modules based on data, and b) the effects of an IoT implementation on workforce and customers. Technical content should provide information about: 1) sensing and circuit implementation, 2) communication and network technology, 3) technology to connect users to Internet of things, 4) security and contents protection, and 5) convergence & practicum (Cha and Kang, 2015). Additionally, Cunjiang et al., (2014) proposed that IoT technical content should include the following six main areas; wireless sensor networks (WSNs), RFID technology, embedded systems, data mining, middleware, and Global Positioning systems (GPS)/General. Consistent with the practices of strong programs, content should move from basic to complex with many opportunities for application of conceptual knowledge.

Applied Engineering Programs

IoT Engineering is just beginning; every college and university establishes its curriculum based on their present faculty and facilities with different emphases on professional basic courses and major courses. The IoT is comprised of three main fields; Mechatronics; IT; and Computer Sciences and many colleges and universities are building or have already built elements that address IoT Engineering to meet the perceived talent desired by employers in the future (Cunjiang et al., 2014). The same source also indicated that because IoT engineering is an interdisciplinary filed, training and practice may include the following three approaches: 1) Fundamental skills training (basic electric and electronic circuits' courses). 2) Professional practices (this may include teaching students core courses e.g. sensor principles, programming, embedded systems, communications, automation, computer networks, RFID technology, and WSN. 3) IoT Engineering training (e.g. teaching topics that are purely related to IoT). Typical IoT application scenarios, experimental operations, and the use of case studies can be used to promote the students' professional skills (Luo and Wang, 2015). Promoting students' creative problem-solving skills and computational thinking abilities may also be considered (Cha and Kang, 2015). Upon completion of the applied engineering baccalaureate-level degrees that include IoT content, students should be able to: 1) Understand IoT fundamentals; 2) Understand what RFID technology is and how it is implemented; 3) Understand Wireless Sensor Networks and their implementation; and 4) Understand how the IoT can be used in the program context (manufacturing, construction, energy and power, health care, etc.).

Conclusion

ATMAE can benefit immensely from the infusion of IoT technologies content into its curriculum. The blending of technical and management content offered by ATMAE approved programs provides an ideal foundation for the preparation of IoT practitioners. The graduates of these programs, if provided a strong background in the IoT, will become prominent leaders in future organizations and not just the implementers of technologies but also the leaders of the broad disruptive technological revolution that is the Internet of Things.

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ADMINISTRATION

Korean (GNU) Innovation Engineering, Project Management & Disaster Shelter Design Program–Spring 2016

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Introduction

Understanding innovation engineering and engineering project management principles provides engineering students (Korean) with a competitive edge in today's engineering world. Coupling this knowledge with the latest tools in engineering design and their application towards solving real-world competitive design problems in a capstone environment (i.e., Disaster Shelter Design Competition) enhances their future employment opportunities. A collaborative program with a partnering school in the US was needed by a Korean University to develop and implement a program to provide such experiences.

This paper shares a collaborative program between two universities—one in Korea and one in the United States, that promotes the development of skills in engineering project management, innovation engineering, creative thinking and problem solving, oral and written skills in English. It provides opportunities for American and Korean students to share their cultures, and work side-by-side in preparing for a collegiate design competition—the Disaster Shelter Competition, sponsored by Samaritan's Purse and John Brown University.

This paper provides an overview of the program, including background information, logistics, and program planning; objectives of the program; descriptions of courses and related activities; the Disaster Shelter Competition; activities to promote the Korean students' oral and written communication skills; and recommendations regarding future programs. Sufficient information is provided so that other universities may replicate or pursue similar collaborative programs that enrich the education of both domestic and international students.

Background and Planning

Pittsburg State University (PSU) and Gyeongsang National University (GNU) enjoy a rich history of collaboration and providing unique educational experiences for GNU students. Experiences have included: the ***Korean Summer Programs*** (2001-2005); the ***GNU PSU Baja SAE Program*** (2002-2009); The ***PSU to Baja Korea Project*** (2006-2007); ***the Korean Engineering Management Program*** (2005 To 2008), and most recently, the ***Korean Four-Week American Industry Cooperative Experience*** program (Summer, 2014 and 2015), and the initial ***Korean (GNU) Innovation Engineering, Project Management & Design Program–2015*** (Spring, 2015) . These experiences have proven to be mutually beneficial for both institutions.

In Summer 2015, PSU faculty reviewed feedback from the initial ***Korean (GNU) Innovation Engineering, Project Management & Design Program–2015*** (Spring, 2015), and developed a proposal for the Spring 2016 program. Central to the proposal was developing a timeline for the program that took in account key dates associated with the Disaster Shelter Competition held in Arkansas, as well as enhancing activities that would improve Korean participants oral and written English communication skills, use of engineering management and innovation engineering tools, and familiarization with U.S. industry practices. A budget was developed to accommodate forming two teams of six students each (12 total) to participate in the Disaster Shelter Competition, including design-build costs, registration, and travel costs. The budget also included costs for a faculty coordinator, teaching assistant, lab assistant, stipends for faculty making special presentations in topic courses developed for the program, and five English speaking partners.

After initial discussions with GNU officials, the formal proposal was submitted to GNU and approved. In Fall 2015, GNU used an internal process to select 12 students—ten from engineering and two from business, to attend PSU from January to May 2016. These students participated in additional English preparatory experiences prior to arriving on campus. Based on previous PSU-GNU joint programs, it was apparent that the better a student understands English upon arrival, the more one gains from the program. An initial foundation in English is key to one's success in this immersion-type program.

The Korean (GNU) Program—Spring 2016

In Spring 2016, PSU hosted 12 GNU students in an unique 16-week program, consisting of two organized special topics learning experiences, multiple regional field trips, industrial tours, and a post-disaster transitional shelter design-build competition. Students also participated in a variety of local university events, such as the Automotive Orientation Day and company recruitment presentation. Additionally, special conversational English sessions and written English experiences were provided Korean participants. Program courses and program activities are described here.

GNU Course #1: Creative Thinking, Problem Solving, Innovation Engineering, and Tours

Two special courses were developed to address specific topics the GNU and PSU faculty agreed would be most beneficial to the GNU students in complementing their studies in Korea. The first 16-week course addressed Creative Thinking, Problem Solving, Design, Innovation Engineering, Industrial Tours, and Special Sessions. The topical content covered in these sessions is noted below.

Creative thinking (Weeks 2 and 3). At the conclusion of initial program orientation session in week one, each Korean student was provided a copy of Roger's von Oech's ***A Whack on the Side of the Head*** and assigned readings and feedback questions to complete prior to class meetings. During class meetings, chapters were discussed and related activities completed. At the conclusion of these sessions, students completed von Oech's "Whack Examination," that required participants to be very introspective and reflective in answering. All these oral and written activities contributed to their English skill development.

Problem solving (Weeks 4-6). The Korean students were introduced to the six-step problem solving process using divergent thinking to solve ill-structured problems with multiple solutions. Students participated in a problem solving activity in teams of two, and were required to provide documentation of the problem solving process, their solution, and an oral presentation. This was followed by solving a series of problems using the Rokenbok Educational Systems, which were documented and presented by the students.

Technology and Engineering Education lab experiences (Week 7). Students had opportunity to participate in a variety of laboratory experiences of their choosing in the lab, which featured a variety of fabrication equipment, laser cutting systems, automated systems, robotics, design software and 3-D printers.

Innovation Engineering® (Weeks 8 and 9). Innovation Engineering® (IE) is a new field of study that "increases innovation speed up to 6x and decreases innovation risk". It does this by applying the systems thinking mindset of Dr. W. Edwards Deming to innovation. (Innovation Engineering Home Page, 2016) Students spent two weeks completing activities and learning associated with ***IE: Create*** and ***IE: Communicate***, the first two courses in Innovation Engineering. Sessions were conducted by an Innovation Engineering® Black Belt instructor.

Special sessions (Weeks 10-12). These sessions included a week devoted to professional development; a week associated with the ***Great Gorilla Games*** (a day-long technology and engineering competition for high school students) and the ***Construction Expo*** (a day-long event for students, featuring the latest in construction equipment and demonstrations of new tools and material processing); and a special work session prior to the Disaster Shelter Competition.

Industrial tours (Weeks 13-15 and special dates). Each week, the Koreans visited two or three local industries, eight in total. The industries included:

- AZZ (http://azz.com/about-azz) - metal enclosed structures for electrical distribution
- Pitt Plastics (http://www.pittplastics.com) - blown film extruded plastic bags
- Unique Metal (http://www.umfi.com) - metal fabrication for structures
- Progressive Products (http://progressiveproductsinc.com) - specialty pipe for processing
- Apex Stages (http://www.apexstages.com) - manufacturing of portable concert stages
- Pitsco Inc. (www.***pitsco***.com) - prototyping; and distribution of STEM products
- Pitsco Manufacturing (www.***pitsco***.com) - manufacturing proprietary STEM products
- Millers/Mpix (http://www.millerslab.com/about/pittsburglab) - photo processing

GNU Course #2: Engineering Project Management, Disaster Shelter Competition, Tours

The second 16-week course was developed to address GNU's desire for their students to learn about engineering project management (EPM) and apply those skills via participation in a national collegiate design competition. The ***Disaster Shelter Competition*** is addressed separately in more detail. The course content is described below.

Engineering Project Management--EPM (Weeks 1-15). Following the conclusion of the initial program orientation session in week one, each of the Korean students was provided with an English text copy of the Project Management Institute's ***Project Management Book of Knowledge (PMBOK), 5th Edition***, along with access to an electronic Korean text copy, and assigned readings to complete prior to class meetings. During class meetings, individual chapters were discussed and related hands-on applied learning activities were completed. Examples of the hands-on activities students completed in-class and the associated PMBOK area of knowledge are listed in Table 1. Following each class sessions, students were given assignments related to specific sections of their individual project management report. At the end of the semester these assignments were compiled to generate their final project management report. The final report was tailored to the disaster shelter design-build competition the students competed in as part of the course.

Table (1): Example of Hands-On Project Management Activities

Hands-On Activity	Description	PMBOK Area of Knowledge
Paper Tower Exercise	Students build paper towers with and without assigned roles and planning time.	Intro to Project Management
Lego Kit Team Build	Students build basic Lego kits using only pictographic, verbal or written directions	Communication Management
Grocery List	Students develop a grocery list for a dish. The individual ingredients and equipment needed to prepare the dish were then sourced from multiple vendors and purchase orders generated.	Cost Management Procurement Management
Personal Schedule	Students develop a typical schedule of daily tasks. The schedule then has resources, durations and logical relations (predecessors and successors) assigned to each task.	Time Management

Disaster Shelter Competition **(Weeks 2-15)** The *Disaster Shelter Competition* is a national collegiate design-build competition in which students are asked to develop creative solutions to solving the housing problem for people displaced by various natural or man-made disasters. Engineering, Construction Management and Architecture student teams are invited to design and construct a rapidly-deployable transitional post-disaster shelter for use by aid organizations in response to disasters throughout the world. The 2015 and 2016 Competition scenarios were in response to the refugee crisis in the Middle East and Eastern Europe. While centered on this current world issue, shelters were required to be applicable throughout the habitable environments worldwide. Each shelter was to be designed and constructed to have an inherent value of $1500 or less, minimum floor space of 14 square meters, and weigh no more than 200 kg. In 2015 the Korean students developed a single shelter project with a 10-person team, and in 2016 they developed two projects, each with a six-person team.

Two day-trips for industrial tours. As part of the 2015 and 2016 program, trips were made as part of this course to the Wichita/ Hutchinson and Kansas City areas. These trips included trips to:

Wichita/Hutchinson Area

- Case –New Holland –Wichita (http://www.cnhindustrial.com) - this tour featured a World Class Manufacturing facility, where skid steers are manufactured.
- Chance Rides (http://www.chancerides.com/about/factoryinfo.html) - manufacturer of rides for the amusement industry—coasters, amusement park rides carrousels, people movers, gondola wheels, etc.
- *Kansas Cosmosphere and Space Center* (http://www.cosmo.org) - world-class science center is affiliated with *Smithsonian's National Air and Space Museum*. Exhibits associated with this 105,000 square feet science education center include an SR-71 Blackbird, the Apollo 13 space capsule, and many more artifacts that trace the development of space exploration.

Kansas City Area

- Harley-Davidson (http://www.harley-davidson.com/content/h-d/en_US/home/events/factory-tours/kanascitymo.html) - steel-toe tour of the manufacturing plant for Harley-Davidson motorcycles.
- Dimensional Innovations (http://www.dimin.com) - design-build firm that designs and produces a wide variety of architectural projects from premier sets for blockbuster movies to sports hall of fame displays to specialty furnishings.
- Smith Electric (http://www.smithelectric.com) - electric vehicle manufacturer that builds delivery truck and other electric vehicles.

Emergency Shelter Competition

Competing in the Disaster Shelter Competition (associated with School of Construction) involves engineering project management, design report, cost reports, business case analysis, and prototype construction. The results in events comprising the competition are scored using a rubric. (Note: In 2016, GNU earned 3rd place and PSU placed 2nd overall in this competition. In 2015, GNU earned 3rd place and PSU placed 4th overall in the competition.) The competition is described in detail at the John Brown University Shelter Competition website. (Shelter Competition, 2016) GNU built their structure(s) alongside the PSU student competition team. (Modified for submission, 2015).

For the first few weeks of the semester, student teams brainstormed and researched previous shelter designs, along with applying knowledge in their personal areas of study (e.g., mechanical engineering, aerospace engineering). Design options were then refined and prototyped in scale to provide greater understanding of how to bring their concepts to reality. This prototyping lead to selection of a final design for each student team. In mid-March, each student team was required to submit a preliminary design report and draft business case analysis per the competition guidelines.. Following this, the student teams constructed their prototype shelters using sourced materials per each project. By late April the students have completed their prototype shelters along with a complete design report and business case analysis. The projects were then packed up for travel with the students to the competition site at John Brown

University in Siloam Springs, Arkansas.

The students then presented their design report and business case analysis to a jury of industry professionals, comprised of engineers and personnel form emergency relief agencies. The prototype shelters underwent physical testing for livability, seismic loading, thermal retention, water infiltration, and wind loading. Descriptions and photos of these tests are shown in Table 2.

Table (2): Emergency Shelter Competition Tests

Test	Description	Image
Seismic Loading	Seismic load is simulated using a shake table. The platform of the shake table will be constructed of wood. Therefore, teams are required to have a mechanism for fastening to the wood platform.	
Wind Loading Water Infiltration	To validate physical performance against the elements, the shelters are subject to a wind generating apparatus ("the Wolf") that simulates high wind and rain.	
Heat Retention	Heat retention capabilities of the shelters are evaluated by enclosing the shelters in a temperature controlled environment, cooling the surrounding air to 40 degrees F, then heating the closed shelter to 80 to 100 degrees F and recording the temperature decrease over a 30 minute period.	
Livability	For livability, the shelters are occupied overnight by a disaster "victim" during the competition. These are students who volunteer to help evaluate the performance of the shelters.	
Timed Erection	Student teams are timed for how long it takes to erect their structure from its bulk shipped configuration, as it would have been delivered to the disaster site.	

Additionally, in 2016, the students competed in an onsite problem solving activity in which teams were required to build an emergency shelter with the materials provided. This event provided an excellent opportunity to apply problem solving and other skills learned in their other courses.

The work of the GNU student teams has been publicized by both Pittsburg State University and local news agencies ("Samaritan's Purse Disaster Shelter Design Competition", 2016) ("PSU Construction Students Participate in Disaster Shelter Competition", 2015) (John Brown University, 2016) (Pittsburg State University, 2015) (Pittsburg State University, 2016).

English Development Activities

The Korean students were immersed in speaking English with conversational English partners, PSU faculty, students, and English speaking students working with them. For written English skills development, they maintained a daily log of activities a daily journal, and completed written reports (e.g., field trip reports, class assignments). Their English writing and oral presentation performances were monitored closely throughout the semester.

Summary and Recommendations

The PSU-GNU program completed its second year of operation in Spring 2016. The following changes and recommendations were noted:

1. Twelve Koreans participants organized into two teams of six for the Disaster Shelter Competition in 2015, worked better than one team of ten students in 2015.
2. Interaction of conversational English partners with Korean students was critical.
3. Another key was having a Korean faculty member that meets weekly with the students and serves as a liaison between them and the rest of the faculty, as well as serving as a liaison with the partnering Korean university.
4. The benefits of the rich international experience, for both the Korean and American students, make the program worth all costs associated with it.

This development and implementation of ***Korean (GNU) Innovation Engineering, Project Management & Disaster Shelter Design Program*** is but one example of collaborative projects between two institutions-one Korean and one American, interested in enriching the lives of its students through an international experience. Similar international collaborative programs could be developed at other universities to provide international experiences for their students.

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EECT

Applied Software Defined Networking (SDN) Research: Equivalent Test Between Openflow and Ethernet Pipelines of Latency and Jitter to Evaluate the Use of SDN Controllers for Disaster Recovery Exercises (DREs)

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Abstract

Availability of mission critical applications is one of the most important requirements for modern enterprises. Data centers, where these applications run, are often very complex systems comprised of network, compute, and storage resources. In order to ensure high-availability of mission-critical applications, most businesses conduct Disaster Recovery Exercises (DREs). One of the more challenging aspects of conducting DREs is to ensure isolation of the resources being used for the DRE from the production resources. It is common for organizations to temporarily reassign a subset of resources for DREs. After the DRE is completed, the resources are reassigned back to the production environment. If not planned carefully, it is possible to impact the production applications up to and including corruption of the production data.

There have been various attempts to use technology to address the need for network isolation. These include creation of network sandboxes and various virtual isolation techniques (Romney & Stevenson, 2004). A comprehensive solution specifically designed for network isolation in enterprise networks was developed in 2011. Rapid Adjustable Network (RAN) architecture has the ability to isolate both virtual and physical servers anywhere from a single server to thousands of servers in a few seconds. The main limitation of this architecture is it is VLAN based. This limitation requires advanced planning and requires the servers that will be used for DREs be positioned on a VLAN that can float or transition between the production area and the DRE area. This makes positioning the RAN architecture in an existing data center problematic in that it usually requires readdressing of the server's IP address that is targeted to float between the two areas (Teeter, 2011).

To address these problems, we propose the use of Software Defined Networking (SDN) Controllers to centrally program virtual and physical network devices and automate the isolation of virtual and physical network resources for the purpose of Disaster Recovery Exercises (DREs). To this purpose, an application, SDN Rapid Adjustable Networking (RAN), was developed that's function is to rapidly isolate virtual and physical resources needed for a DRE via an SDN controller.

By examining network quality indicators, Latency and Jitter (Beuran, Ivanovici, Dobinson, & Thompson, 2003), it can be determined if it is possible to virtually isolate production resources for DREs utilizing SDN Controllers.

Introduction

This thesis presents a principled approach to DREs that takes advantage of a recent development in computer networking called Software Defined Networking (SDN). Traditional network devices contain both the control plane and data plane in the same physical device. SDN abstracts the control plane from the physical network device and centralizes it in a SDN controller. Network administrators can use an SDN controller to centrally reconfigure the forwarding path of network devices instead of manual configuration of each separate network device.

We demonstrate, by examining network quality indicators (Latency and Jitter), it is possible to virtually isolate production resources for DREs utilizing SDN Controllers. SDN Controllers can be placed in an Ethernet network comprised of traditional Ethernet switches and facilitate and automate the isolation of network resources for disaster recovery exercises.

According to research done on Ethernet Networks, two of the most important factors to consider when determining quality are Latency and Jitter (Beuran et al., 2003). Latency refers to the delay between sending and receiving a message over a network. The International Telecommunication Unit (ITU) G.114 specification recommends less than a 150 millisecond one-way end-to-end delay for high-quality real time traffic. However, according to the same specification, interactive applications like Voice over IP (VoIP) often require the one-way delay to be 100 milliseconds or less (2003). Network latency can be determined by transmitting a small number of Internet Control Message Protocol ("ICMP") "ping" packets to the destination device. ICMP testing reports on reachability (e.g., "pinging"), performance, error reporting, congestion control and other maintenance (Borella, Schuster, Sidhu, & Grabiec, 2001).

Network Jitter is another important factor related to network performance. Jitter measures latency variations caused by congestion, queuing, etc. Jitter is a measurement of network performance consistency. If a network does not introduce any variability, the jitter is zero (Kay, 2009). Interactive applications like Voice over IP (VoIP) are more sensitive to jitter than many applications. For VoIP applications, jitter should be no higher than 50 ms (Wu, 2008).

One of the common tools used to measure jitter is iperf. Iperf can generate UDP or TCP data streams which can then be used to determine transfer rate, bandwidth, and jitter values (Hartpence & Kwasinski, 2015). For a traditional or SDN network to be viable for enterprise applications that include interactive applications, the network must have a 200 ms or lower round-trip rime (RTT) and a jitter of 50 ms or lower.

Purpose of Study

The purpose of the study was to conduct research and run equivalent tests between OpenFlow and Ethernet pipelines to determine the differences in Jitter and Latency and make an evaluation on the use of SDN controllers for Disaster Recovery Exercises (DREs).

Research Questions

Research questions defined were:

1. Will the Latency in the SDN Pipeline (DRE network) have no significant difference from the Latency in the traditional Ethernet Pipeline (production network)?

2. Will the Jitter (Latency Variation) in the SDN Pipeline (DRE network) have no significant difference from the Jitter in the traditional Ethernet Pipeline (production network)?

Hypotheses

Research questions were further developed into the hypotheses. Hypothesis 1 relates to the research question one. Hypothesis 2 relates to the research question two.

Hypothesis One: The Latency in the Two Network Pipelines

- H_{o1}: The distribution of Latency is statistically the same across categories of the tested pipelines (OpenFlow and Ethernet).

- H_{a1}: The distribution of Latency is not statistically the same across categories of the tested pipelines (OpenFlow and Ethernet).

Hypothesis Two: The Jitter in the Two Network Pipelines

- H_{o2}: The distribution of Jitter is statistically the same across categories of the tested pipelines (OpenFlow and Ethernet).

- H_{a2}: The distribution of Jitter is not statistically the same across categories of the tested pipelines (OpenFlow and Ethernet).

Experimental Design

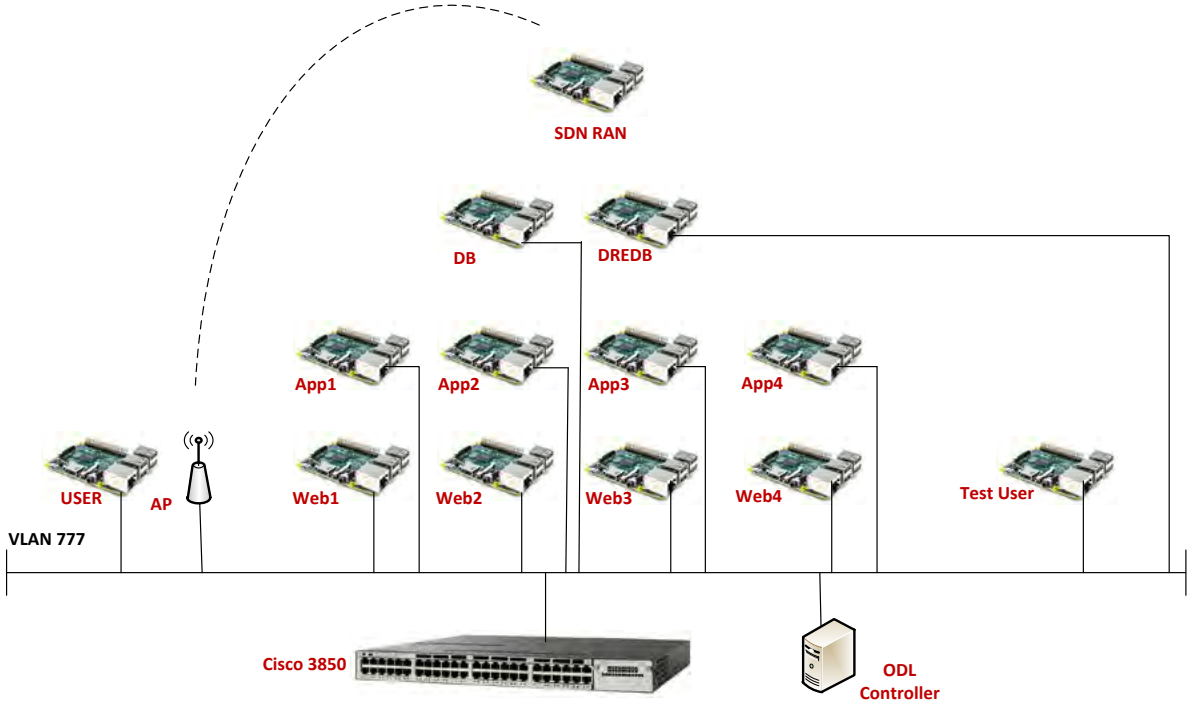
An experimental lab was setup to test the hypotheses. The experimental production and disaster recovery exercise environment consisted of several hardware and software components.

Experimental Design Hardware

The hardware was comprised of a Cisco Catalyst 3850 48 Port PoE switch, 13 Raspberry Pis, a HP Envoy Desktop, and an 802.11n Wireless AP. The Cisco Catalyst 3850 is a Gigabit Ethernet switch that is widely deployed throughout the United States and represents a traditional Ethernet pipeline in a data center in the experiment. The Raspberry Pis are first generation model B with a 4 GB SD card. They are being used to represent traditional Linux network servers that have various functions in a modern data center including web server, application server, database server, and user desktop. The HP Envoy Desktop is being used to run VMware Workstation 10 in support of the OpenDaylight Controller. The HP Desktop has 12 GB Ram, 1.8 TB Hard Drive, and an Intel Core i5-4570 CPU @ 3.2 GHz. The wireless AP is a Cisco Meraki MR18 Cloud Managed AP.

The Cisco 3850 Catalyst switch has 12 Raspberry Pis connected to 12 ports via RJ45 Category 6 Ethernet Cables. See Figure 1. The HP Desktop is connected to the Cisco 3850 Catalyst switch via a Category 6 Ethernet Cable. The Cisco 3850 Catalyst switch is also connected to the Cisco Meraki MR18 Cloud Managed AP via a Category 6 Ethernet Cable.

Figure (1): Experimental Lab Topology



Experimental Design Software

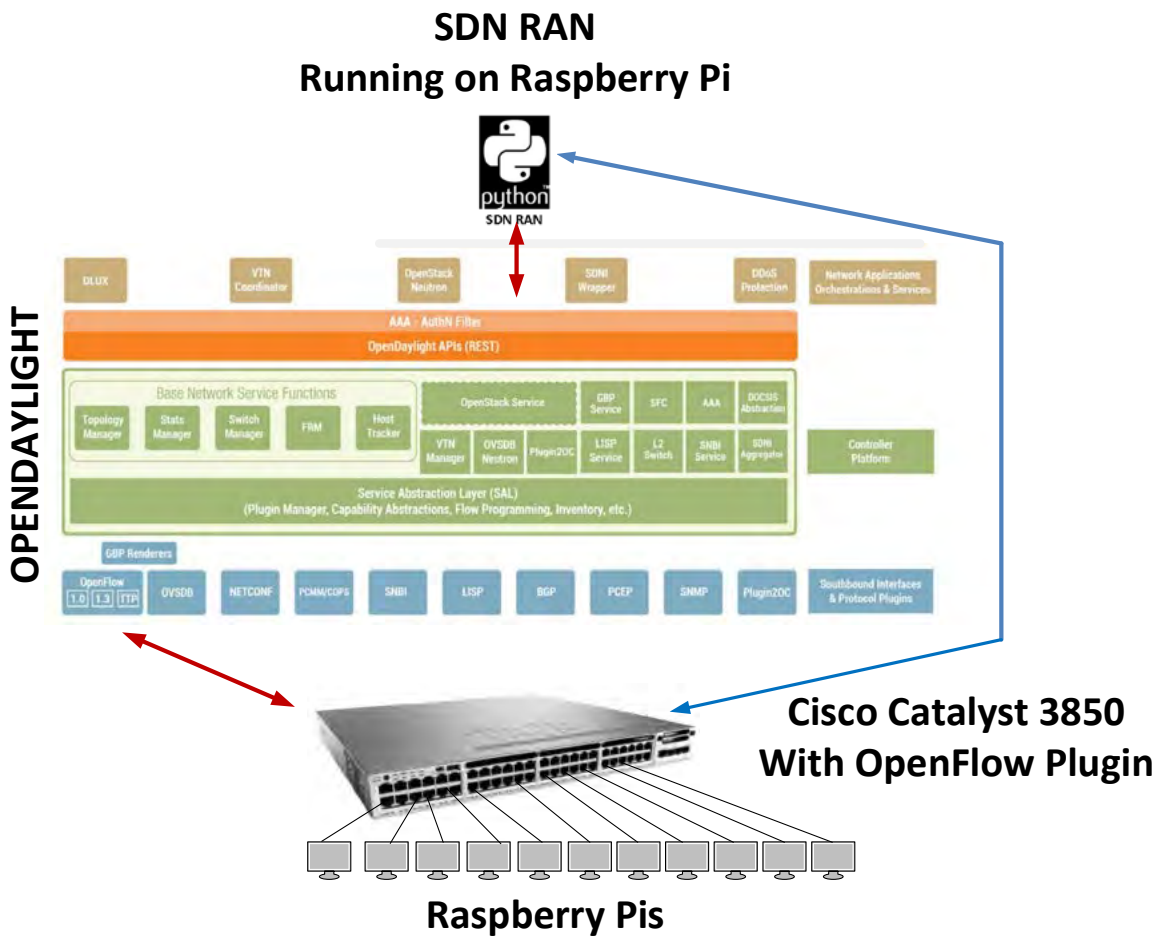
The software was comprised of Raspbian operating systems, a Windows 8 operating system, one VMware Workstation 10, one Fedora 20 Virtual Machine, one OpenDaylight Controller, one OpenFlow Plugin, and the SDN RAN application. Raspbian is a free operating system based on Debian software that has been optimized for Raspberry Pi hardware. Raspbian was installed on the Raspberry Pis. Windows 8.1 64-bit operating system was installed on the HP desktop. VMware Workstation 10 was installed on the HP Desktop in order to support a Virtual Machine for the OpenDaylight Controller. A Fedora 20 Virtual Machine with 8GB RAM, 1 Processor, and 20 GB Hard Disk was installed on VMWare Workstation 10. The OpenDaylight SDN Controller used in this experiment was the Helium release (distribution-karaf-0.2.1-Helium-SR1 release). The OpenDaylight controller was installed on the Fedora 20 virtual machine. The OpenFlow Plugin is a Cisco OpenFlow Plugin version 2.0 and is installed on the Cisco 3850 Catalyst Switch. SDN RAN is written in Python and was using the Python 2.7.3 interpreter which is part of the Raspbian operating system.

Experimental Design Control Data Flow

The SDN Rapid Adjustable Networking (RAN) application was run on a Raspberry Pi that was connected with the rest of the network via the Cisco Meraki MR18 Cloud Managed AP. The SDN RAN application communicates to two devices: the OpenDaylight SDN Controller and the Cisco Catalyst 3850. See Figure 2. The SDN RAN application can send commands to the Cisco 3850 Catalyst Switch to move individual Gigabit Ethernet ports from the Ethernet Pipeline to the OpenFlow Pipeline. It can also send commands to move individual Gigabit Ethernet ports back form the OpenFlow Pipeline to the Ethernet Pipeline. The SDN RAN application also communicates with the OpenDaylight Controller via the built in REST API.

The OpenDaylight controller sends commands via OpenFlow 1.3 to the Cisco OpenFlow software plugin that is running on the Cisco Catalyst 3850. The controller sends commands to the software switch (OpenFlow plugin) to update the OpenFlow forwarding table that controls the data plane of all devices (Raspberry Pis) connected to Gigabit Ethernet ports. The Gigabit Ethernet ports that are connected to the OpenFlow pipeline have been moved from the Ethernet Pipeline by commands via Pexpect that the 3850 switch has received from the SDN RAN application.

Figure (2): SDN RAN Communications



Methodology

For the testing in this research, quantitative research methods and measurement-based experimental quantitative approaches were used in a controlled test environment to determine if the amount of Latency and the amount of Jitter was affected by different types of Network Pipelines (Ethernet Pipeline and OpenFlow Pipeline).

The control objectives for this study were to conduct the tests in an environment as close to the real world as possible while limiting any biasing influences. For Hypothesis 1, Latency measurements were collected using the ping utility. The ping utility was ran first between two hosts on the Ethernet pipeline. Latency measurements were then collected on the OpenFlow pipeline using the ping utility. The measurements were recorded in Excel.

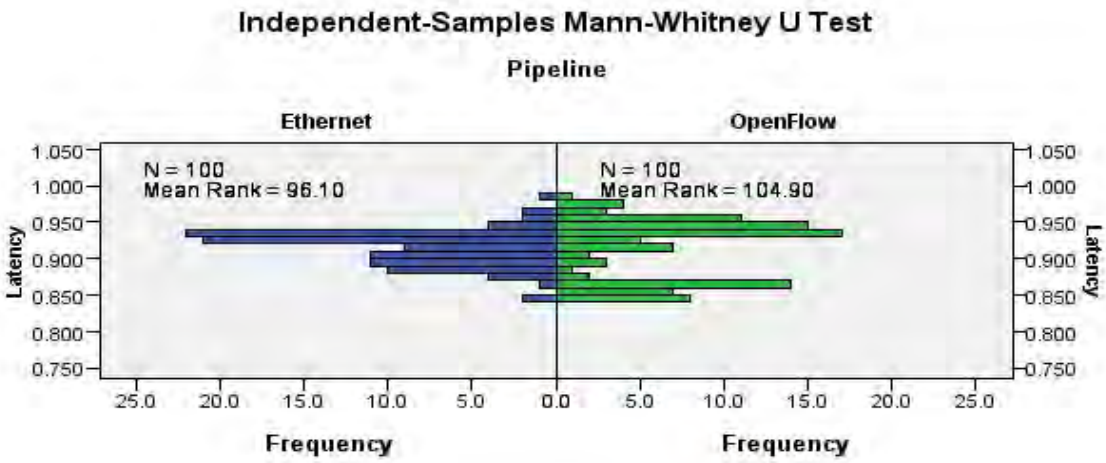
For Hypothesis 2, jitter measurements were collected using the iperf utility. The iperf utility was ran first between two hosts on the Ethernet pipeline. Jitter measurements were then collected on the OpenFlow pipeline using the iperf utility. The measurements were recorded in Excel. The data obtained from this experiment was recorded in Microsoft Excel and imported into IBM SPSS Statistics package Version 23 for this analysis.

Results

Statistical Analysis was done using Independent-Samples Mann-Whitney U Test to determine: (1) whether the distribution of Latency is statistically the same across categories of the tested pipelines (OpenFlow and Ethernet); (2) whether the distribution of Jitter is statistically the same across categories of the tested pipelines (OpenFlow and Ethernet).

The data from the Independent-Samples Mann-Whitney U Test performed on the latency measurements on the two types of pipelines, suggest latency is not significantly different when flowing through an OpenFlow pipeline as opposed to an Ethernet pipeline. The data specifically showed distributions of Latency for OpenFlow and Ethernet were not similar (Figure 3), as assessed by visual inspection. However, Latency for OpenFlow (mean rank = 104.90) and Ethernet (mean rank = 96.10) were not statistically significantly different, U = 5,440, z = 5,440, p = .282.

Figure (3): Independent Samples Mann-Whitney U Test for Hypothesis One



Total N	200
Mann-Whitney U	5,440.000
Wilcoxon W	10,490.000
Test Statistic	5,440.000
Standard Error	409.207
Standardized Test Statistic	1.075
Asymptotic Sig. (2-sided test)	.282

Figure (4): Latency Hypothesis Test Summary

Hypothesis Test Summary

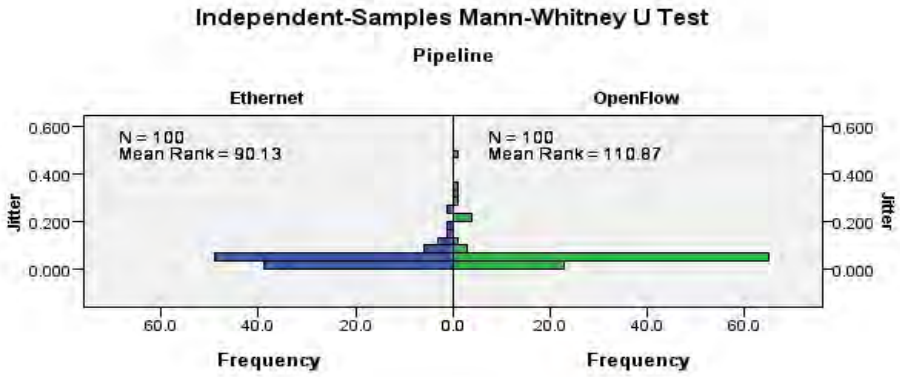
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Latency is the same across categories of Pipeline.	Independent-Samples Mann-Whitney U Test	.282	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .01.

The first null hypothesis that the distribution of Latency is statistically the same across categories of the tested pipelines (OpenFlow and Ethernet) failed to be rejected (Figure 4).

The data from the Independent-Samples Mann-Whitney U Test performed on the jitter measurements on the two types of pipelines, suggest jitter is not significantly different when flowing through an OpenFlow pipeline as opposed to an Ethernet pipeline. The data specifically showed distributions of Jitter for OpenFlow and Ethernet were similar (Figure 5), as assessed by visual inspection. Furthermore, median jitter for OpenFlow (.04400) and Ethernet (.03650) was not statistically significantly different, U = 6,037, z = 6,037, p = .011. The second null hypothesis that the distribution of Jitter is statistically the same across categories of the tested pipelines (OpenFlow and Ethernet) failed to be rejected (Figure 6).

Figure (5): Independent Samples Mann-Whitnet Test for Hypothesis Two



Total N	200
Mann-Whitney U	6,037.000
Wilcoxon W	11,087.000
Test Statistic	6,037.000
Standard Error	409.104
Standardized Test Statistic	2.535
Asymptotic Sig. (2-sided test)	.011

Figure (6): Jitter Hypothesis Test Summary

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Jitter is the same across categories of Pipeline.	Independent-Samples Mann-Whitney U Test	.011	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .01.

Conclusion

The quality of a network can be tested for two important attributes: Latency and Jitter. The data from both Independent-Samples Mann-Whitney U Test suggest both attributes latency and jitter are not statistically significantly distributed differently between a network using an Ethernet pipeline and a network using an OpenFlow pipeline. Therefore, the Independent-Samples Mann-Whitney U Test analysis leads to the conclusion it is possible to use Software Defined Networking (SDN) controllers to program network devices and automate the isolation of network resources for the purpose of disaster recovery exercises (DREs). Besides the Independent-Samples Mann-Whitney U Test analysis that was performed, it should be noted the maximum Latency in the OpenFlow pipeline was .980 ms with a mean of .91366 ms and the maximum Jitter in the OpenFlow pipeline was .488 ms with a mean of .06278 ms. These sub 1 millisecond measurements are well below the 200 ms latency round-trip time and 50 ms jitter discussed as requirements for quality networks. This in conjunction with the fact no datagrams were lost during the experiment on the OpenFlow pipeline further strengthen the argument for the capability of using SDN controllers to program network devices on traditional Ethernet switches and automate the isolation of network resources for the purpose of disaster recovery exercises (DREs).

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Graphics

Influence of Substrate Properties (weight and brightness) on Color Quality of Electro-photographic Digital Color Printing

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Introduction

Over the past two decades, the printing (or the graphic arts) industry has been revolutionized. Technology, workflow, management strategy, markets, and customer expectations have changed. Today, print is just one of many media channels which consumers can access. Advancements in science and engineering field are enabling the printing and graphic professionals to apply scientific research methods across prepress, pressroom, and quality control areas for quality color reproduction on a wide variety of substrates (papers). The value and role of printing is changing. The use of print is merged across multiple communications channels, such as: web, mobile, and social media. Due to advancements in computer networking and digital printing technologies, print media has become a powerful multi-channel marketing and communications tool. Modern printing has evolved from a craft-oriented field toward a color management science. This is demanding a greater color control among the devices (printing and non-printing) and substrates used in the printing and imaging industry. The quality of color image reproduction of any type of printing (digital or traditional), is largely influenced by the properties of paper. Paper is considered a commodity but its properties are a long way from being standardized (Wales, 2009).

A continuous-tone color (or grayscale) photograph is composed of a full spectrum of shades and colors, from near white to dense black. The method by which a continuous-tone photographic image is transformed to a printable image is called halftoning. In this method, varying percentages of the printed sheet are covered with halftone dots to represent the varying tones in the image. Digital printing technologies can be described as methods that do not use image carriers such as printing plates. Today, most digital printing environments utilize a digital halftoning process for color printing. A simple digital image could be a binary picture, [h(x, y)], with each point being either completely black or completely white (Pnueli & Bruckstein, 1996). A digital halftone is a pixel map, with bit depth, that gives the impression of an image containing a range of gray shades or continuous tones. An 8-bit grayscale image contains 256 different levels of gray (from white to black). Advancements in digital technology enable the industry to engage in short-run color printing that can achieve levels of color quality comparable to that of the traditional offset printing process.

Print reproduction involves physical/mechanical interaction between the imaging cylinder, dry/liquid toner, and the substrate (Avramoci & Novakovia, 2012). Most photographic technology prints will heavily degrade after about fifty to one hundred years after their initial printing. This allows for determining which factors, including the paper, play the most crucial role in the longevity of printed images. Other distortions may happen to images during the printing process. Printing paper or substrate is considered to be the fifth color for process color printing. The perception of color quality evaluation is strongly influenced by the properties of the paper (weight and brightness), and it is one of the most important factors in judging the color appearance of the printed material. Substrate thickness can influence the paper weight also. Color can be viewed as a science where the optical aspects of color are quantitatively analyzable and measurable. The human eye, however, perceives color more subjectively, which poses a challenge at times for the printing and image reproduction industry.

Literature Review

Literature summarized in this section was found to be important as it relates to the paper properties effect on the color/print attributes ***(primary colors/gray hue, gamut volume, etc.),*** which enables this research to examine/evaluate to determine the quality of color printing. Digital printing methods differ in that they usually do not have a direct physical impact on a substrate. Color electrophotography, or color laser printing, is commonly used and employs charged toner particles that transfer electrostatically to a substrate and create an image that is fused to the surface. The advantage of dry, toner-based digital print technology is that it can create varying images from one sheet to the next and it is more cost-effective for shorter production runs. In 2003, McIlroy posited "all printing processes exhibit dot gain, or more correctly, tone value increase, to varying extents." McIlroy continued by stating, "this includes desktop inkjets, laser printers, digital presses, and any conventional printing press" (p. 261). This establishes not only that dot gain is likely to be a measurable factor in digital printing but provides a basis for defining dot gain and how to measure it. Leurs supports this definition and further refines it by stating "Dot gain is sometimes referred to as TVI (tone value increase). TVI is a more generic description of the difference in tone value between a requested value and the final output. It is also a more suitable name for processes in which, some devices may not actually deliver a dot in the final output" (2013).

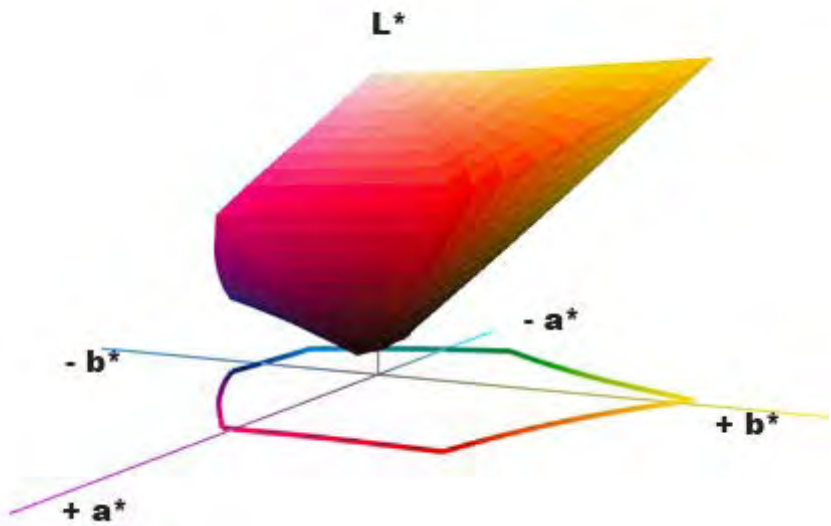
Gray balance is a useful measure of color reproduction because it indicates problems that will impact all other colors. Correct gray balance is a fundamental measure for proper color balance. Printing that does not maintain gray balance will have a color cast that does not only show in the gray area but throughout the entire image. Grays produced using the primary CMY toner colorants must be measured and adjusted regularly to avoid color shifts. The value of a stable, predictable printing process is essential to any color-managed digital printing workflow. The color gamut is defined as the range of colors producible (captured or displayed) or printable on a particular device such as: digital camera/scanner, monitor, or printer. A monitor, which displays red, green, and blue (RGB) signals, typically has a greater color gamut than that of a printer, which uses CMYK dry-toners or liquid inks. Since the paper or the substrate is considered to be the fifth color of multi-color printing, it has a direct effect on the printed colors. For example, image/colors printed from the same device on different types of paper substrates will have a different color appearance (color hue). A simple scenario could be, printing on 75 LBS coated paper vs. 75 LBS un-coated paper, the color results will be different by showing the significant variation visually and quantitatively among the print attributes. Color gamut volume (CGV) is quantifiable in the colorimetric color space. The CGV is generally examined in the CIE L* a* b* color space, and it can be interpreted as the number of colors that are discernable within a tolerance of $\Delta E=\sqrt{3}$ (Fleming & Veronica, 2009).

CIE L* a* b* Color Model

The Commission Internationale de l'Eclairage (CIE), also known as the International Commission on Illumination, is responsible for international recommendations for colorimetric measurements (ANSI/CGATS.5-2003). In 1976, the CIE developed the CIE L*a*b* or CIELAB color model (scale) for quantifying color values numerically. It was intended to provide a standard, approximately uniform color model that could be used by the industry so that color values could be easily compared or expressed (ANSI/CGATS.5-2003). The CIE color model utilizes three coordinates to locate a color in a color model. In a uniform color model, the differences between points plotted in the color model correspond to the visual differences between the colors plotted (Hunter Lab, 1996). The CIELAB color space is organized in a cube

form. The L* axis runs from top to bottom. The maximum for L* is 100, which represents a perfect reflecting diffuser. The minimum for L* is zero (0), which represents black. The +/-a* and +/-b* axis have no specific numerical limits. +a* is indication of red color and –a* is green color in the color model. Additionally, +b* is yellow and –b* is blue (see Figure 1). The center of this model represents the neutral or gray colors. These color scales are based on the opponent color theory of color vision, which means that one cannot be both green and red at the same time, nor blue and yellow at the same time. As a result, single values can be used to describe the red/green and the yellow/blue attributes (X-Rite, 2002).

Figure (1): Schematic Diagram of CIE L*a*b* Color Model



The following equations are used by a spectrophotometer to calculate the CIE L* a* b* values from a color or any colors (ANSI/CGATS.5-2003, p.28).

$L^* = 116\,(Y/Y_n)^{1/3} - 16$

$a^* = 500\,[(X/X_n)^{1/3} - (Y/Y_n)^{1/3}]$

$b^* = 200\,[(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}]$

where: X_n, Y_n, Z_n: tristimulus values of XYZ for 2° standard observer

CIE Color Difference (ΔE)

Assessment of color is more than a numeric expression. Usually it's an assessment of the difference in the color sensation (delta) from a known standard. In CIELAB color model, two colors can be compared and differentiated. The expression for these color differences is expressed as ΔE (Delta E or Difference in Color Sensation). The following equation is used to calculate the ΔE (ANSI/CGATS.5-2003, p.29).

$\Delta E = \sqrt{(L^*_1 - L^*_2)^2 + (a^*_1 - a^*_2)^2 + (b^*_1 - b^*_2)^2}$

where: 1 = Color 1 and 2 = Color 2

CIE Lightness, Chroma, Hue (L* C* H*) and Gray

Each color has its own distinct appearance based on hue, chroma (saturation), and value or lightness (X-Rite, 2007). By describing a color in terms of these three attributes, one can accurately identify a particular color and distinguish it from others. When asked to describe the color of an object, most people mention its hue first. Quite simply, hue is how people perceive an object's color, such as red, orange, or green (X-Rite, 2007). Chroma describes the vividness or dullness of a color: how close the color is to either gray or to the pure hue. For example, the red of the tomato is vivid, but the red of the radish is dull (X-Rite, 2007). The luminous intensity of a color (i.e., its degree of lightness) is its value. Colors can be classified as light or dark when their values are compared. For example, when a tomato and a radish are placed side by side, the red of the tomato appears to be much lighter. In contrast, the red of the radish seems to have a darker value (X-Rite, 2007).

The L* c* h* color space uses the same coordinates as those of the L* a* b* color space, but it uses cylindrical coordinates instead of rectangular coordinates. In this color space, L* indicates lightness and is the same as the L* of the L* a* b* color space, C* is chroma, and h* is the hue angle. The value of chroma C* is 0 at the center and increases according to the distance from the center (See Figure 2). Hue angle h* is defined as starting at the +a* axis and is expressed in degrees; 0° would be +a* (red), 90° would be +b* (yellow), 180° would be –a* (green), and 270° would be b* (blue). Metric chroma C* and the metric hue angle h* are defined by the following formulas (Morovic, et al. 2002).

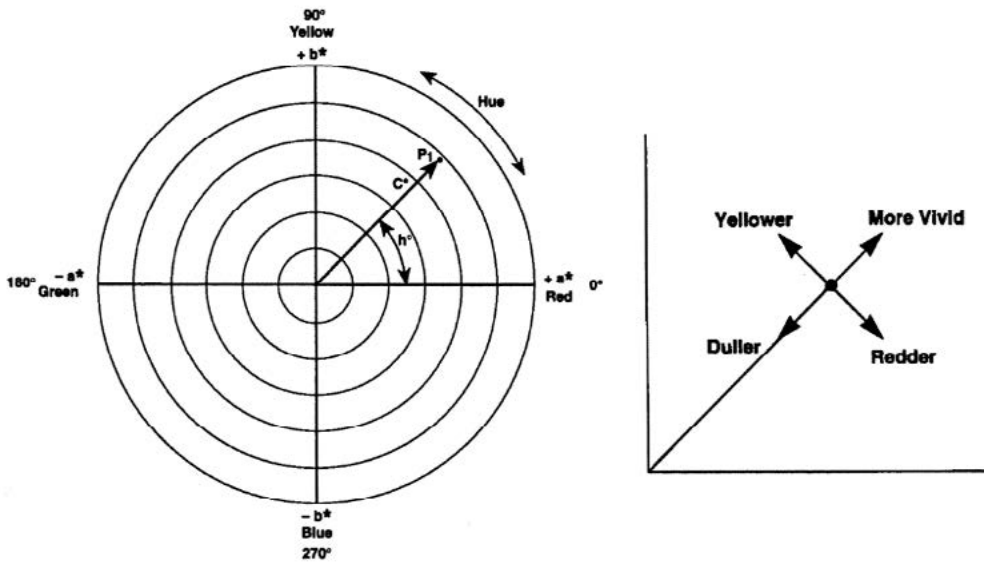
Metric chroma $C^* = \sqrt{(a^*)^2 + (b^*)^2}$

Metric hue angle: $h^*_{ab} = \tan^{-1}\left(\frac{b^*}{a^*}\right)$

where: a*, b* are chromaticity coordinates in L* a* b* color space

Gray balance is the proper percentages of "overlap/combination" of cyan, magenta, and yellow inks that produce neutral shades of gray. Hue shifts will occur when there is any imbalance of one of the components. The imbalance is due in large part to ink impurities. Gray balance is a significant factor in determining overall color gamut. Gray balance can be determined by careful evaluation of a full set of tint charts printed with process inks. Colorimetric method is used to determine ***if the hue of gray*** is desirable in order to make sure that the black ink scale is neutral.

Figure (2): Schematic of L*c*h* Coordinates



Hue difference (ΔH*) is calculated by the following formula (Morovic et al., 2002).

$$\Delta H^* = \sqrt{(\Delta E^* ab)^2 - (\Delta L^*)^2 - (\Delta C^*)^2}$$

$$= \sqrt{(\Delta a^*)^2 + (\Delta b^*)^2 - (\Delta C^*)^2}$$

Purpose of the Research

The experiment was conducted in a digital color printing workflow (DCPW) to determine the effect ***(impact or influence)*** of paper properties ***(thickness and brightness)*** on the color quality based on the statistical evaluation among nine ***(K = 9)*** different types of substrates (printing papers). Each substrate (paper) in the experiment was considered as a group, noted by letter "K" ***(K = 9).*** Paper samples with different properties (weight and brightness) were used (or selected) for the experiment. This study was focused on the measurement of color prints, printed on multiple types of substrates by using dry-toners on a digital color printing device which uses a color electrophotographic (color laser) printing technique.

Color quality was determined by carefully evaluating the printed ***primary colors hue*** [Cyan, Magenta, Yellow, and Black (CMYK) and ***gray hue*** (overlap of CMY)]. Colorimetric, denstometric, and spectrophotometric computations were used to determine the printing colors (solid CMYK) and gray color (overlap of C = 50%, M = 40%, and Y = 40%) ***"hue variation"*** (ΔH) among the nine (K = 9) types of substrates with various thickness/brightness. Type of paper used for the printing will have a significant impact on the print attributes, in turn they

affect the print quality/visual appearance of colors (hue). In order to print a quality halftone image, the printer (or press operator) must carefully manage several variables and attributes which are associated with the printing process. The technology of interest for this study is dry-toner color electrophotography. The following one-tailed non-directional hypothesis was established, because of the multiple types of substrates ***(groups, K = 9).***

> H_o: There is no significant difference (or relationship) in the printing CMYK ΔH and Gray ΔH (CMY overlap) of multiple types of substrates, when the printed colorimetry is compared against the reference colorimetry.
>
> H_a: There is a significant difference (or relationship) in the printing CMYK ΔH and Gray ΔH (CMY overlap) of multiple types of substrates, when the printed colorimetry is compared against the reference colorimetry.

Limitations of the Research

For this experiment, there were limitations to the technology used within the graphics program laboratory. Prior to printing and measuring the samples, the digital color output printing device and color measuring instruments (spectrophotometer and densitometer) were calibrated against the recommended reference. The print condition associated with this experiment was characterized by, but not restricted to, inherent limitations. For example: colored images (ECI2002, ISO300, and ISO12647-7) chosen for printing, desired rendering intent applied, type of digital printer for proofing/printing, type of paper for printing, type of toner, resolution, and screening technique, use of predefined color output profiles, calibration data applied, and so on. Several variables affected the facsimile reproduction of color images in the DCPW, and most of them were mutually dependent. The scope of the research was limited to the color laser (electrophotographic) digital printing system (printing proof/printing) and other raw materials and the multiple types of color measuring devices and color management and control applications (data collection, data analysis, profile creation, and profile inspection) used at the university graphics laboratory. Findings were not expected to be generalizable to other DCPW environments. It is quite likely, however, that others could find the method used and the data of this article meaningful and useful. The research methodology, experimental design, and statistical analysis were selected to align with the purpose of the research, taking into account the aforementioned limitations.

Research Methodology

The digital color printing device used in this experiment is a Konica-Minolta bizHub C6000 Digital Color Press. It uses a Creo IC-307 raster image process (RIP) application (front-end system). This study utilized an experimental research method. Nine ***(K = 9)*** different types of substrates with various properties (weight/thickness and brightness) were used for the printing. Two page custom test image (12" x 18" size) was created for proofing and printing use for the experiment ***(See Figure 3 & 3A).*** The test target contained the following elements: an ISO 300 and generic images for subjective evaluation of color, and an ISO 12647-7 Control Strip, and an ECI 2002 target for gamut/profile creation. Table 1 presents the variables, materials, conditions, and equipment associated.

Colorimetric, Densitometric, and Spectrophotometric data were extracted by using an X-Rite Eye-One Spectrophotometer and X-Rite i1iO Scanning Spectrophotometer from the color printed samples for the statistical analysis to determine the significant differences that

exist among the nine different types of substrates primary colors and gray hue. Print/Color attributes (primary colors and gray hue) from each group were analyzed/compared with one another. For all the nine groups ***(K = 9),*** a total of 900 samples of target color images were printed, 100 prints for each substrate group, noted by letter "N" ***(N = 100).*** Of 100 samples of each group, 80 samples (n = 80) were randomly selected from each substrate group, and measured, noted by the letter "n" (n = 80). Glass, G.V. & Hopkins, K.D. (1996), provides an objective method to determine the sample size when the size of the total population is known. The following formula was used to determine the required sample size, which were 80 (n) printed sheets of each type of substrate for this study.

Figure (3): Page One of the Test Image for the Experiment

Figure (3A): Page Two of the Test Image for the Experiment

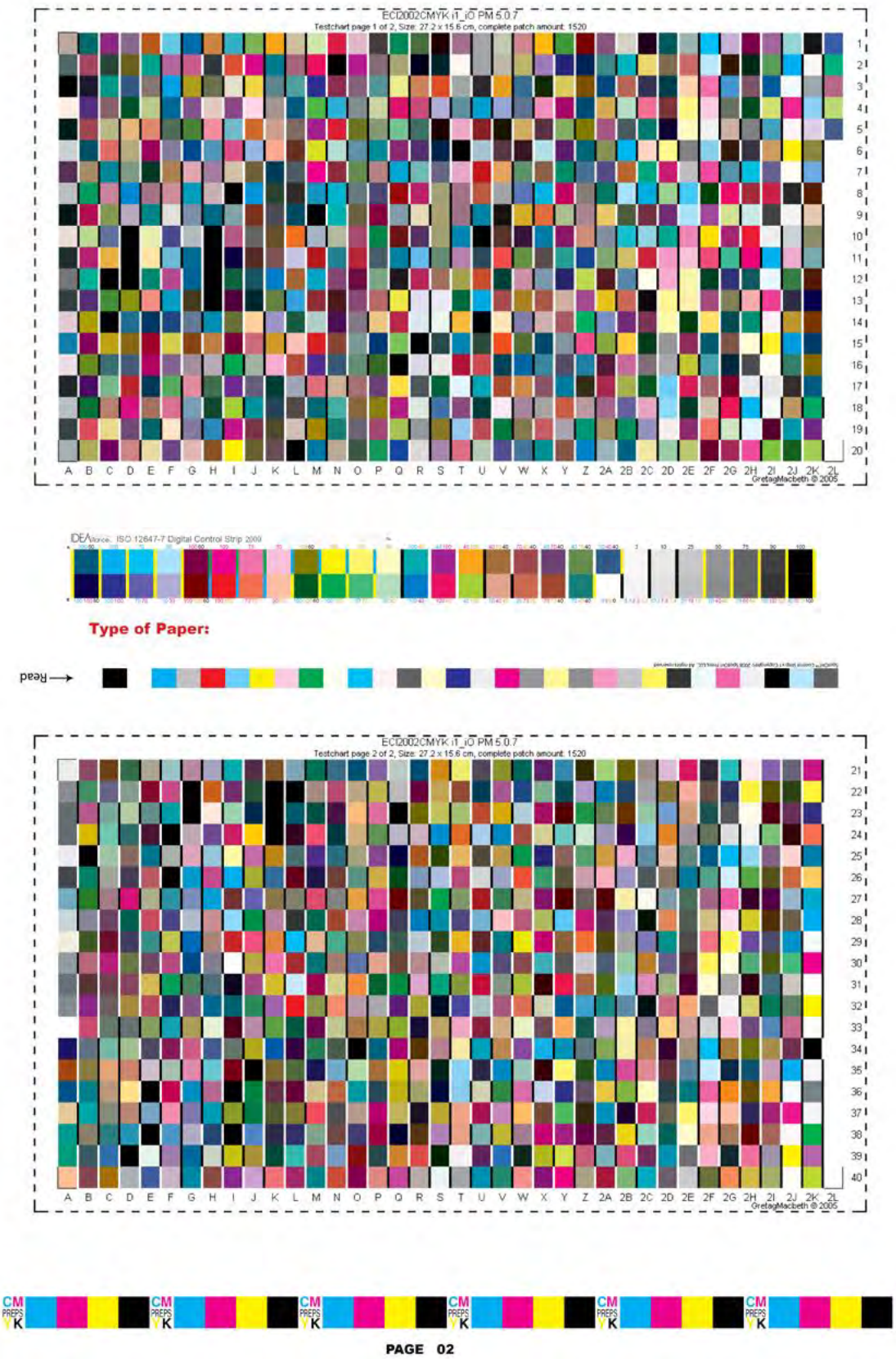


Table (1): Experimental and Controlled Variables

Variable	Material/Condition/Equipment
Test image	Custom Test Target, 2 pages
Control strips/targets	ISO 12647-7, ECI 2002, and SpotOn!Press
Profiling Software	X-Rite Profile Maker 5.0.10
Profile Inspection Software	Chromix ColorThink-Pro 3.0
Image Editing Software	Adobe PhotoShop CS-6
Page Layout Software	Adobe InDesign CS-6
Source Profile (RGB)	Adobe 1998.icc
Emulation Profile (CMYK)	None
Destination Profile (CMYK)	Custom, Konica-Minolta.icc
Color Management Module (CMM)	Adobe (ACE) CMM
Rendering Intents	Absolute
Computer & Monitor	Dell OPTIPLEX/LCD
Raster Image Processor (RIP)	Creo IC-307 Print Controller
Printer	Konica-Minolta bizHub C6000 Color Laser
Achieved CMYK SID for all print runs	C = 1.24; M = 1.27; Y = 0.89; and K = 1.59
Screen Ruling	190 LPI
Print Resolution	1200 x 1200 DPI
Toner	Konica-Minolta Color Laser
Paper (sheetfed)	Multiple types: thickness/weight & brightness 100
Paper Weight/thickness	LBS = 20, 28, 32, 45, 50, 60
Paper Weight/thickness	LBS = 75, 80, 100
Type of Illumination/Viewing Condition	D50
Color Measurement Device(s)	X-Rite Eye-One PRO Spectrophotometer with Status T, 2^0 angle, and i1iO Scanning Spectrophotometer
Data Collection/Analysis Software	SPSS, SpotOn! Press, and MS-Excel

$$n = [\chi^2 NP (1-P)] / [d^2 (N-1) + \chi^2 P (1-P)]$$

n = the required sample size

χ^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.84)

N = the total population size

P = the population proportion that it is desired to estimate (.50)

d = the degree of accuracy expresses as a proportion (.05)

Statistical Method Applied for the Experiment Data Analysis

The total population for this study was 100 (N) printed sheets for each type of paper. Total printed sheets for all the groups, $N_i = 900$, and total randomly selected printed samples from all the groups, $n_i = 720$. Data for this study was collected from ISO 12647-7 Control Strip, and an ECI 2002 target from the test image (part of printed samples). Microsoft Excel and Statistical Package for Social Sciences (SPSS) were used to analyze the collected data to determine the colorimetric variation (COLVA) among the multiple substrates. Since K = 9, inferential statistics were used to determine the significant differences that exist among the ***(K = 9, n_i = 720, and N_i = 900)*** group mean color deviations of the various substrates.

Collected data was arranged in an analyzable format for each attribute of each/every substrate. A Statistical Package for Social Sciences (SPSS) was used for inferential analysis from the ***collected data*** (color hue variation and gamut volume) of all these nine types of substrates to determine the significant differences that exist in the quantifiable print/color attributes of these nine types of paper substrates. Since K = 9, a one-way Analysis of Variance (ANOVA) with equal n's method (at $\alpha = 0.05$) was employed to determine the significant differences that exist between (K = 9, n = 80, and N = 100) printed attributes means/averages for each group. The F-test can be calculated by using the following equation (Glass & Hopkins, 1996).

$$F = \frac{\sigma_b^2}{\sigma_w^2} = \frac{MS_b}{MS_w} = \frac{SS_b / V_b}{SS_w / V_w} = \frac{\sum n_k \left(\bar{X}_k - \bar{X}\right)^2 / K-1}{\sum \left(X_{ik} - \bar{X}_k\right)^2 / N-K}$$

The F distribution and a probability value p, which is derived from F, will be used to determine if significant differences exist in the print attributes of multiple groups of substrates. F is a ratio of two independent estimates of the variance of the sample, namely between the groups and within the groups (K = 9, N = 100). A low p value (or higher F value) is an indication that one of the substrates means (an attribute's average) is significantly different. It would suggest that there is a strong support that at least one pair of the substrate means is not equal. A higher p value (or lower F value) indicates that the means of attributes/substrates are not statistically different. The value of q is the difference between the larger and smaller means of the two samples. Differences among the means at $p \leq 0.05$ will be considered to be statistically significant among all the groups (K = 9) or multiple substrates.

Data Analysis & Research Findings

The descriptive and inferential statistical methods were used to analyze the data and presented in the following pages/tables. Subjective judgment on color difference/deviation was not used in this study. The subjective judgment of color difference could differ from person to person. For example, people see colors in an image not by isolating one or two colors at a time (Goodhard & Wilhelm, 2003), but by mentally processing contextual relationships between colors where the changes in lightness (value), hue, and chroma (saturation) contribute independently to the visual detection of spatial patterns in the image (Goodhard & Wilhelm, 2003). Instruments, such as colorimeters and spectrophotometers, could eliminate the subjective errors of color evaluation perceived by human beings.

Paper property "weight" was tested against the color hue deviation and gamut volume. A total of nine different thicknesses/weights (9 types of papers) were used for the color print quality analysis (see Table 2 for paper/substrate variations). Paper weight is commonly identified as grams per square meter (g/m^2). In North America, paper weights are given as the weight in pounds (LBS) of 500 sheets of paper in basic size (see Table 2). Paper brightness is a measure of the amount of light, of a specific wavelength, that a sheet of paper reflects. The higher the light reflection, the higher the paper brightness. Color printing with higher paper brightness provides more contrast by allowing colors to stand out.

Table (2): Types of Papers/Substrates used for the Experiment: Size 12" w x 18" h

Paper Weight LBS./ Groups / K = 9	*CTD or UNCTD*	*Category or Type of Paper*	*Brand or Manufacturer*	*Brightness or Light Reflection per US TAPPI Scale*
20 LBS.	UNCTD	Text	Hammermill	89
28	MTCTD	Text	Hammermill	80
32	MTCTD	Text	Neenah	75
45	UNCTD	Text	Hammermill	76
50	MTCTD	Color	LYNX	90
60	CTD	Color Laser	MOHAWK	100
75	MTCTD	Cover	Xerox Silk Elite	98
80	CTD	Cover Color	Hammermill	100
100	CTD	Blazer Digital	NewPage	100

UNCTD = Uncoated; CTD = Coated; and MTCTD = Matte Coated

Printing Colors (CMYK) Hue Deviation (ΔH) Reference VS Printed Colorimetry

The average primaries ΔH were different from one substrate to the other. As such, the ANOVA test was conducted to determine if there was any significant difference, $p \leq 0.05$ among the primaries ΔH of the multiple substrates. An ANOVA test revealed that there was a significant difference among the CMYK primaries ΔH produced by each (multiple) paper/substrate, $F(9, 891) = 133.44, p = 0.000$. Data indicated that each of the paper used shows the printed primary colors differently (hue deviation). As such, the effect was significant at the $p < 0.05$ for all nine substrates/papers (see Table 2). Post-hoc ANOVA analysis was **NOT** employed to determine which group (K) of paper means (averages) were significantly different ***(among the multiple substrates means/average primaries ΔH),*** when compared two sample means/averages at a time (Glass & Hopkins, 1996). Descriptive statistical analysis was used to compare the means/averages of multiple substrates means/average primaries ΔH (see Table 4). Color gamut volume (CGV) was extracted from the created profile of each paper (K = 9). ColorThink Pro software was used to extract the numerical information of CGV (***see Figure 4***).

Table (3): Summary of ANOVA for Multiple Papers/Substrates on the Primary CMYK Colors ΔH

Source of Variation	*Sum of Square*	*df*	*Mean Square*	*Cal. F*	*Crit. F*	*Sig.*
Between Group	129.22	8	11.75	133.44	1.83	0.000*
Within Groups	20.77	891	0.09			
Total	149.99	899				

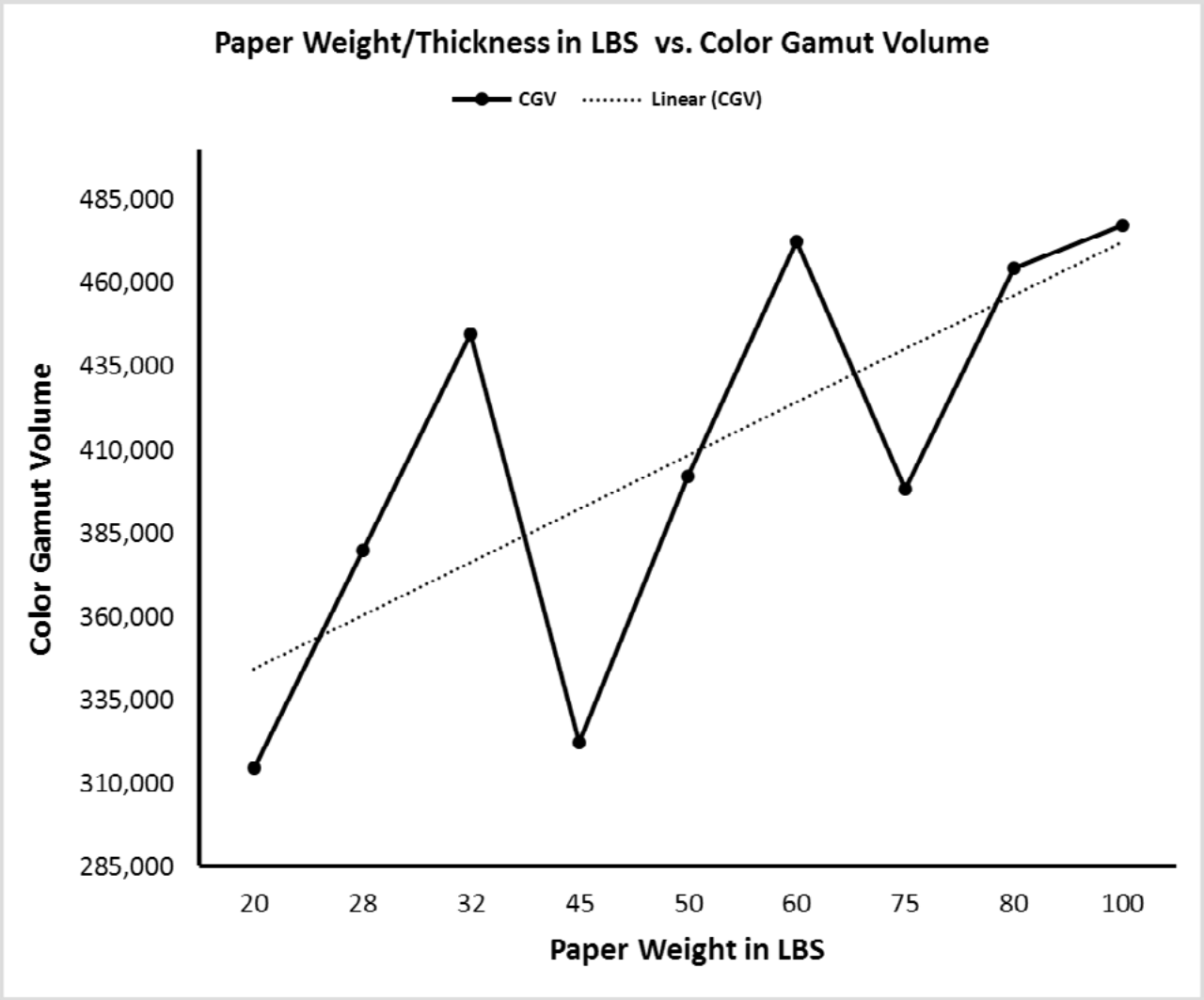
**Significant Difference [(a= 0.05 > 0.001) (F = 133.44 >1.83)]*

Table (4): Comparison Multiple Papers/Substrates on the CMYK Primary ΔH

CPaper LBS./ Groups / K = 9	*Color Gamut Volume (CGV)*	*n = 80*	*Mean n = 80*	*STD/Deviation*	*Sig.*
20 UNCTD	314,798	7.66	0.22		0.000**
28 MTCTD	379,793	6.10	0.43		0.000**
32 MTCTD	444,661	5.36	0.14		0.000**
45 UNCTD	322,392	4.98	0.12		0.000**
50 MTCTD	401,914	5.70	0.39		0.000**
60 CTD	472,661	6.07	0.27		1.000
75 MTCTD	398,140	5.42	0.25		0.000**
80 CTD	464,372	4.89	0.35		0.082
100 CTD	477,190	6.35	0.24		0.189

* $p \leq 0.05$ and ** $p \leq 0.001$

Figure (4): Comparison of Paper Weight VS Color Gamut Volume



CMYK primary colors hue deviation was significant among the paper groups from 20 LBS to 50 LBS, and 75 LBS. No significant hue deviation was detected among the paper groups of 60 LBS coated, 80 LBS coated, and 100 LBS coated. Comparison of primary color hue deviation (ΔH) with printed vs. reference colors, the 80 LBS coated paper produced the least deviation, while 20 LBS uncoated paper produced the highest color deviation (see Figure 5).

Gray Color (Overlap of CMY) Hue Deviation (ΔH): Reference Vs. Printed Colorimetry

An ANOVA test revealed that there was a significant difference among the gray ΔH produced (gray hue appearance) each (multiple) substrate/paper, ***F (9, 891) = 1309.77, p = 0.000.*** Data indicated that on each paper/substrate surface, the gray colors look differently (see Figure 5). As such, the effect was significant at $p < 0.05$ for all the nine substrates/papers of various thickness/weight (see Table 5). Post-hoc ANOVA analysis was **NOT** employed to determine which group (K) of paper means (averages) were significantly different ***(among the multiple substrates means/average Gray ΔH),*** when compared two sample means/averages at a time (Glass & Hopkins, 1996). Descriptive statistical analysis was used to compare the means/averages of multiple substrates means/average Gray ΔH (see Table 6).

Figure (5): Comparison of Paper Weight/LBS VS CMYK Primaries ΔH & Gray ΔH

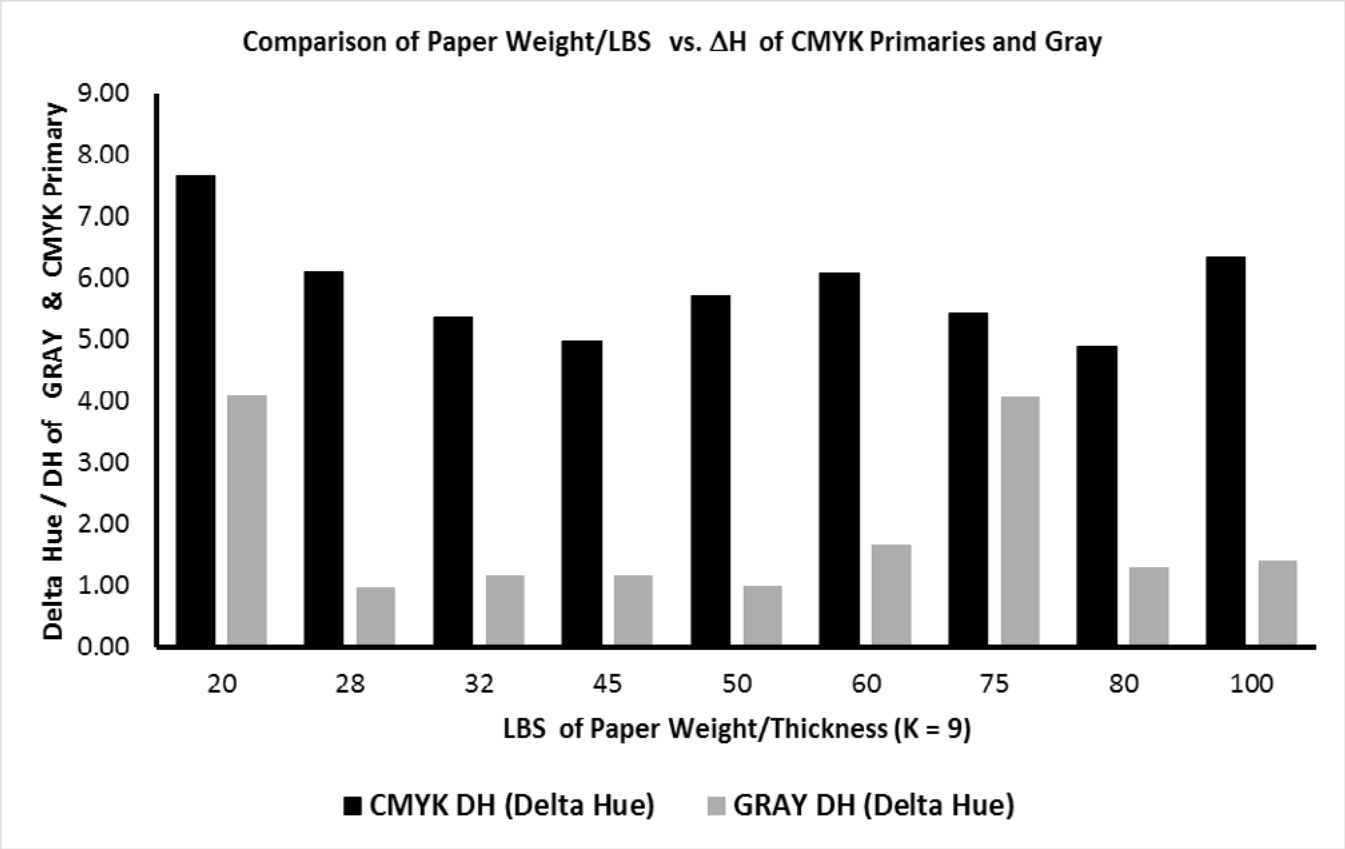


Table (5): Summary of ANOVA for Multiple Papers/Substrates on the Gray ΔH

Source of Variation	*Sum of Square*	*df*	*Mean Square*	*F*	*Cal. F*	*Crit. Sig.*
Between Group	291.77	8	26.52	1309.77	1.83	0.000*
Within Groups	4.80	891	0.02			
Total	296.57	899				

**Significant Difference [(a= 0.05 > 0.001) (F = 1309.77 > 1.83)]*

Table (6): Comparison Multiple Papers/Substrates on the Gray ΔH

Paper LBS./ Groups / K = 9	*Color Gamut Volume (CGV)*	*Mean n = 80*	*STD/Deviation n = 80*	*Sig.*
20 UNCTD	314,798	4.09	0.17	1.023
28 MTCTD	379,793	0.96	0.07	0.000**
32 MTCTD	444,661	1.17	0.11	0.000**
45 UNCTD	322,392	1.17	0.12	0.000**
50 MTCTD	401,914	1.00	0.17	0.000**
60 CTD	472,661	1.67	0.15	1.000
75 MTCTD	398,140	4.07	0.20	1.002
80 CTD	464,372	1.30	0.06	0.103
100 CTD	477,190	1.39	0.19	0.217

* $p \leq 0.05$ and ** $p \leq 0.001$

Gray hue deviation was significantly higher among the paper groups from 20 LBS and 75 LBS. No significant hue deviation was detected among the remaining paper groups of 60 LBS coated, 80 LBS coated, and 100 LBS coated. Comparison of gray hue deviation (ΔH) with printed vs. reference colors, the 28 LBS matte-coated paper produced the least deviation, while 20 LBS uncoated paper produced the highest gray hue deviation. As the thickness of paper increased, the color gamut volume also increased.

Conclusions / Summary

This research demonstrates the use of ANOVA to determine the influence of substrate property (thickness/weight) in the primary colors and gray color hue variation among the nine types of papers/substrates, printed in a digital color printing workflow. The findings of this study represent specific printing or testing conditions. The images, printer, instrument, software, and paper that were utilized are important factors to consider when evaluating the results. The findings of the study cannot be generalized to other digital printing workflow. However, other graphic arts educators, industry professionals, and researchers may find this study meaningful and useful. For example, educators can implement similar models, the presented model, or this method to teach. The colorimetric data of this experiment led to the conclusion that the selection of a suitable paper is an important step for printing colors of choice for a desired use/purpose using a methodology that could be reproduced to test for similar results using differing measurement devices. The study has applications to advancing the printing industry, but also in educating future graphics students.

The conclusions of this study are based upon an analysis of the ANOVA test data and major findings (data and experience of the experiment). The data from the ANOVA test revealed that there were significant differences in the color reproduction among the multiples types of substrates used. As such the null hypothesis were rejected. There were significant differences that were found in gray color hue and primary color hue variation. Furthermore, the experience of the experiments (visual comparison) and analyzed data proved that there were noticeable color differences among the printed samples (photographs, commercial, and digital printing) of various substrates. One could **NOT** achieve the same color output with various types of paper substrates and should be cautioned to identify color hue on coated vs. uncoated papers. Higher color deviations (ΔE or ΔH) mean that the printed colors could be out of established deviation tolerances.

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Management

Re-Shoring - and Why it Makes Sense Now!

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Introduction

There is certain discrepancy among scholars and the general public about the effects of offshoring for the economy of our country. Judy & D'Amico (1998) state that those in favor of offshoring argue that by offshoring, American companies can concentrate in core competencies, leaving repetitive processes or labor-intensive tasks to other nations. According to Wolak (2011) the US specializes in goods that are human-and physical-capital intensive utilizing sophisticated equipment while developing countries specialize in the production of labor-intensive products. However, thanks to offshoring, we can enjoy a plethora of imported consumer goods produced frequently at competitive prices in oftentimes low-cost countries. The core competencies touted by offshoring supporters, is our competitive advantage in the manufacturing of high-technological products, not so easily copied or replicated in offshored countries due to its sophistication and cost. Soros (2002) explains that due to globalization and the easiness of capital movement around the world, developed countries will lose jobs, but will at the end gain from trade exchanges, allowing new jobs with greater value added to surface. The offshoring of American manufacturing has been mainly to developing nations like China, India and Mexico (Shoen, 2015). The problem is why this happened.

Economic Policy Led to Offshoring

During the 1990's three major events took place that might have led America to offshore and change the map of the manufacturing world. First, India opened its doors to foreign investment in 1991. Secondly, China agreed to liberalize its market joining officially the World Trade Organization (WTO) in 2001. Third, The North American Free Trade Agreement came into effect in 1994, allowing the free trade of goods, products and services among the US, Canada and Mexico (Koren, p.10). China, India and Mexico would become America's most frequent offshoring destination contributing to the enlargement of our trade deficit. The cycle of higher imports and decreasing exports began under the government of President Nixon who experienced two economic problems, declining competitiveness and rising inflation. In 1971, the US recorded the first and small trade deficit of $2.3 billion, the first since 1893 (Schaeffer, 2003). According to Schaeffer, a possible explanation for the diminishing competitiveness of the US is found on its foreign and economic policy. He explains, The Marshall Plan designed by the US to accelerate the recovery of Western Europe after World War II, granted these nations approximately $120 billion in today's value as assistance to rebuild their economies. As these countries rebuilt their manufacturing base American businesses, as a result, found it more difficult to sell their products on these markets. Simultaneously the Vietnam War was increasing military spending and pushing up wages and prices, leading to rising inflation. In 1971 President Nixon announced the devaluation of US dollar. To fight inflation Nixon introduced wage and price controls (Schaeffer, 2003). Nixon believed Americans would find the imported goods less affordable and choose to buy American goods again; this, he assumed, would decrease the trade deficit. American buyers continued showing preference for foreign products. The increased demand for foreign cars together with a higher demand for foreign oil increased

the trade deficit (Schaeffer, 2013). President Reagan also attempted to stabilize the dollar. Reagan backed the Plaza Accord agreement signed by the five most powerful nations of the time: West Germany, France, Japan, the UK and the US (aka G5). These nations reached an agreement to devalue the US dollar and stabilize the trade deficit. The meeting was held under secrecy to prevent foreign governments holders of US dollars from cashing their dollars in exchange for gold at $35 to the ounce (Schaeffer, 2013). The implementation of high interest rates during the 1980's (to attract foreign investors and their American dollars) made it difficult for US companies to borrow the money needed to expand and grow. The financial environment of the US in the 1980's led to the massive flee of the domestic manufacturing industry to developing countries offering a much more attractive business environment. China and India became the main recipients of US companies through outsourcing (Morley, 2006). Mexico, member of NAFTA, offers a convenient location, low cost labor and educated workforce (Farrel et al, 2007).

The Offshoring of American Manufacturing

The manufacturing industry has been directly affected by the fiscal policies adopted by the US government. Since China joined the (WTO), the US deficit with this nation has only increased. Scott reported in 2007 that the US trade deficit with China has displaced production that could have led to the creation of 2,166,000 jobs in America. In a 2014 report Scott states that in a 12 year period, (from 2001- 2013) around 3.2 millions jobs have been lost, and three quarters of those jobs were in manufacturing (Scott, 2014). The Commission of the European Communities (1993) as cited by Krugman and Venables, (1995) state that "the rise of Third World manufacturing nations has already had serious adverse impacts" for developed nations. Although China has several laws that protect their workers, these are frequently ignored or not enforced (Hogan). However, Soros states that countries offering cheap labor, have not taken measures to provide better labor conditions to its citizens. This, he says, "suits the corporate interests of multinationals just fine", since without labor regulations, worker compensations can be kept at a minimum. According to Krugman (2000) if China continues to grow at 7 percent per year while the US is growing at only 3 percent a year, China will have the world's largest economy by 2025. The World Bank states that China's GDP growth has averaged nearly 10 percent a year—the fastest sustained expansion by a major economy in history—and has lifted more than 800 million people out of poverty. Schaffer states that China's economic development could not have been possible without the large capital contributions from the US for its development, in the form of foreign direct investment (FDI). In 1996, China alone received $42 billion dollars in FDI, India of similar population size received only $3 billions and Mexico with 97 million people received $6 billions (Schaffer, 2013). Although China's growth is touted as a miracle, the World Bank classifies China still as a developing country. China still has a population of 70.17 million people living in poor rural areas (The World Bank, 2016). Krugman also notes that developing countries, as a group, will eventually overtake the economic superiority of developed nations. This, Krugman explains, is not that "America is doing something wrong, but because many other countries are also doing something right" (pg. 175).

The US deficit reached $500 billion in 2015, and this trend continues into 2016 as well. The government's economic measures have played a significant role in the evolution and acceleration of offshoring of the domestic manufacturing industry. It is unquestionable that primarily US male workers have suffered directly the consequences of offshoring. Schaeffer (2013) posits that "monetary policy is gendered: changing exchange rates primarily affect men in manufacturing" (p. 69). Despite this fact, both men and women suffer

equally the consequences of offshoring: when men are laid off, women usually take up jobs in the service industry to make up for the lost income. The presence of both on the labor market depresses even further the wages paid to them. The Bureau of Labor statistics lists unemployment rates in manufacturing at 4.9 percent in June 2016, thus the number of unemployed persons increased by 347,000 to 7.8 million (The Bureau of Labor Statistics, 2016).

Several factors are mentioned as the main motivators for the offshoring experienced: cost reduction, cheaper labor, workforce skills, market expansion, better technology and production systems (Hogan, 2013). According to a survey conducted by Nirupam Bajpai 70 percent of the respondents stated that cost-savings was the main reason for offshoring followed by increased capacity, labor cost and access to better technology (Smith, 2006). Trefler, as cited in Cheung, Rossiter, Yi, (2008) states that closer proximity to customers is another motivator. Being close to the customer and being able to adapt quickly to market changes (Pickett, 2015) is an enormous opportunity for global companies to supply their customer needs. Accent surveyed 287 manufacturing executives in 2011 and found out that labor cots remains as the major motivator for offshoring. Hagel (2004) estimates that productivity might have tripled by moving operations to Asian countries. Other reports show that the cost of moving manufacturing operations abroad represented also an increment of tangible and intangible costs that could be as high as 24 percent of the total product cost (Hogan, 2004). Despite the reasons provided by the offshored companies, for many, the expectations of great returns and competitive advantages did not materialize. Hogan (2013) posits "companies are lured by tales of low labor cost and decide to transition their products to China, only to find the initially estimated savings were never realized".

Disillusionment is also on the consumer side. Choate (2008) emphasizes the dangers consumers have encountered after purchasing products from China and India. One of the most recent cases is the Chinese laminate flooring. People who purchased this flooring is about three times more likely to develop cancer. The retailer suspended its sales of all Chinese laminate flooring after the reports surfaced (Bomey, 2016). The case of lead paint in Mattel toys was discovered after 300,000 toys had already been sold in the US (Story, 2007), (Stewart, 2015). The predominant problem with India is the counterfeit of consumer-packaged goods. Since 2010, India has been under the radar on the US Priority Watch List of countries, due to repeated violations of intellectual property rights. The Economic Times in 2015 reported that counterfeit goods is a real problem for improving the image of India and the "Make in India", a slogan promoting the Indian manufacturing sector.

The Time for Reshoring is Now!

According to Morris (2015) the cost of labor in China has more than quadrupled since 2006. This, he states have prompted Chinese companies to relocate their production to other Asian countries offering the advantages of even lower-labor costs (Callari, 2016). According to Hogan (2013) Chinese labor rates ranged from $0.33/hr to $4/hr depending on location, while Oppenheimer (2016) states that when offshoring began wages were in the range of 0.50/hr. Today, he states US industries need to pay Chinese workers $4 to $5/hr . Moser states that for the past decade Chinese wages have risen 15 to 18 percent a year and are expected to continue increasing (as cited in Branham, 2016). There is not indication of a halt on Chinese wages so they will soon be equitable with those paid in the US. The infrastructure and the cost of energy in China has significantly improved, but at the expense of increased costs. Morris (2015) states that electricity is now more reliable but has experienced a continuous cost increase of 15 percent per year for the past six years. Karl et al state that China's electricity is already expensive, costing on average 15 percent less than in the US while in some provinces prices are equal to those paid in the US (Karl, 2011). According to Spegele (2015) the instability of the Chinese electric grid is still experiencing frequent power outages. The US, Spegele states, can offer energy at a lower cost as a result of shale gas explorations (Van Den Bossche et al, 2014). Karl notes that China subsidizes the price of energy for heavy energy consuming industries while the US approach to energy prices is to reflect their actual cost. American manufacturing offshored to exploit the advantages of mass production and low-skilled workers (Korem, 2010). A problem encountered in China is the lack of skills of the workforce. According to Datsmalchi (2007) companies hastily moved their operations to China without considering the actual capabilities of their workers.

Figure (1) China's Wage Increase in CNY. Trade Economics, 2016

Conclusion

According to the 2013 Census Bureau report there are over 45 million Americans (or 14.5 percent of the population) living under the poverty line. The BLS lists 7.8 million people as unemployed in the area of manufacturing. It is stated that America does not have a qualified workforce (Colombo, 2016) or that labor-intensive manufacturing is not the path to revitalizing the industry. According to Brahman skills are a critical component in manufacturing. If this is the truth, then the US provides a better-qualified workforce even at the unskilled labor level they need. The advantages of having a close-by, accessible and English-speaking workforce with at least a high-school diploma would reduce or possibly eliminate the re-work, defects and waste experienced when production takes place at distant places. We need a manufacturing base that covers the entire spectrum from labor-intensive to high-tech manufacturing, able to absorb the labor available in the US. Believing that only high-tech manufacturing will provide wealth to our society is inaccurate; much of China and India's wealth was created by low-skilled labor in mass-production factories. A country like the US cannot continue producing most of its consumer goods manufactured in offshored nations, while the country is starving for work. The gains of low-labor cost once touted as the main advantage of China have vanished, making the wages paid on both sides of the ocean comparable. Thus, there is no reason to continue manufacturing abroad only on the basis of labor cost.

Access to reliable energy is key for sustained production. China and India have insufficient grid capacity to provide the energy needed to high-energy-consuming industries. The low cost of energy together with its reliability and interrupted supply gives the US an economic advantage over those nations. Any state in the US has a better-developed infrastructure than those found abroad. Transportation is another major area of concern, not only due to its fluctuating cost, but also due to externalities like pollution. The number of ships crossing the oceans and transporting mostly commodities is polluting the oceans. According to Pearce, just 16 percent of the world's largest ships can produce as much lung-clogging sulphur pollution as all the world's cars. Ships use the cheapest, filthiest and high-sulphur content fuel that is not allowed on land (Pearce, 2009). According to Barboza (2015) seaports attract trucks, trains and locomotives to move the cargo out of the port, releasing emissions into the air. Studies show that communities in the proximities of seaports are facing increased occurrences of asthma and cancer from air pollution (Pearce, 2009).

Employing American skilled and unskilled labor contributes to the development of the economy by providing an income, lifting people from welfare assistance, and stimulating the economy while providing capital that can be reinvested in the country. Due to scarcity, Americans still are forced to buy foreign products due to the limited availability of American-made products on the market. Making goods in America again, will not only provide work to the large numbers of unemployed Americans, but also facilitate the resurgence of Made-in-America goods again. The resurgence of the American manufacturing industry can only happen if government, industry and academia join forces to shape the labor forced needed in the country. UCLA Professor Chris Tilly argues "too many Americans attend college fixated on the idea that a college degree is the only way to make big bucks" (Gillespie, 2015). Moser states that students are skewed towards university degrees they are not interested in for the only reason of prestige. He argues the names "trades" and "vocations" are a deterrent for students to opt for those studies. He recommends changing their name to "professions" as to increase academic recognition and self-fulfillment need of those taking that educational path.

The government at both State and Federal levels is implementing programs geared towards attracting investment again. The Obama administration is seeking to discourage companies from offshoring by providing tax incentives, tapping synergies among universities and industry, research centers and business, and reducing the cost of energy. Another initiative is the "Make it in America Challenge", encouraging U.S. companies to maintain, expand and/or bring home their manufacturing and, consequently, to accelerate the creation of jobs and at the same time to induce foreign companies to implement business investment in the US (TWH). States are also attracting companies: the State of Pennsylvania with the initiative "PA Made Again" is creating new jobs through the preservation and expansion of the manufacturing sector. South Carolina has implemented the "Select SC" a program focusing on improving in-sourcing, development and FDI.On the industry side, Wal-Mart, after decades of supplying the American market with low cost products from China and Asia, has rediscovered the value of "Made in the USA". Wal-Mart's has announced an investment of $250 billion over the next 10 years to increase their sales of US manufactured products (Marsiglio, 2016). It is estimated that approximately 300,000 manufacturing jobs and a total of 1 million jobs will be created (Reshoring Initiative, 2016). This is a clear opportunity for domestic manufacturers to revitalize the American manufacturing sector providing employment to those that were once dislocated or who have not been able to find any employment at all and to rebuild their image of a true American company.

Figure (2) Reshoring, Jobs added. The Reshoring Initiative, 2015

The Reshoring Initiative has recorded 357 cases of U.S. companies returning to the US. Their return has created over 240,000 jobs in the past six years (Cole, 2016).

The Boston Consulting Group's fourth annual survey of senior US based manufacturing executives at companies with at least $1 billion in annual revenues states that they are already in the process of reshoring (GTNews, 2016). Companies like Caterpillar and GE have found reshoring as a way to bring their manufacturing back home. The time is here and now to take advantage of the opportunities given by the US, its solid infrastructure and stable economy. America needs it and the workers are demanding it.

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Management

The Revised Certified Technology Manager Exam: The First Year's Results

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Introduction

The objective of this study was to evaluate the performance of the revised Certified Technology Manager (CTM) exam after implementation in order to determine if it is meeting expectations and if further revision is needed. In addition, this study provided a methodology framework for evaluating other similar exams both now and in the future. Three groups benefit from this research. Test-takers can have a fair evaluation of their performance. Test-designers can use the results of the study to improve their question design skills for other exams or revisions to the current CTM exam. The Association of Technology, Management, and Applied Engineering (ATMAE) and hiring industrial organizations can have confidence that the exam results actually measure the relevant competencies specified by the certificate.

Background for the Study

In the academic year 2014-2015, the ATMAE Certification Board released a revised version of the ATMAE Certified Technology Manager (CTM) exam. Reasons for the revision were that the previous exam was based on 10-year old ATMAE accredited program curricula and accreditation standards. The previous exam also created prior to the 2011 outcomes-based program accreditation standards. Thus, the exam was looking backwards rather than forward. The goal of the new exam was to be congruent with current industry needs and useful for outcomes-based program assessment. As the previous exam was often used as an output measure of program competency, the revised CTM exam also needed to focus on technology manager competencies, not just technical competencies.

In order to ensure the validity of the revised exam, the Certification Board drew upon previous research conducted by the ATMAE Management Division that defined technology management core competencies using a technology management model (Doggett, McGee, & Scott, 2014). The model provided a generic set of entry-level competencies for a technology manager within a category of knowledge (i.e., processes, projects, systems, and operations) for a specific managerial context such as managing people, quality, risk, and self. The ATMAE Management Division ratified the management competencies and technology management model in 2013. In addition, the source literature most frequently assigned to students in technology management courses within ATMAE accredited programs was utilized as the body of knowledge for the exam (Doggett, 2015). This literature and a sampling of the exam questions is listed in the CTM Certification and Assessment Study Guide available on the ATMAE website (www.atmae.org). In summary, the objectives of the revised exam were to (a) emphasize technical managerial professional skills, (b) align with the technology management body of knowledge, (c) be competency-based, and (d), be able to be incorporated into outcomes assessment, accreditation, and individual evaluation.

The Revised Exam Architecture

Before describing the revised exam, a brief description of the previous exam is relevant. The previous exam consisted of 160 questions in nine major topic categories with 42 sub-categories. It contained a heavy focus of quality and safety within a manufacturing context. The perspective of the exam was that of a technologist with questions not only on technology and management, but also chemistry, physics, and English. ATMAE has since expanded its influence to more than manufacturing programs and the technologist has evolved into the technology manager, particularly at the four-year level. The revised exam needed to reflect the current competencies required for the technical managerial professional across all industrial contexts.

The revised CTM exam has 160 questions in ten major topic categories with 38 sub-categories. It is based on the technology management body of knowledge with a balance of questions across the categories. Approximately 45% of the questions are new. The ten major categories are leadership (10 questions), self-management (18 questions), systems (18 questions), processes (19 questions), operations (19 questions), people (19 questions), projects (19 questions), quality (19 questions), risk (7 questions) and safety (12 questions). Of the topic categories, 100% of the questions from the old exam were retained for quality, risk, and safety. For the other topic categories, the following percentages of questions were retained from the old exam: people 68%, processes 52%, operations 50%, systems 50%, and leadership 30%. Alternatively, the project management and self-management questions were primarily new consisting of 85% and 100%, respectively. Ten questions were revised to correct for mechanical errors or gender bias.

First Year Findings

The 2014-2015 academic year was the first implementation year for the revised exam and it was taken by 436 examinees. Of the 436 who completed the exam, 267 (61%) passed with the minimum cut-off score of 95 or higher. The average score was 96.3 with a standard deviation of 26.6. Three of the examinees did not answer any questions. Each question on the exam is worth one point and the range of scores was 138. The average percentage of the 160 questions answered correctly ranged from 12 to 90 percent. For example, 21 questions on the exam were answered correctly 80-90% of the time. These 21 questions represented 13% of the entire exam questions. Table 1 shows the number and percentage of questions scored correctly.

Table (1) Number of Questions Correctly Answered by Stratified Percentage

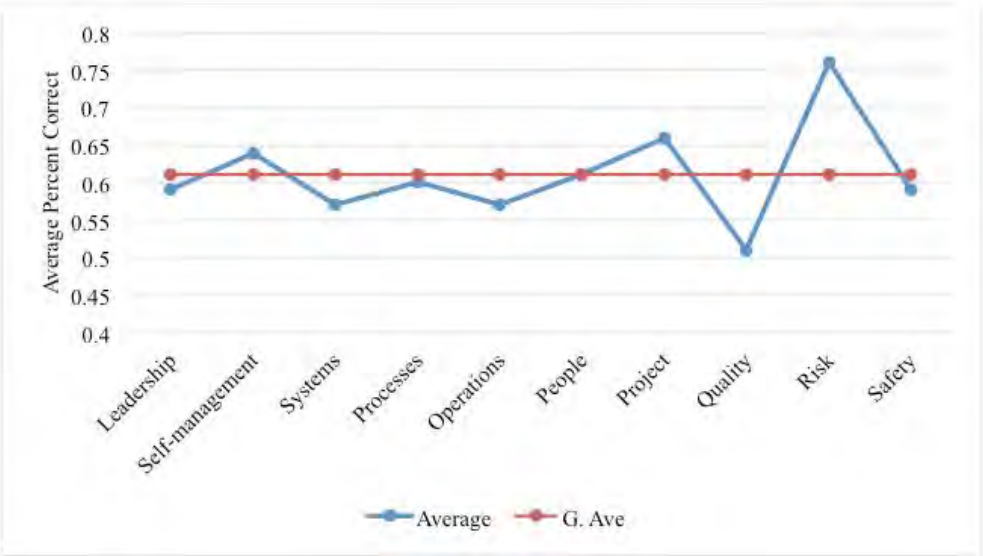
Average Percent of Correct Responses	Number of Questions	Percent of Total Questions
12%-19%	4	2%
12%-29%	6	4%
30%-39%	9	6%
40%-49%	19	12%
50%-59%	32	20%
60%-69%	37	23%
70%-79%	32	20%
80%-90%	21	13%

The grand average across all exam categories was 60% with an average standard deviation of 16%. The average range was 56%. The average chart for each question is shown in the Appendix. Table 2 shows the overall average, standard deviation, and range for each topic category. The average percent correct by topic category is shown in Figure 1. The lowest scoring category was quality (51%) and the highest scoring category was risk (76%), which also had the lowest variation (11%). The most variation was in the category of safety (21%).

Table (2) Average, Standard Deviation, and Range for Each Topic Category

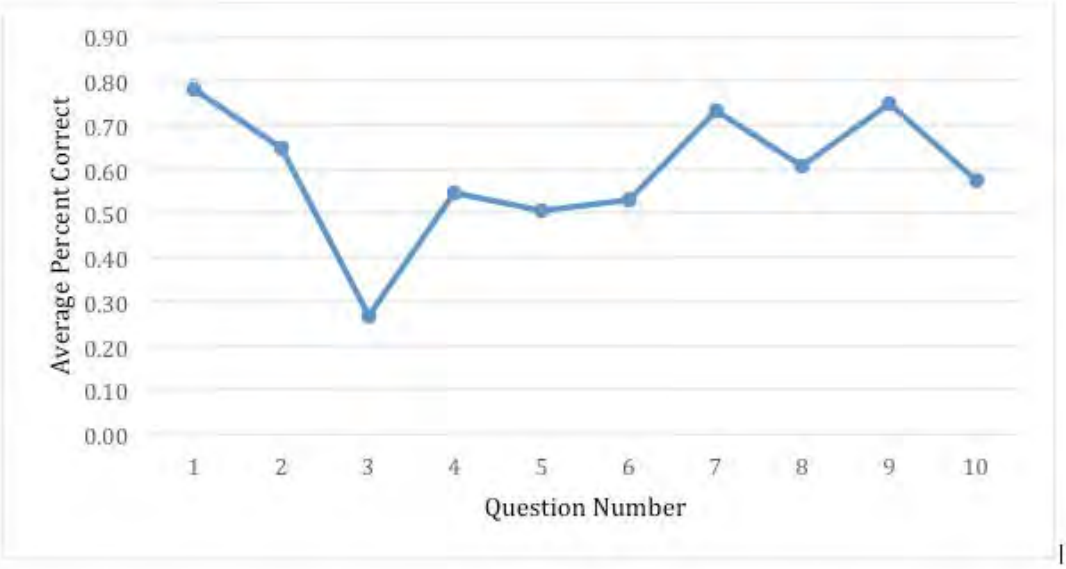
	Lead.	Self-Mgmt.	Sys.	Proc.	Ops	People	Proj.	Qual.	Risk	Safety
Avg.	0.59	0.64	0.57	0.6	0.57	0.61	0.66	0.51	0.76	0.59
SD	0.15	0.16	0.15	0.15	0.16	0.15	0.19	0.18	0.11	0.21
Range	0.51	0.52	0.58	0.57	0.62	0.53	0.78	0.61	0.28	0.61

Figure (1) Average Percent Correct by Topic Category



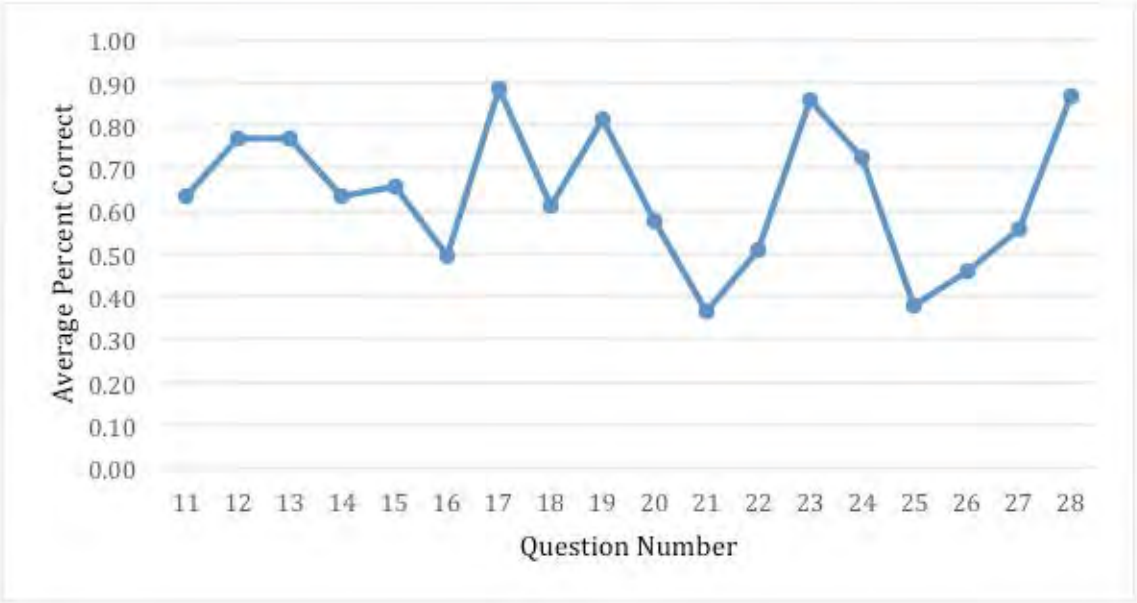
The following paragraphs discuss the exam results by topic category. Each topic category was broken down by question and the average percent correct plotted. The questions in each category were also analyzed for correlation to each other. Some of the questions within the categories appeared to be correlated. A notable category for correlation was projects, which will be discussed later. In the leadership category, question 1 had the highest correct response (78%) with question 3 having the lowest correct response (27%). None of the questions were correlated. See Figure 2.

Figure (2) Leadership: Average Percent Correct Responses by Question



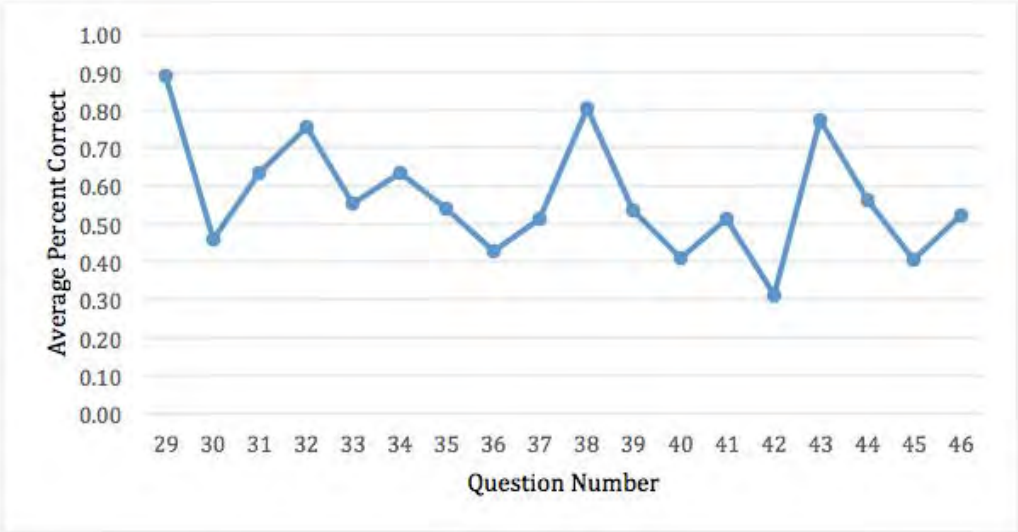
For the self-management category, question 17 had the highest correct response (89%) with question 21 having the lowest correct response (36%). See Figure 3. Question 17 may also have a relationship to question 23 with a correlation coefficient of .43.

Figure (3) Self-Management: Average Percent Correct Responses by Question



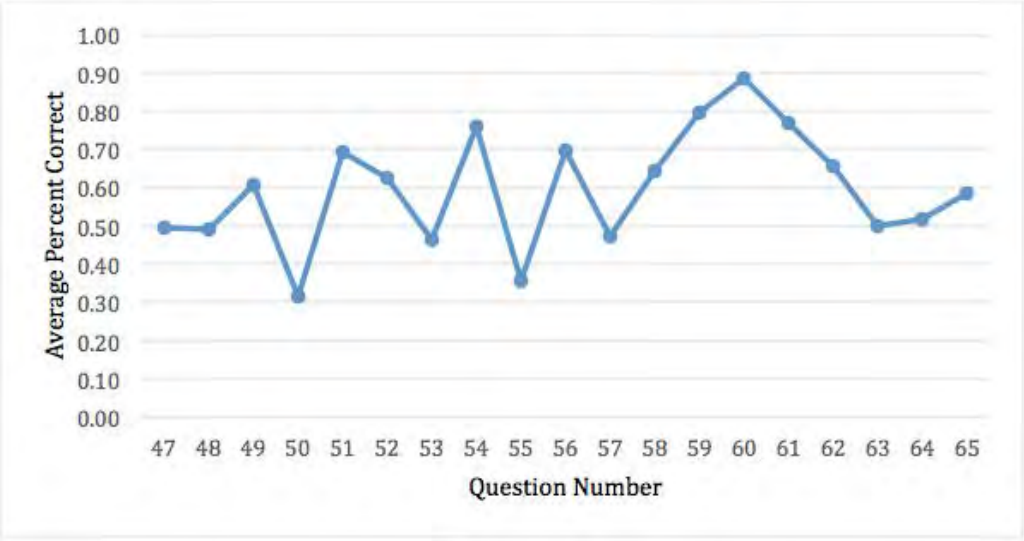
In the systems category, question 29 had the highest correct response (89%) and the lowest correct response was on question 42 (31%). Refer to Figure 4.

Figure (4) Systems Management: Average Percent Correct Responses by Question



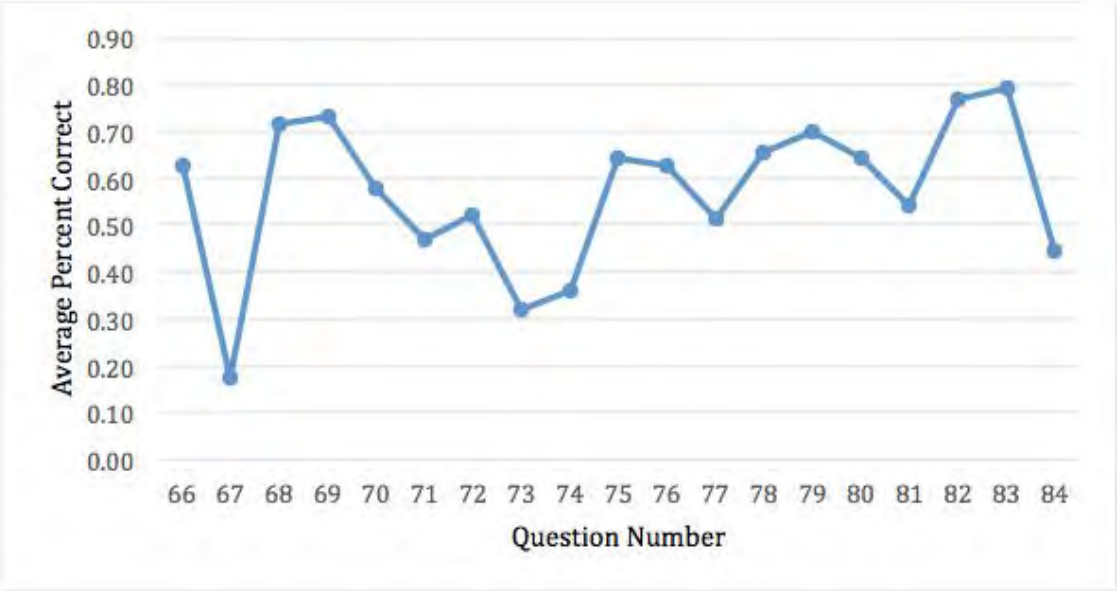
For the process category, question 60 had the highest correct response (89%) and the lowest correct response was for question 50 (31%). Refer to Figure 5.

Figure (5) Process Management: Average Percent Correct Responses by Question



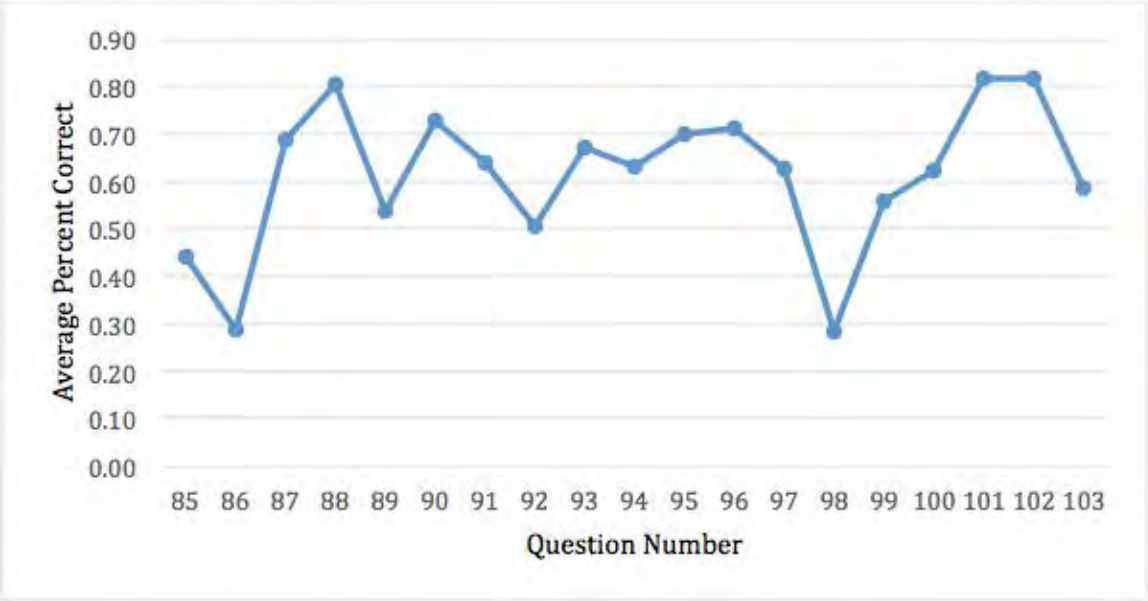
In the operations category, question 83 had the highest correct response (79%) and the lowest correct response was for question 67 (17%). Refer to Figure 6.

Figure (6) Operations Management: Average Percent Correct Responses by Question



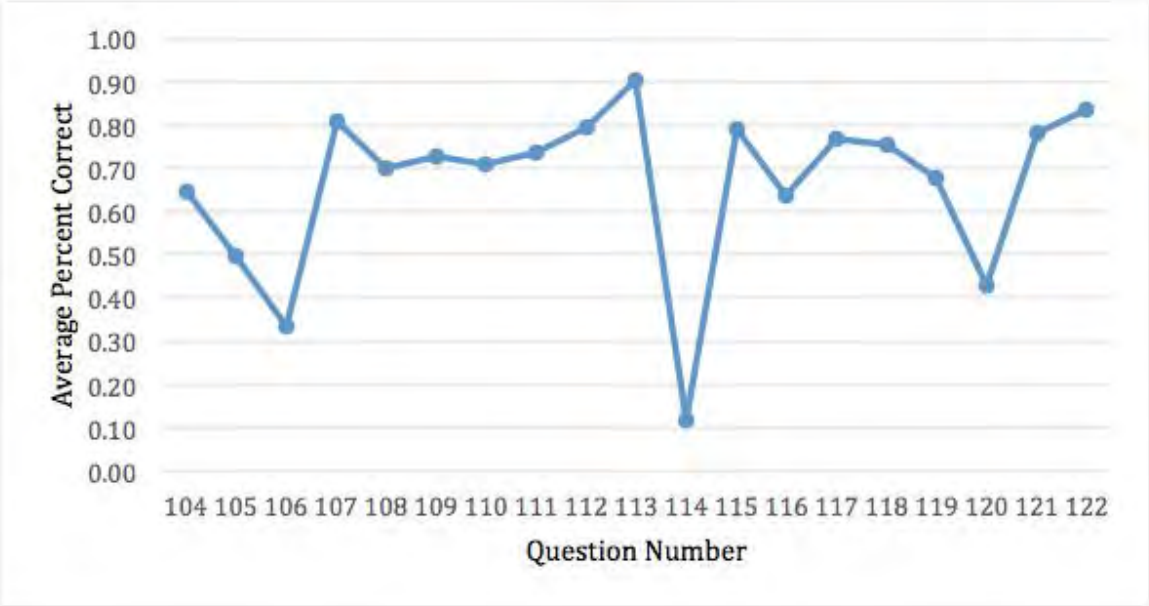
In the category of people, both questions 101 and 102 had the highest correct responses (82%) followed closely by question 88 (81%). The lowest scoring questions were numbers 98 and 86, which had correct responses of 28% and 29%, respectively. Refer to Figure 7. Questions 88, 101, and 102 may also be related, as they appear to have larger correlation coefficients (.52. .42, and .40) than other questions.

Figure (7) People Management: Average Percent Correct Responses by Question



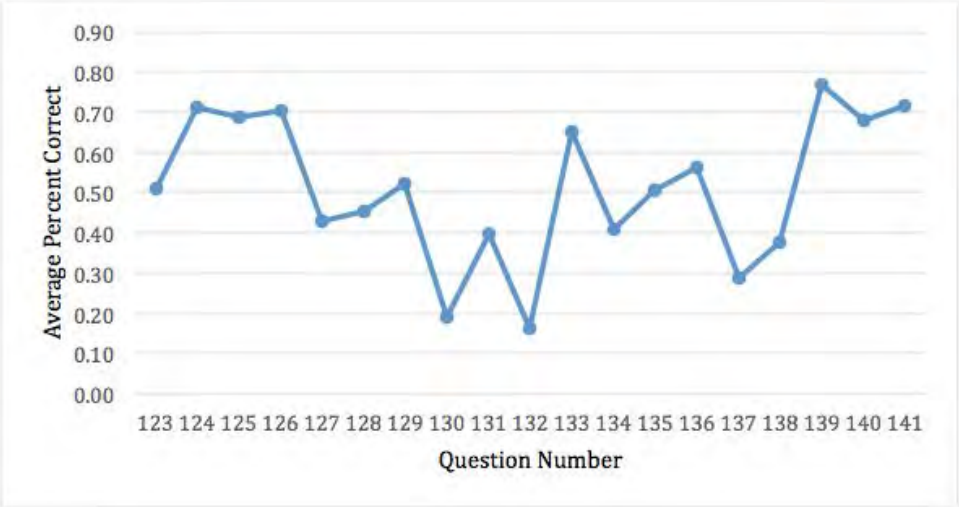
In the project category, question 113 had the highest correct responses (90%). The lowest scoring question was number 114, which had correct response of 12%. These two questions, coincidently presented back-to-back on the exam, represented the highest and lowest overall average scores for the entire exam. See Figure 8. In addition, questions 108, 109, and 110 appear to be closely related, as their correlations were .64, .66 and .66. No other set of questions within a single category had this much correlation. This presents an opportunity for critical evaluation as these questions are likely measuring the same competency.

Figure (8) Project Management: Average Percent Correct Responses by Question



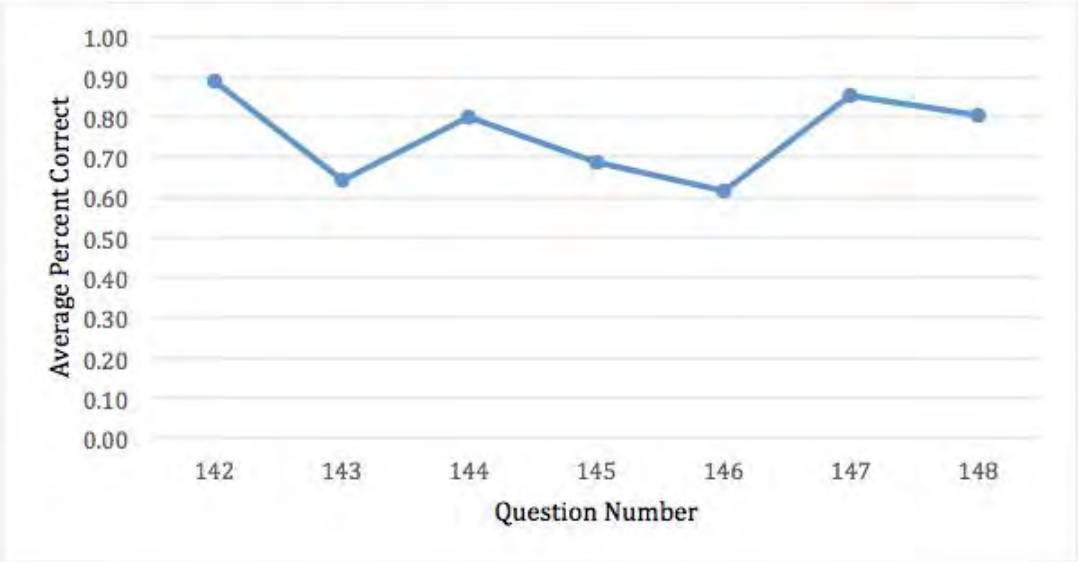
In the quality category, examinees answered question 139 correct 77% of the time. The lowest scoring question in this category was number 132, being answered correctly only 16% of the time, which was the second lowest of the entire exam. As previously indicated, this category had the lowest overall average. See Figure 9.

Figure (9) Quality Management: Average Percent Correct Responses by Question



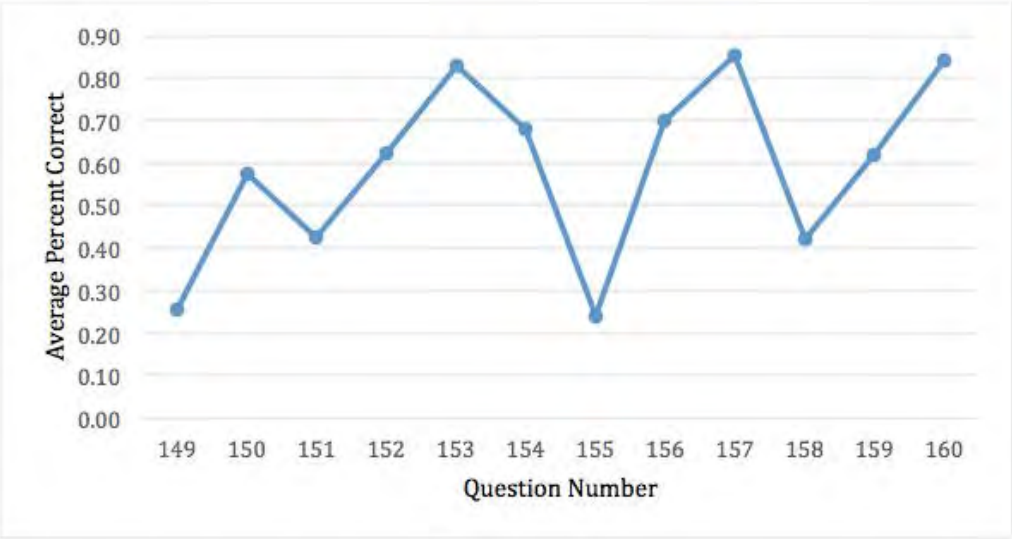
In the category of risk, which consisted of only seven questions, number 142 had the highest percent of correct responses (89%) with number 146 scoring lowest. As mentioned earlier, this category had the highest overall average with the lowest standard deviation of any category topic. See Figure 10. Question 142 may be related to question 147 with a coefficient of .49.

Figure (10) Risk Management: Average Percent Correct Responses by Question



The final category of safety had question 157 as the highest scoring (86%) with two questions (155 and 149) scoring 24% and 25%, respectively. Stating once again, this category had the highest standard deviation of all the topics. Refer to Figure 11. Questions 153, 157, and 160 may be related with correlation coefficients in the low .40s.

Figure (11) Safety Management: Average Percent Correct Responses by Question



Discussion and Interpretation

The topic categories with the highest (risk) and lowest (quality) percent scores and the highest (safety) and lowest (risk) standard deviation were the categories in which 100% the previous exam questions were retained. Based on future exam results, these questions may need to be further revised to reflect current practice in the discipline. In addition, the categories of safety and risk appear to have related questions that may measure similar knowledge. The categories of people and self-management should also be analyzed for redundant concepts. However, the project management category appears to need the greatest amount of revision as it includes both the highest and lowest scoring questions on the exam and three questions appear to be measuring the same construct.

In terms of overall performance on the exam, ATMAE should discuss and determine if a grand average of 60% with an average standard deviation of 16% is acceptable. As the certification cut-off score is slightly below this average, the Association may want to raise or lower the threshold to build membership or conversely increase prestige. An evaluation of the second and third year results will likely assist the ATMAE Certification Board in these discussions. On a question-by-question basis, preliminary data of second year results seem to indicate a very close relationship to first year results. This would suggest the exam has high reliability. A recommendation for future study would be to administer the exam to a control group as a repeated experiment over some predetermined and meaningful time period. As more data points are collected, another study could set control limits on the averages for each question to determine if any exceed the expected normal distribution of mean and standard deviation. Obviously, a stable examination would need to be in place before this could occur.

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Appendix

CTM Exam: Correct Score Percent for Each Question

Manufacturing

Design and Fabrication of the Power Transmission System of a Large Scale 3d Printer

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Abstract

The design, manufacturing and integration of the gear drive for facilitating rotary motion of the 6 ft. diameter worktable of an innovative rotary style 3D printer is detailed in this study. The methodology discussed in this paper can be applied to the design and manufacture of machine elements similar to this 62.5 in. pitch diameter internal ring gear system, which cannot be produced in one setup due to size limitations of most CNC machining centers. The approach discussed in this paper is to design and manufacture the ring gear in segments, and to integrate the segments to form a single functional element. It is generally not pragmatic for prototype shops, tool rooms or low production volume shops to purchase special purpose gear hobbing machines which otherwise would be necessary. Also, ring gears with pitch diameters over 8 to 10 in. are unavailable for direct purchase from most gear manufacturers. To design the 62.5 in. pitch diameter internal ring gear, the parameters are calculated based on the fundamental gear equations for stress as per AGMA standards which are then checked for failure. The M and G code to machine the gear is developed using Siemens NX Computer Aided Manufacturing (CAM) software. The toolpath for the gear tooth profile is generated and machined in a general purpose Haas VF3 Vertical Machining Center. After installation of the internal gear sections on the 3D printer table it is concluded that smooth engagement is achieved with a standard purchased spur gear. Ultimately, the 3D printer drive components are fully assembled, and the system is tested where one rotation of the pinion gear yields approximately 20 degrees of table rotation.

Introduction

3D printing technology has become quite common over the past years initially used for prototyping only, but now used for direct digital manufacturing. RepRap (self-replicating rapid prototyper) 3D printers (Sells et al., 2009 & Gibb, 2015) are open-source 3D printer designs available for anyone to build. According to Wittbrodt et al. (2013, 2014), the cost of an open source 3D printer used for printing household components, (such as a Pierogi Mold or Paper Towel Holder) can be recuperated within a year or two if a reasonably fair number of household items are printed using the 3D printer. Additive manufacturing techniques are used in entertainment, medical and even the defense industry, although a limitation of 3D printers is the build envelope. The 3D printer build envelope is the size of the print platform times the printing height capability. Current desktop 3D printers such as the Prusa RepRap have a build envelope of 8 in. Length x 8 in. Width x 6 in. Height (Mendel – RepRapWiki, 2015). Large scale 3D printers, which are 5 to 10 times the size of the current desktop 3D printers have been developed, but are experimental and expensive to produce. It is the goal of this team to overcome size restrictions of desktop 3D printers by producing a large scale 3D printer within a modest budget, currently just $3,000 for the purchase of material such as bearings, drive components, motors, steel, acme power screw and nut. With a 3D printer of this magnitude larger 3D printed

parts, such as 4 ft. wind turbine blades or propeller blades, could be printed in a single setup without needing to join segments together. Since 3D printed parts such as these operate at potentially high RPMs, any structural concerns lead directly to safety concerns making it advantageous to produce the part in one continuous 3D print.

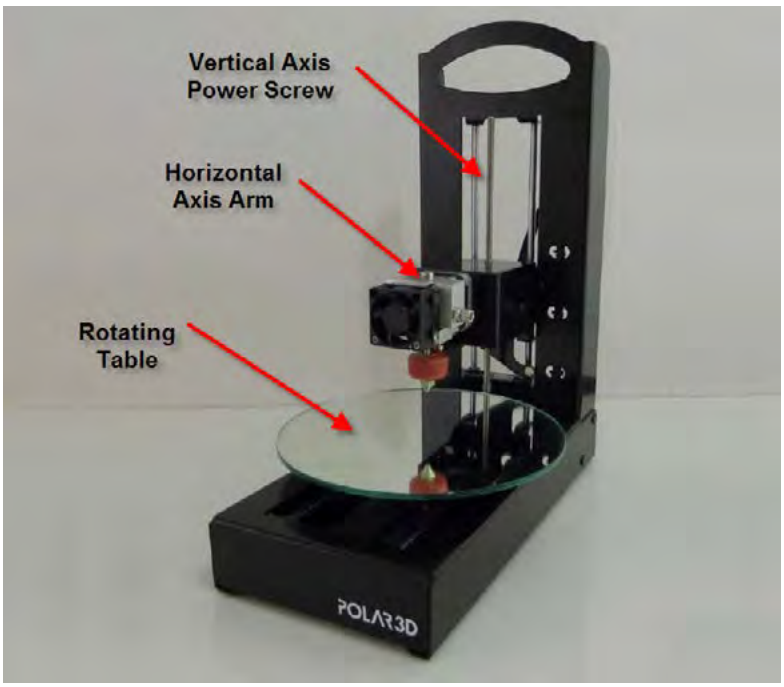
Here, a large scale 3D printer is proposed having a build envelope of 6 x 6 x 5 ft. The main power transmission component for the rotary work table is a stepper motor turning a spur gear driving an internal ring gear, which is manufactured by machining segments to be integrated together to form the 62.5 in. pitch diameter internal ring gear. The software used to operate this 3D printer will be similar to that used for the RepRap open source 3D printers.

Background

3D printers are restricted by the dimensions of the printing area as well as the height of the machine. When printing large parts, operators are required to make multiple pieces which will fit in the printable area and combine them into one larger assembly. This challenge evolved into a need for a 3D printer that would be capable of producing parts that require a large build envelope with similar dimensional accuracy as the desktop printers.

Currently there are many different 3D printer configurations such as the X, Y, Z Cartesian coordinate method that operates similar to a CNC machining center, or a Delta method that has a stationary build platform with the nozzle moving in in the X, Y and Z. Another method for controlling the extrusion of material is with a polar system. A benchmark Polar3D 3D printer (Polar3D, n.d.) can be seen in Figure 1 showing the components of the 3D printer, although it only has a build area of 8.0 Diameter x 6.0 Height (in.). In the fall semester of 2014 an undergraduate senior design team used the Polar3D 3D printer as a datum design to develop the initial 9:1 scale polar 3D printer CAD design and a set of manufacturing drawings. The Polar3D system utilizes a rotating table with an arm that translates horizontally along a single axis to and from the center of the printing surface. The Z translation in this system is controlled by a linear power screw and guides located beyond the edge of the rotating surface. The Horizontal Axis Arm is fixed perpendicular to the translating Z component of the power screw.

Figure (1): Polar 3D Printer



Similarly, to operate the Z axis, (vertical height) in the 2014 undergraduate senior design team's design there is a cantilever beam mounting system that is guided by rails mounted to a vertical I-beam driven by an acme nut and power screw. The Theta axis (rotating table) is designed using a 20 to 1 worm drive reduction located at the center of the circular table to reduce the torque needed to drive the plate while increasing print resolution. This increase of resolution causes a large decrease of overall rotational speed. The R axis (horizontal translation) is designed using an extruded aluminum 80/20 beam to minimize deflection and a belt driven carriage system to position the material extruder and heated nozzle. An early concept model of the 9:1 Scale Polar 3D Printer can be seen in Figure 2, and the final concept model is shown in Figure 3.

Figure (2): Early Concept Model - 2014

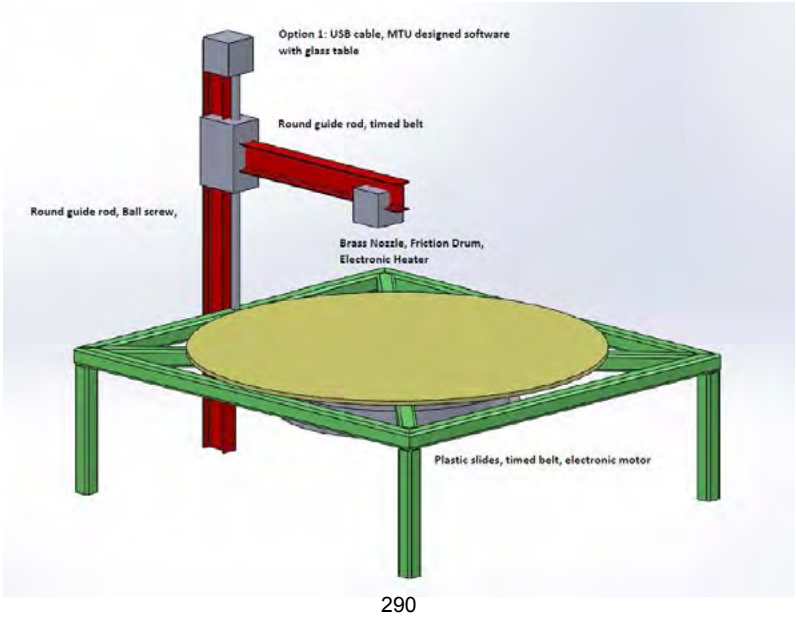
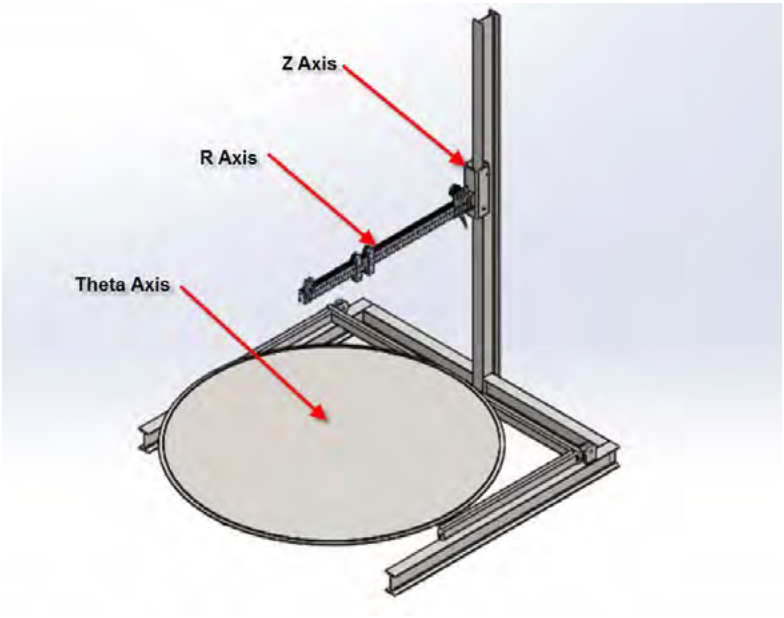
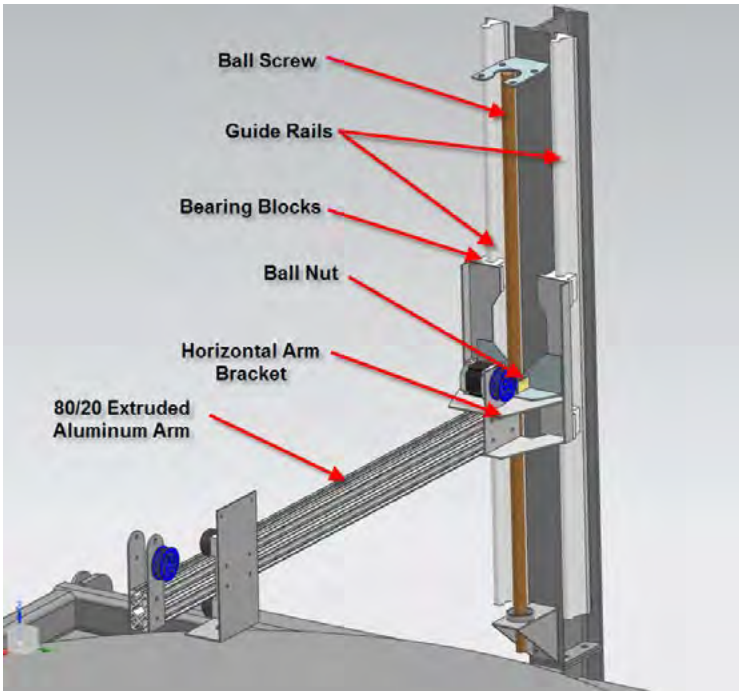


Figure (3): Final Concept Model - 2014



In summer of 2015 the manufacturing of the 3D printer and redesigning of the Z axis was completed, followed by initial testing of the motions of the 3 axis. The Z axis was redesigned to incorporate guide rails mounted to the vertical I-beam. Also, a new design was created for the bracket connecting the horizontal arm to reduce deflection. The 2015 redesigned model can be seen in Figure 4 in particular showing the improved guide rail and horizontal arm support bracket.

Figure (4): Improved Z and R Axis Design - 2015



With the three axis manufactured and assembled, testing was initiated for the system before actually attempting to create a 3D printed part. The Theta axis for the rotating table was of the most concern at this point. The original configuration for the drive system for the Theta axis having a center shaft welded to the circular steel table inserted into a center bearing mounted to the frame structure is shown in Figure 5. Calculations for the torque required for the motor indicate that a Nema 34 motor specified has sufficient torque to rotate the table. The required torque calculated to rotate the table is approximately 1.0 lb-ft and the motor torque is rated to approximately 3.6 lb-ft as shown in Table 1. During testing, it was observed that the initial torque required to start the table rotating, stopping and reversing directions caused the motor to skip steps, which would cause miscalculations in the 3D printing software. Another concern was that there was significant backlash in the operation of the worm gear when changing directions. After inspecting the system, it was determined that the backlash was not the result of a loose keyway, improperly machined driveshaft spacer, or the gears not fully aligned to their respective pitch diameters, so a redesign of the Theta axis drive system was determined to be necessary.

Figure (5): Theta Axis Testing

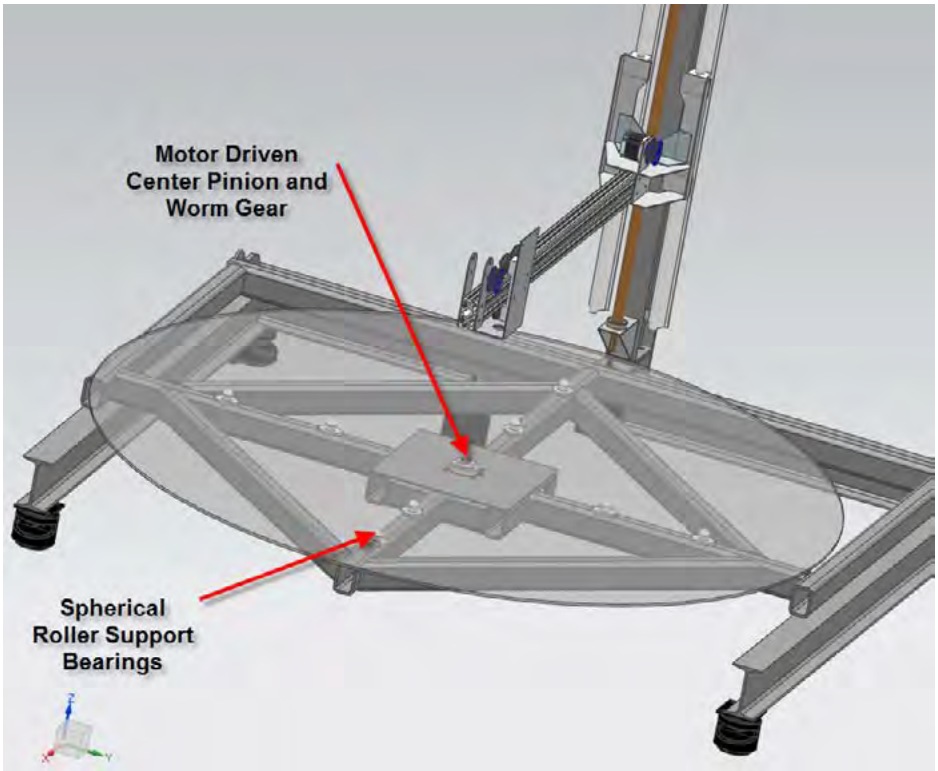


Table (1): Theta Axis Motor Torque Calculations

Total Rotating Mass		Print Surface Radius		Moment of Inertia			
550	lb	72	in				
249.4758	kg	1.8288	m	417.1871	kg•m^2		
Max Print Velocity at Perimeter		max time to speed		Perimeter Angular Acceleration		Torque Required to Accelerate	
10	in/s	1	s	0.1389	rad/s^2	57.94265	N•m
1.33	rpm					42.73631	lb•ft 512.8357 lb•in
0.14	rad/s						
						Motor (input) Torque Needed	
Reduction Ratio		Max Motor Speed					
40	:1	53.05165	RPM			1.068408	lb•ft 12.82089 lb•in
						Max Possible Output Torque	
Nema 34 specs							
1000	oz•in	Max Torque				208.3333	lb•ft 2500 lb•in
5.208333	lb•ft						
700	oz•in	@ ~ 160 RPM & 48V					
3.645833	lb•ft						

3.645833 lb•ft > 1.068408 lb•ft

Drive System Design and Manufacturing Methodology

To remedy the issue with the backlash in the Theta axis a 2015 design team redesigned the drive system using an internal gear and pinion combination to reduce the torque required on the motor by moving the pinion to the outside of the table diameter. In this section, the methods used to design and manufacture the drive system for the large scale 3D printer are explained in detail.

The drive system consisted of a driving pinion gear directly mounted on the motor shaft using a bushing arrangement and a driven internal ring gear which is bolted onto to the underside of the table. The 3D printer work table is a 6ft diameter circular steel plate weighing approximately 550 (lbs.). The stepper motor drives a 20° involute, 3-inch pitch diameter, 24 tooth pinion gear, which rotates the worktable by meshing with an internal ring gear. Based on the pinion gear, the diameter of the worktable and the center distance, a ring gear is designed having a 62.5 in. pitch diameter, with 500 teeth and 8 diametral pitch. The design, manufacturing and integration of the drive system followed this procedure:

1. Selection of pinion: According to Jindal (2010), a full depth 20° involute is the most widely used system where the problem of interference and undercutting are reduced. The pinion selected was 20° pressure angle, 24 teeth, 3 in. pitch diameter for a 1 in. shaft diameter based on the motor shaft diameter of 14 mm, given that 17 are the minimum number of teeth to avoid interference (Maitra, 1994). The gear would then be mounted onto the motor shaft using a bushing arrangement which is discussed in the following sections.

2. Design of internal ring gear: The 3D CAD model of the gear was generated in NX using GC toolkit (Siemens GC Toolkit Gear Modeling, 2010). The toolkit expects a certain set of gear design parameters to be input, after which it outputs the solid 3D model of the gear. This model was further modified to have locating holes and segments cut from a single large 3D model. This modified 3D CAD model shown in Figure 6 was used in the NX manufacturing application to generate M & G codes for machining the part.

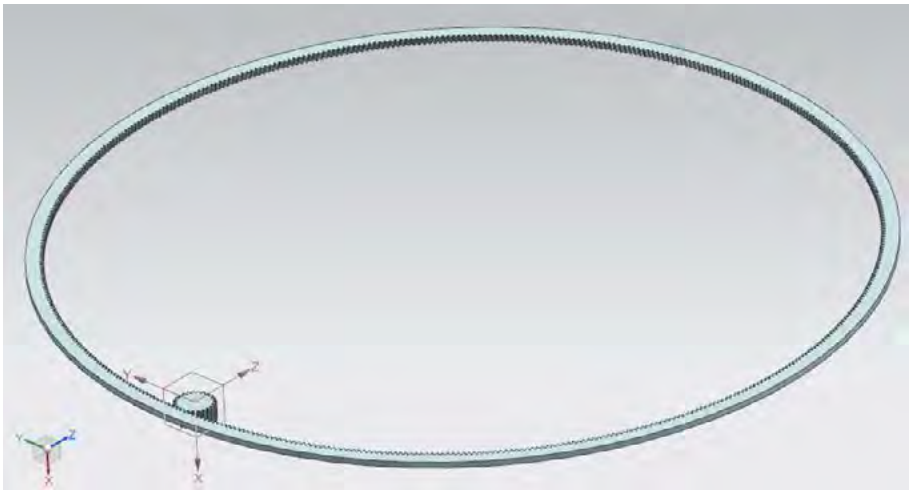


Figure (6): Internal Ring Gear and Pinion in NX CAD

3. Manufacturing of internal ring gear using NX CAM: DXF files were generated for plasma cutting the gear blanks. As shown in Figure 7, the tool path was generated and simulated to verify the material removed after machining. Appropriate tool sizes such as .25 in. end mill for roughing and .125 in. end mill for finishing was selected based on corner radius to be achieved and simulated material removal shown in Figure 8. A large aluminum block was used as fixture and holes were drilled on it to hold the gear segments using bolts.

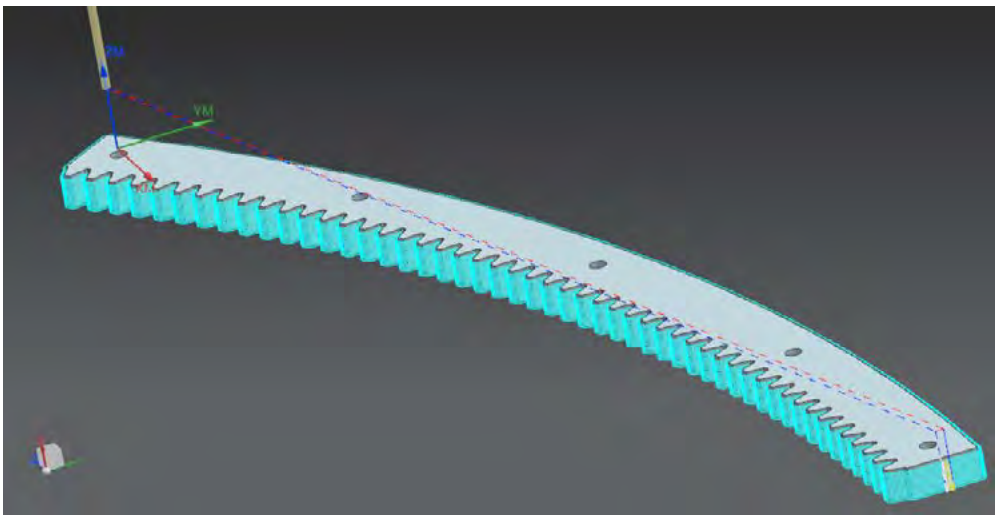


Figure (7): Internal Ring Gear Segment and Tool Path in NX CAM

Figure (8): Pinion and Internal Gear in Meshed Condition

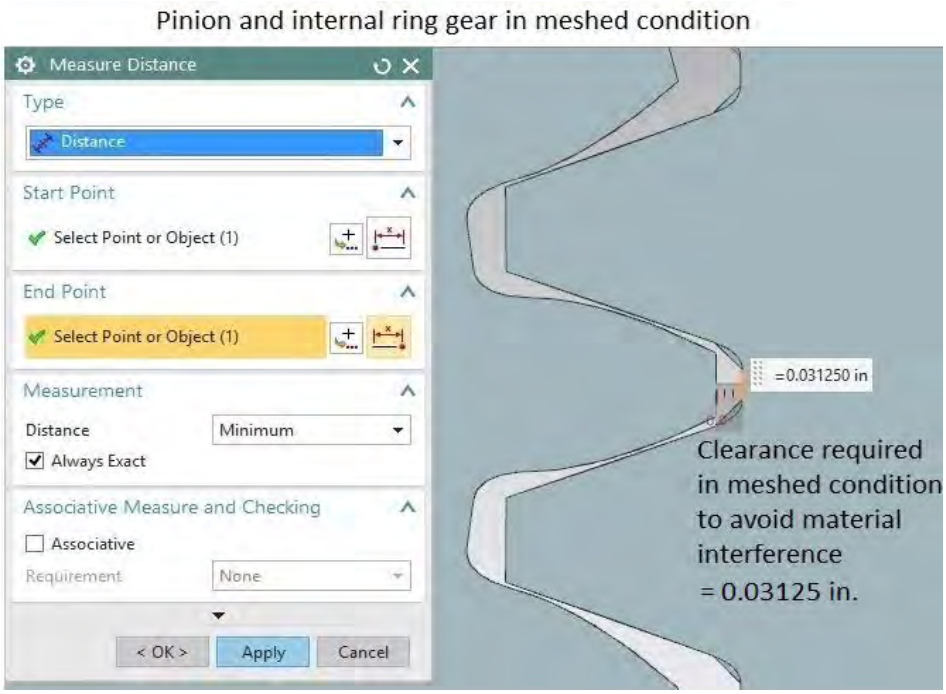
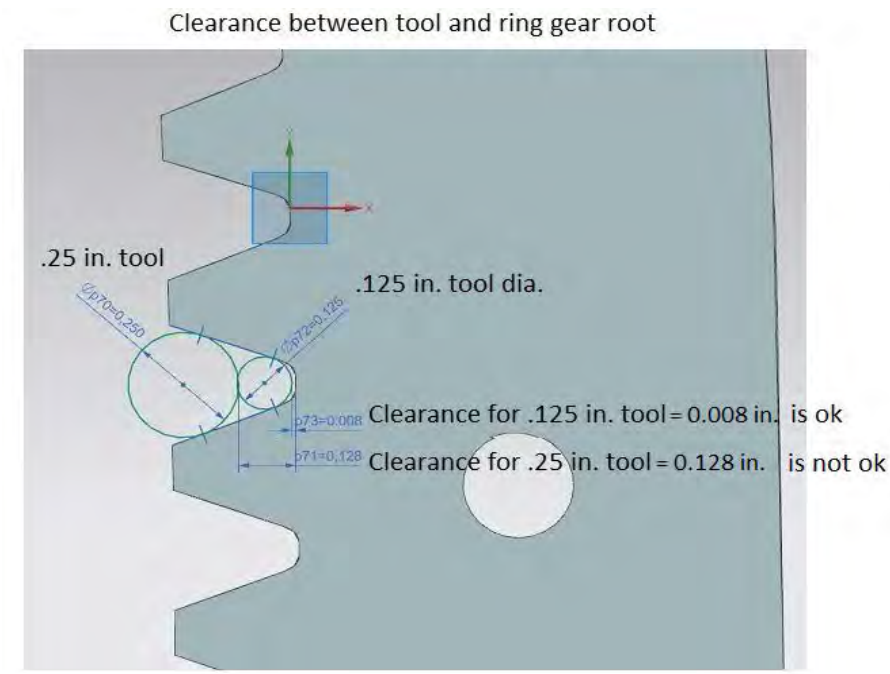


Figure (9): Clearance Between Tool and Ring Gear



4. Integration of drive system: The integration of the drive system was achieved in the following three steps.

   A. Mounting the driven internal ring gears: To mount the gear segments on the table, a template was designed and plasma cut such that its OD is equal to the table dia. while ID is equal to the ring gear OD. Gear segments were set up on the top side of the table as shown in Figure 9 and the hole patterns were transferred to the table. These holes in the table were later tapped to allow fastening gear segments to the table. Loctite was used on the threads while fastening to prevent loosening of bolts from shock and vibration.

Figure (10): Mounting Gear Sections

B. Mounting the driver pinion gear: The mounting of pinion gear onto motor shaft involved manufacturing an appropriate bushing to mount the pinion onto the motor shaft. The OD of the bushing was designed to be press fit inside the pinion gear hole, whereas the ID of the bushing was machined using a boring operation in order to make it slip fit over the motor shaft while constraining the rotation motion using a set screw. Finally, the motor is mounted under the table at an appropriate location by using a motor support bracket welded to the frame.

C. Software integration: The Theta axis, R axis and Z axis motors of the polar 3D printer will be controlled by Franklin software (Franklin – RepRapWiki, 2016) through RAMPS 1.4 Controller Board and DQ542MA Microstep driver.

Results and Discussion

The following image shows one of the 10 ring gear segment after the machining process is completed. As shown in Figure 10, the gear segment is fixed on the aluminum block using screws. The gear section machining and set-up time was approximately 4 hours each.

Figure (11): Ring Gear Segment Machining

Each gear section was inspected for accuracy and proper meshing with the pinion gear as shown in Figure 11, although during installation some of the gear sections mounting holes needed to be enlarged for proper alignment with the pinion. Also, the shaft welded at the center of the table was relocated to be more concentric with the ring gear for improving the gear teeth meshing. The gear profile accuracy, noise and motion between the pinion and the ring gears were tested on a preliminary basis by mechanically rolling the pinion gear over the ring gear segments in the assembled condition on the table.

Figure (12): Verification of Meshing Between Pinion

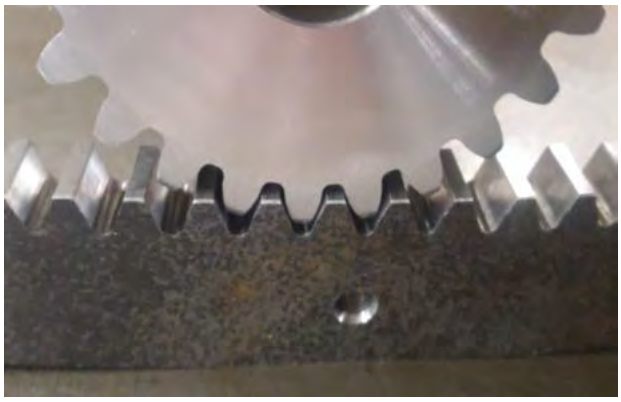


Figure (13): Pinion Gear Mounted Under The Table

Conclusions

Smooth engagement in the meshed condition shown in Figure 12, was verified at the locations where the ring gear segments join to form a continuous large ring gear. The circular table achieves a full 360-degree rotation. One rotation of the pinion gear yields approximately 20 degrees of table rotation, verifying the 24 to 500 gear tooth ratio as designed. Large scale machine elements such as this 62.5 in. pitch diameter internal ring gear can be economically produced for a prototype or low volume build. This approach of producing large machine elements can be replicated by machine shops limited by unavailability of special purpose machines such as gear hobbing or machine size limitations.

Recommendations for Future Research

It is not feasible to produce large internal ring gears as a single unit due to manufacturing machine limitations. They can be produced by splitting the CAD model into a smaller number of segments for manufacturing. The number of segments and the location of splits will depend on the number of teeth, pitch diameter of the gear, and machine size capabilities. For example, in this case the engineering application requirement was smooth engagement of the two gears, which can be accomplished by having the large ring gears split at the root and splitting the gear into 10 segments facilitated ease of manufacturing. Further research can be carried out to find better methods to reduce the cost of the final product while meeting the functional requirements.

Further research and development for the 9:1 scale 3D printer, (shown in Figure 13) will be to test and optimize the "Z" and "R" axis. This will be followed by the calibration, testing and optimization to determine the 3D printer's full potential using this innovative pinion and ring gear table rotation method. Future testing of this 3D printer will reveal whether the relocation of the table drive system using the ring gear will be sufficient to rotate and change directions of this 550 lb work table at the necessary speeds to produce a dimensionally accurate part.

Figure (14): 9:1 Scale Polar 3D Printer

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Manufacturing

Integrating Sustainability--Lean and Green Secondary Wood Manufacturing Practices in an University Wood Technology Program

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Abstract

Sustainability—lean and green secondary manufacturing practices through material selection, engineered wood material innovations, hardware, emerging finishes and optimizing process technologies, are keys to today's manufacturing environment. It is also a key to the future of architectural millwork, cabinetmaking, store fixtures and furniture production.

This paper highlights how the Wood Technology program at Pittsburg State University provides its students with a unique program in the U.S. It addresses state-of-the-art manufacturing material and processes associated with sustainability--lean and green secondary manufacturing practices used in leading woodworking industries. Collaborative efforts of the wood industry—AWI, WMIA, WIC, and Wood Advisory Council, and PSU are done to develop a Wood Technology program that meets the need for qualified wood industry professionals.

Through this paper, the audience will understand the development and implementation of the PSU Wood Technology program to reflect today's industry sustainability requirements. Program development and practices presented can be applied to other manufacturing programs at other higher education institutions.

Major components of this paper include:

- Collaborative efforts of the wood industry and PSU in program development;
- Materials and supplies associated with sustainability—lean and green manufacturing;
- Facilities and equipment associated with sustainability—lean and green secondary wood manufacturing, including panel processing equipment, optimizing equipment, CNC, etc.;
- Integrating emerging design, engineering and lean manufacturing practices into program.

Integrating Sustainability into Wood Technology Program Background

Wood Technology at Pittsburg State University (PSU) is well known in the industry as a unique, niche program. It offers its students a four-year, secondary wood manufacturing program using state-of-the-art equipment, industry-based curriculum, hands-on laboratory experiences, and facilitating industry internships. The program's well-rounded graduates are sought after to work in the architectural millwork, cabinet making and store fixture industries.

The comprehensive, industry-based curriculum is intended to give the students a broad base of technical knowledge and skills for practical application in the industry. The curriculum is guided by an advisory board consisting of individuals representing different aspects of the industry. These include a vice-president of the largest store-fixture company in the world to the owner of a small three-man architectural millwork company, from a major European hardware supplier representative to a director of a major supplier of wood processing equipment. These individuals, as well as members of the Wood Machinery Association (WMIA), the Architectural Woodworking Institute (AWI), and Wood Industry Conference (WIC) collaborate with PSU faculty to keep the program's curriculum and facilities up- to-date and applicable to the industry as a whole.

This collaborative effort, along with support from numerous wood machinery, software, and supply manufacturers and dealers, provides a truly unique program. The program prepares not only college students, but also wood industry professionals through PSU and the Wood Technology Industry Institute's (WTII) "***Boot Camp***". Throughout the operation of PSU's Wood Technology program, efforts are made to have the program reflect best practices in lean and green manufacturing for sustainability.

What are Lean and Green Manufacturing?

The fundamental concept of lean manufacturing is to maximize values and minimize waste. The ideal lean manufacturing facility would be to fabricate a product with perfect value to the customer with a perfect manufacturing process that had no waste. The Department of Commerce defines sustainable ("green") manufacturing as "the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economical sound." (Mani, 2013)

The Big Conundrum

The real issue with lean and green manufacturing comes where the rubber meets the road. For the most part, lean manufacturing practices are generally accepted and valued by most of the secondary wood manufacturing industry. On the other hand, green manufacturing is not as financially feasible to implement from a management standpoint. It is very important that students learn lean and green manufacturing aspects, and also sound management practices associated with both.

Sometimes proposed green manufacturing ideas are not applicable in a large scale production setting, and sometimes not even in a relatively small operation. One example of this is the use of "urban" cut lumber. This is the use of wood products that are coming from trees that would normally be either put though a wood chipper or burned at a waste site. While this is wishful thinking, some inherent problems arise when using this in any type of production. Problems may include quality and usability of the material, or possibly the quantity available. While this is a proposed green practice it is difficult to develop beyond small, custom pieces.

Plausible Lean and Green Practices

There are definitely some very applicable lean and green processes regularly used in the woodworking industry that can be integrated into college-level programs. PSU's Wood Technology Program works with a variety of individuals from across the wood industry, along with industry associations such as AWI and WMIA to make sure it equips students with relevant knowledge to meet the challenges facing today's wood manufacturing industry. Faculty members assume the responsibility to educate students so that they understand materials, processes and methods, which are environmentally-friendly and profitable. Some of the relevant topics discussed in more detail in this paper, include: the use of software in CAD and CNC for optimization, optimizing equipment (e.g., optimizing gang rip saw), engineered wood materials, veneers, and finishes.

CAD – "Value" Engineering

The use of design and engineering software is nothing new to wood manufacturing, but it does play a huge role in effectively managing resources and allows the engineer to "play" out designs and/or even material types. Design software can be the ultimate tool in allowing a person to optimize their products prior to any material being used. These programs can allow the student design a product, optimize the material being used, and then generate the program to machine it using CNC. The software programs, being taught in the Wood Technology area, are reviewed annually by its advisory board to ensure that it's up-to-date with industry needs. All students are required to learn CAD software, and use that knowledge to engineer projects before purchasing or machining any materials. Their experience with various software packages makes students better consumers of software products.

Figure (1): Student and Instructor Review a Room with Cabinetry Model, Drawn in AutoCAD

Software currently used by PSU Wood Technology students, include:

- AutoCAD
- MasterCam
- Inventor
- Wood WOP
- CabinetVision

CNC Equipment

How can the use of computer numerical control (CNC) equipment be considered "green"? In nested-based machining, a cutting tooling can be programmed to start and stop anywhere on the machines table. This allows for a much higher utilization of material when compared to traditional cutting methods. By cutting down on material usage, a shop inherently becomes leaner, as there are lower costs associated with materials, material handling, storing, and waste removal. These are all very important when looking at the bottom line—productivity, quality and efficiency equal profitability.

Students are able to utilize programming software to simulate the machining programs, and identify areas that may reduce cycle times and increase productivity. By having multiple CNC equipment platforms, students can determine which option will perform the fastest, and provide best quality. The belief is that the more familiar students are with the machines and their programs, the more efficient they will be with the material they are machining.

Figure (2): Programming Material on Holzma CNC Panel Saw (a), and Using a C.R. Onsurd 5-Axis CNC (b)

a. b.

Veneers and Engineered Wood Materials

Veneering uses very thin slices of wood cut from a log (veneer), that are glued onto a substrate (e.g., a composite core material, plywood, medium density fiberboard [MDF]). Veneering has been used in the production of furniture for hundreds of years. So what makes veneer a desirable green product? First is the amount of material that is being used from the original product. Since veneer is sliced from the log and not sawn like lumber, no material waste (i.e., sawdust) is generated from a saw blade cutting the log. Consistency of product is another reason why veneer products are often chosen by architects and designers. A large tree can yield thousands of square feet of material that has the same color and grain characteristics. Using the material from the same log results in a more consistent appearance of material and final product, than a comparable product made from solid lumber. Stability is another reason why many manufacturers and builders choose to use veneer. When glued on a composite material, it has less movement from changes in humidity or moisture, compared to moisture's effect on solid wood.

Veneer also allows woodworkers to use exotic species they may not be as readily available. The practice of cutting veneer, instead of solid lumber out of these trees, provides better utilization of the tree. It is also much more cost effective. A given size panel of MDF and veneer, is considerably cheaper than the same size panel of solid wood of the same wood species.

In Pittsburg State's Wood Technology program, students use advanced veneer processing equipment, such as: a double knifed guillotine (See Figure 3 a), a veneer splicer, a clipper (cuts veneer perpendicular to the grain), and a hot press (See Figure 3 b). Each one of these pieces of equipment allows the student to be very efficient with the product and with their material.

Figure (3): Cutting Veneers on Double Knifed Guillotine. (a) Examining Material After Being Hot Pressed. (b)

a.

b.

The use of engineered wood products is very common not only at Pittsburg State, but also throughout the secondary wood manufacturing industry. The use of these products gives manufacturers a stable and consistent product. Many of these products are made from either wood waste product or from less desirable trees, which in either case is better utilized in the engineered-wood product. The consistency and stability of these products can result in a high quality end product that is much easier to engineer compared to less stable, inconsistent solid lumber.

Veneer can also be an engineered-material product. Greenline Veneers from Certainly Wood is an engineered product that is using sustainable woods to create a product that looks very similar to species that are not as readily available. "They are truly a green choice that removes the supply burden from other less available species." (Certainly Woods Green Veneers Page, 2016).

Common engineered products used by faculty and students, and in industry, include:

- LDF/MDF (Low Density Fiberboard/Medium Density Fiberboard)
- Particleboard
- Agri-fiber
- Green Veneers

Finish

When using the term "green" to describe stains and finishes, the first thing many people think of is "water-based". In many cases, this is correct, but the whole finishing process needs to be evaluated. Just because a manufacturer makes a change in product type from oil-based to water-based, it does not mean they are automatically "green". One constant challenge in finishing is making sure the product is appropriate and fits the need. For a long period of time, this was the major negative of water based finishes. At the time of their introduction, these products were inferior to their petroleum-based counterparts.

Water-based finishes were difficult to use, and its overall performance was not very good. Regardless of how good a product is for the environment, it still has to perform and meet the users need. These water-based products have improved dramatically and are now more commonly used by many wood companies. Not only are these products becoming easier to use, but also the quality of the finish is greatly improved. Both the finishing material and the process for applying it contribute to the overall environmental footprint. At PSU, students are taught about both the finishing materials and application processes simultaneously. Students understand finishes and application processes in total, and become more efficient and leaner in the production process, which inherently leads to "greener" production.

The application method of product plays a huge role in not only the quality of the finish but also the amount used versus the amount wasted. This describes "transfer efficiency". If one has a low percentage of material actually making it onto the product during the spraying process, the material that goes elsewhere is being wasted in many cases. There are several methods which help reduce this waste. The easiest, and many cases the most cost effective, is to change your spray gun to a higher efficiency gun. Many production shops are now using air-assisted spray guns (See Figure 4 a), which can be up to 90% efficient. At PSU, faculty work with specialist from companies like Gemini Coating, Sata Spray Equipment, and Kremlin Rexon to make sure students are well versed on the different types of coatings available and in different application methods. This can also extend to larger, automated systems that have recovery systems. so very little of the finishing material is lost and wasted (See Figure 4 b).

Figure (4): Kremlin Xcite Airmix Spray Gun (Kremlin Rexon Xcite Manual AIRMIX Spray Gun Page, 2016) (a)

a. b.

Figure (4): Superfici Automated Spray line (Superfici Sprayers Page, 2016) (b)

Assessing Implementation of Sustainability Practices

In assessing sustainability—lean and green, practices, one can look at comparative data and anecdotal observations based on a series of questions. Sample questions are noted below:

For a given amount of product production:

- Is there more material waste or less waste as a result of manufacturing processes used?
- Is less finish required due to an application process selected (i.e., transfer efficiency)?
- Is there an increase or decrease in the amount of hazardous waste that needs to be removed (e.g., reduction by use and clean-up of water-based finishes in finishing area)?
- Is the production environment less healthy or healthier (e.g., dust) for the workers?
- Are the product designs contributing more to sustainability or less?
- Are the materials and/or processes selected contributing to sustainability?

The answers to these questions by general observations, or more specifically through data collection and analysis, provide a good means of assessing the success of sustainability efforts. For example at PSU, one observes that accuracy resulting from properly programmed CNC machines has reduced considerable waste attributed to inaccurately machined parts using conventional machining practices or poor programming. Also, significant hazardous waste in the finishing area has been reduced by going to more environmental-friendly finishes; and by using high efficiency spray guns requiring less finish to be used.

Summary and Recommendations

Sustainable (green) manufacturing and lean manufacturing are very much a part of today's manufacturing environment. As it is in other manufacturing arenas, each year it becomes more prevalent in the secondary wood manufacturing industries of architectural millwork, cabinetmaking, store fixtures and furniture production. It is incumbent upon today's industrial and engineering technology educators to impart a solid understanding of these manufacturing practices to their students, by integrating lean and green practices into their curriculum and laboratory practices.

Specific recommendations for paralleling the application of lean and green sustainability practices presented here to broader manufacturing programs at other universities include:

- Incorporate sustainability criteria in design and engineering of products. Specifically, require students to design products with environmental-friendly materials and processes in mind, including: lighter weight materials for reduction for use and in shipping; product dimensions that optimize use of standard stock material sizes in manufacturing to reduce waste; etc.

- CNC machining. Use appropriate automated machining practices, such as nested-manufacturing and other CNC practices to machine metals, plastics, or composite sheet materials to reduce waste and inaccurate parts.

- Material selection. Select materials that minimize environmental impact associated with its acquisition, primary processing, its processing as standard stock material into products, and finally its use and its maintenance in the final product.

- Finishing. Finishing processes are integral to all production--manufacturing and construction, whether for aesthetics or protection. Selecting materials friendly to the environment, or on the basis of environmentally-friendly application practices (e.g. higher transfer efficiency), or long-term durability or use, are all sustainability considerations.

At Pittsburg State University, the Wood Technology faculty members believe that when students, who are passionate about woodworking, are provided access to state-of-the-art woodworking production equipment and related software, instruction by faculty with real-world industrial experience, and receive hands-on experience in these technologies and related management practices, the result is individuals well prepared for today woodworking business and industry. The students, who work in an environment where lean and green practices are integrated into the program, are enabled to be much "leaner" in production processing, and "greener" in regard to material selection and use.

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Teaching Innovations

Improving Teaching Effectiveness of Automotive Sensing and Communication using Customized Signal Conditioning Circuits

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Introduction

Engineering education is undergoing major shifts to both accommodate the challenges it faces and also to embrace the unprecedented opportunities. One of the trends, identified by Froyd et al., shows a renewed focus on design as the major and distinctive element of engineering education. In particular, more and more schools are interested in design teams to be comprised of students from different programs. The advantages of this composition is obvious, yet the main issue is to find proper problems or projects where student talent and knowledge can best mesh and produce.

One area that a multidisciplinary team can easily find common interest is automotive electronics and control. There are several reasons. First, a joint team of automotive and electrical students can help each other gain fundamental knowledge and experience in vehicle electronics and computer systems, which play the key role of driving the vision for ideal automobiles in a sustainable future. Automotive students would benefit from the partnership the most for better understanding of "the application of computers in analysis, design, manufacturing, and operation of facilities" required by accreditation criteria[3]. Second, despite the consensus that automotive engineering technology (AET) curriculum needs more mechatronics materials both in theory and experiential learning, vehicular electronics and control systems have yet been systematically integrated into core AET courses, and the lab facility and hardware are still heavily mechanical. Consequently, there exist many student projects with various scales of complexities that could lead to new materials to complement and enhance existing lab content, and help improve teaching effectiveness and course delivery.

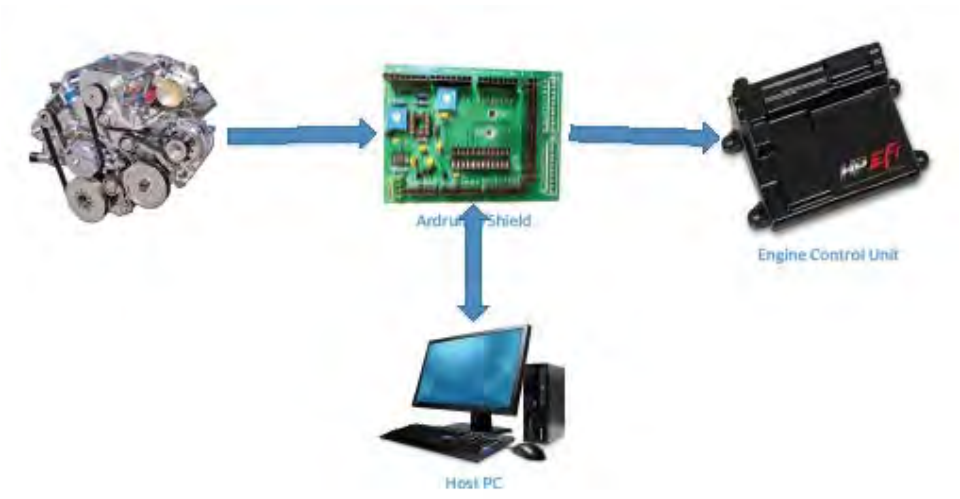
Among the core AET subjects that are intrinsically tied to electronics and computers, engine control, which focuses on the theory and application of on-board diagnostics and monitoring system, provides many interesting opportunities for students to explore. The nature of the course requires a heavy hands-on laboratory component. The most common tools in use are engine diagnosis scanner and software from commercial vendors. Those tools, though providing nice complement to classroom teaching, do have some significant shortcomings.

- They only offer textual rather than graphical interface, which is inadequate to offer students the visualization of the engine running status;
- They can only passively display the engine parameters without allowing instructors or students to alter values to observe pertinent responses;
- They are all proprietary and cannot be easily adapted to different engines.

Under the support of National Science Foundation's (NSF) Transform Undergraduate Education in Science, Technology, Engineering, and Math (TUES) program, we aim to develop customized microcontroller (MCU) boards to engage students in engine-targeted measurements, communications and controls. To this end, we assemble a team that consists of faculty and students from AET, computer engineering technology (CET), and mechanical engineering technology (MET). We first focus on creating lab units for engine sensors to demonstrate their working and communication mechanism. Sensor data acquisition using microcontroller is a fundamental technique in process control[4]. There are numerous MCU boards on the market, yet all of them lack the support, such as limited expansion and user friendly interface, for applications that target automotive students as users.

Based on these observations, we have decided to use the widely-used Arduino board as our base platform. Using Arduino/shield is a novel approach since it offers greater flexibility and adaptability. The most important features that suit our need are: board design is open-source; multiple shields can be stacked to allow different sensors to be processed simultaneously; and Arduino's own library and third-party software make developing front-end friendly graphical user interface (GUI) very easily.

Figure (1): Sensor Manipulation Through Arduino/Shield



Using open-source Arduino platform to monitor engine state has become very popular. Two of the most successful projects are MPGuino [5], which is to simplify wiring to the vehicle and to access engine management data available using OBD (On-Board Diagnostics), and OBDuino[6], which displays information such as instantaneous fuel economy and engine tuning parameters. Because these projects do not intend to serve instructional needs in lab setting, the products all use simple display devices such as LCD, and interfaces to end uses are not very friendly. In our project, we run the user interface, which is based on virtual instruments developed using LabVIEW, on a host computer. The computer displays the conditioned engine sensor signals out of the Arduino/shield combination. Not only the students can observe the engine dynamics through various graphing tools in GUI, more importantly, they are allowed to change the sensory data to strategically "lie" to ECU about the status of one or more engine sensors under certain conditions in such a way that the ECU's standard logic provides modified engine management.

Table (1): LS2 Engine Sensors Data

Sensor	Input	Output	Commentary
Crank Position Sensor(CKP)	5 volt reference signal	varying frequency pulse	On/off DC pulse of varying frequency depend upon engine speed
Cam Position Sensor(CMP)	5 volt reference signal	varying frequency pulse	On/off DC pulse of varying frequency depend upon engine speed
Throttle Position(TP)	5 volt reference signal	5 volt return	2 variable resistors; acting with PPS
Pedal Position Sensor(PPS)	5 volt reference signal		two low voltage and two 5 volt reference signals
Manifold Absolute Pressure (MAP)	ECU provide 5 volt	ECU monitors voltage drop across sensor	as manifold pressure changes voltage drop across sensor changes
Engine Coolant Temperature (ECT)	ECU provide 5 volt	ECU monitors voltage drop across sensor	thermistor
Intake Air Temperature (IAT)	ECU provide 5 volt	ECU monitors voltage drop across sensor	thermistor
Knock Sensor 1	5 volt reference signal	5 - 18 khz	high frequency short duration
Knock Sensor 2			
Engine Oil Pressure(EOP)	5 volt reference signal	1.0 - 3 volts	
Heated O2 (HO2) A1	no input	varying between .3 and 1.0 volts	continuously varying with .45 volts as the midrange
Heated O2 B1			
Ignition Coil Trigger (IC)	pulse input	used to generate trigger signals	is supplied to the ECU using the crankshaft position sensor

Methods

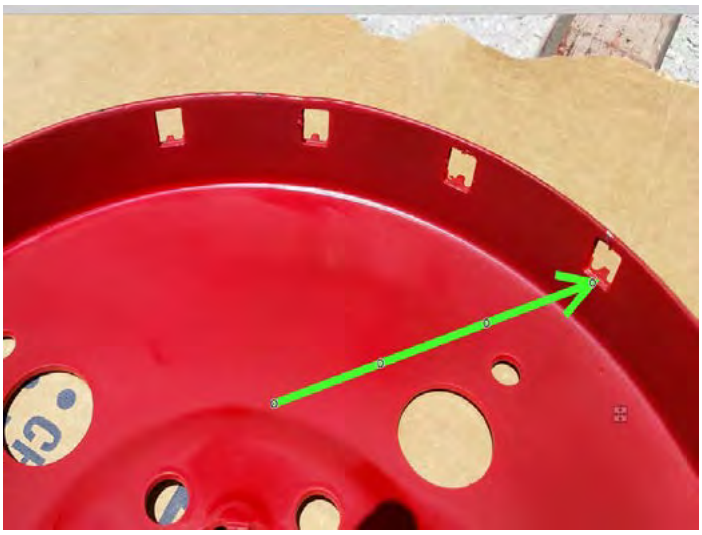
The engine that we work with is General Motors (GM) LS2[7] used on GM line of rear wheel drive vehicles. Table 1 shows the key engine sensors and their electrical characteristics.

At 2015 annual ATMAE conference, we presented an Arduino shield for engine coolant temperature sensor. In this paper, we demonstrate the shield and device for crankshaft position sensor (CKP).

CKP measures crankshaft location and relays this information to the engine control module (ECM). The ECM uses this crankshaft position information to time the spark properly, or on some systems for misfire detection[8]. For the project, we build a system where we attach a magnet behind the sensor, and place the front of the sensor near where the "gear teeth" are on the flywheel. The arrow in Figure 2 points to the missing tooth on the flywheel that represents the zero timing mark, while the arrow in Figure 3 indicates the window where the CKP sensor reads and generates the timing waveform. As the teeth alternate between being metal/air when the device turns, the device causes magnetic field near the sensor to change. This creates the alternating voltage waveform, which is then conditioned on the Arduino shield before being converted to digital signals.

Figure (2): Flywheel for CKP Sensor Reading

Figure (3): Flywheel for CKP Sensor Reading



Traditionally, the sensing of speed and position in geared systems has required the use of mechanically linked systems that are prone to wear[9]. Using a Hall sensor allows the teeth of the actual gear to be sensed without contact, thus reduce wear. The main task in the project is still developing Arduino shield as the signal conditioning unit to convert sensor reading into a clean square wave that can be processed on a microcontroller in real time with limited system resources.

The conditioning circuit is designed to be used with Arduino and Arduino Mega compatible microcontroller boards. There are two signal conditioners on the board that allow two inputs and two outputs to be used at the same time. The adjustments are independent and separate from each other.

Figure 4 shows the conditioner schematic for channel 1 of the board. The sensor is connected to the input terminal (J_1). The terminal supplies +5 volts, ground, and takes the raw signal to the positive input of the differential operational amplifier (op-amp). The differential amplifier amplifies very small sensor signal buried in a much larger one. Potentiometer (R_1) provides a variable voltage reference to help remove the +3 to +4.5 volts DC voltage on top of which the small signal rides. The 100 KΩ negative feedback resistor (R_5) is used to stabilize the amplification stage.

The output of the amplification can be visualized on an oscilloscope using test point 2. The signal is passed to the negative input of the LM311 comparator. The negative input is used because we are using a single supply of +5 volts, and negative bias voltage is not available. The 100 KΩ potentiometer R_3 is adjusted to set the switching point of the comparator. The reference voltage applied to the comparator can be measured at test point 3. When the voltage at test point 2 is greater than test point 3, the output goes low and an LED, D_1 lights. The output of the LM311 is an NPN transistor and can drive up to 50mA. The configuration used here is to drive high level TTL +5 volt logic. Pull up resistor R_7 provides +5 volts when the output is switched off. The decoupling capacitor (C_2) provides some noise filtering to keep the power rails clean when the LED's are flashing.

Figure (4): CKP Sensor Shield Schematic

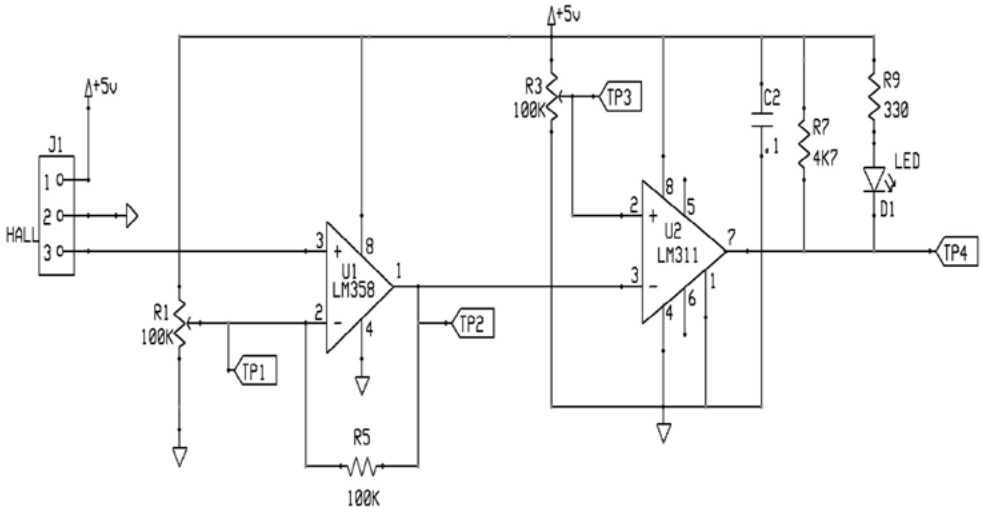
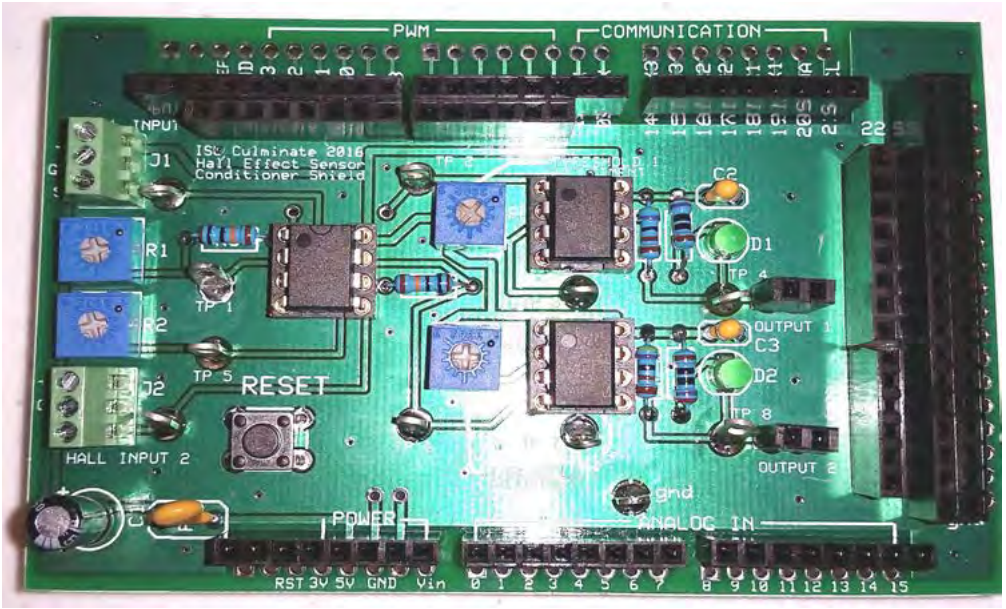


Figure 5 shows the boards produced by ExpressPCB's free layout software. The size is 3.8 x 2.5 inches and works well for Arduino Mega layouts. The board is a shield that can be stacked on top of an Arduino compatible board and it carries the signals through and above to allow more boards to stacked above it if needed. The only lines that are hard wired are the ground, +5 volts and the reset line. The user is provided with extra headers to allow a short length of wire to connect the output to the desired pin on the Arduino.

Figure (5): Arduino Shield for CKP Sensor Conditioning



Results

Figure 6 is captured from the screen of a Rigol 4-channel digital oscilloscope, model DS1054Z. It shows the output of the differential amplifier (blue) and the output of the comparator (yellow) given a consistent +5 volt TTL level square pulse such as driving digital logic or microcontroller digital inputs. Looking at the blue trace, one can see the result of the differential amplifier removing the +3 volt bias and amplifying the small difference made in the output voltage of the sensor as a tooth passes close to the face of the sensor.

Conclusion

In this paper, we present an Arduino signal conditioning shield to collect and monitor engine cranshaft position sensor. Because the board allows additional circuitry to be added externally before connecting the output to the microcontroller, in addition to automotive electronics and microcontroller programming, it can be used in teaching pulse circuits, analog design, and process control. The following list enumerates some of the applications:

Figure (6): Amplified Signal (Blue) at TP_2 and Output Signal (Yellow) at TP_4

1. Speed and position sensing
2. Signal amplification and conditioning
3. Op-Amp theory using differential amplification to remove DC bias in a signal
4. Comparator theory
5. Closed loop feedback control of speed and position using a microcontroller
6. Programming microcontrollers to sense speed and position using a real signal
7. Substitution of the variable speed control with a motor control shield would allow closed loop feedback experimentation

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Teaching Innovations

Managing Industry-Based Projects In a Senior Project Course

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Abstract

The senior project course in the Industrial Technology and Packaging (ITP) program at California Polytechnic State University (Cal Poly) is a two-quarter long capstone course that complements the "learn-by-doing" educational approach at Cal Poly. This paper presents some background on the author's experiences in managing industry-based senior projects in ITP program. In addition to applications of operations management, product development, and packaging design/testing to solve a real-life business/industrial problem, students develop the soft skills such as team work, written and oral communications, and ethics. The administrative management and monitoring of projects including pre-enrollment planning, project selection, orientation meetings, and assessment tools are discussed. Several examples of industry-sponsored projects are presented.

Introduction

As with most engineering and technology programs, the Industrial Technology and Packaging (ITP) department in California Polytechnic (Cal Poly) State University has a final year capstone senior project course. Most senior projects in ITP program are industrially sponsored projects. These type of projects promotes sense of responsibility of students to a sponsor thus motivate them to learn and apply problem solving techniques to a real world problem. These projects help students to integrate coursework, reflect on learning experiences and transition from the academic world to the professional world. Furthermore, the projects provide a practical way for the faculty to keep in touch with industry by being involved as advisors to student teams charged with solving industrially relevant projects [1].

The subject of capstone experience through senior project or senior design course has been discussed in a number of studies. In one study [1], a guideline for recruiting and selecting industry-sponsored projects is presented along with pros and cons of this kind of project including assisting student placement, potential funding by sponsors, liability and intellectual property issues. In another study [2], the relationship between four pillars of manufacturing and industry focused senior project is analyzed by mapping the course content to various categories of the pillars including materials and manufacturing processes, manufacturing systems and operations. Several program assessment tools are used in an industrially sponsored senior design project course including assessment by sponsoring agencies, alumni, and reflection by faculty [3]. In a study, a summary of authors' experience in managing an industry based capstone design course are presented and pointed out to feedback on the students' performance as the most important part of the course [4].

This study compliments the aforementioned studies by sharing the author's experience in several aspects of managing industry-based senior projects including:

- pre-enrollment-planning
- project selection criteria
- project progress monitoring/feedback
- challenges of assessing team projects
- application of decision making/critical thinking skills
- presentations of project results

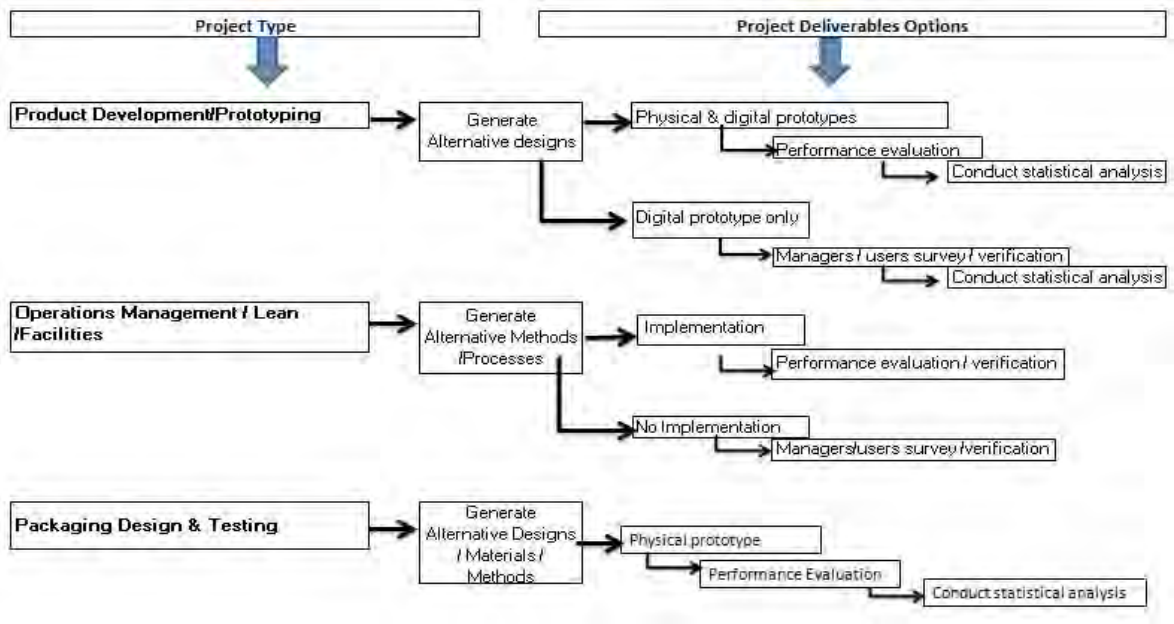
Project Types

The ITP program at Cal Poly is due in large part to the demand of the local and regional industrial community for a technically educated workforce. The graduates of this program can make an immediate and relevant contribution to industry. The senior project experience is a major component of "learn-by-doing" education of ITP students and enabling them in making immediate and relevant contribution to industry. The projects are intended to solve technology-oriented or operations management problems in businesses or industrial firms. The learning objectives of the course include:

- applying a subset of skills and techniques that students have learned during their undergraduate studies to real-world problems,
- developing solutions for improving the operations management, product development and packaging problems, and
- enhancing the technical writing ability of students through development of a professional report that details their project activities

Project deliverables (Fig. 1) typically involve product prototype or a method for improving operations management. The product prototyping entails designing and fabricating a functional product and/or package. The operations management projects involve developing solution for an operational problem within a defined scope. These types of projects normally ends with a set of recommendations for a company. In most cases, due to academic deadline constraint, the recommendations are implemented after the last day of classes if the company wishes so. As part of the senior project requirements, the project findings must be validated by the sponsored company. To do so, students develop a survey tool and conduct a survey of the company's staff closely involved in the project. A statistical analysis is applied to the result of the survey. All projects require a written formal report, class presentation and poster presentation.

Figure (1): Project Types and Deliverables



Pre-Enrollment Phase

The senior project is a two-quarter course in IPT program with expected workload of 200 hrs/student. With such constraint, it is essential to manage the course in an efficient manner well ahead of start date of the project. Figure 2 shows pre-enrollment planning flow chart as implemented during 2014. An introductory orientation meeting was held in April, approximately six months prior to first day of the classes, with attendance of all eligible senior students.

During the meeting, general information about senior project objectives and requirements are explained and a list of potential sponsoring companies is provided. Students are asked to form teams of size 2 or 3 and pick a team coordinator. In the weeks following the initial meeting, an intensive search and exploration begin by the teams for finding potentially acceptable projects. The course instructor is consulted along the way for appropriateness of the topic. Subsequently, a detailed proposal is submitted to the instructor for reviewing, rejection or approval. Most teams were able to meet the June deadline in obtaining an approved proposal. A few teams continued their search over the summer. By the first day of classes in fall, all teams secured a project.

Figure (2): Pre-Enrollment Planning Flow Chart

Project Selection

To assure all projects are at par with program standards and meet the learning objectives, a set of criteria is used as a basis for accepting or rejecting a project proposal:

- project must solve a technology/management problem
- clear definition of needs to justify the project
- must have a scientific/technical foundation: operations management,
- product development, lean manufacturing and so forth.
- be related to ITP courses
- doable in 20-week timeframe (Oct.-March)
- feasible to prototype/fabricate in ITP labs or outsource
- no small business except small manufacturing companies

Project Development Stages

The following is a list that represents the milestones that students were expected to achieve during the course:

1st Quarter

Weeks 1&2 Attend the orientation meetings
Week 2 Finalizing project proposal/confirm project agreement_
Week 3-5 Develop/submit progress report #1
Introduction
Literature/Background Review (50% completion)
Week 6-10 Develop/submit progress report #2
Literature/Background Review (100% completion)
Solution (30% completion)

2nd Quarter

Week 11 Mid-term class presentation
Week 11-17 Develop/submit progress report #3
Solution (80% completion)
Results/Analysis (50% completion)
Week 18 ATMAE CTM exit exam
Week 19 Course evaluation
Week 20 Submit final report
Week 20 Presentation to industry
Week 20 Poster Presentation

Literature Review

One of the components of ITP senior projects is a cursory review of the literature, previous projects, historical background related to the subject of the project and a charge ahead based on "I have a great idea." Having great ideas is what we want to see happen, but students really need to build on the great ideas of those who have gone before, and then use that as the launch pad for their own cool ideas. The knowledge gained through this review can lead a student to a better solution. There are a number of benefits associated with this background review including:

- revealing facts about the subject of the project, redefining the problem
- building on great ideas already presented by others
- benchmarking: how much value does your project add to previous works?
- Improved solution cannot be found unless the existing solutions are thoroughly understood.
- avoiding duplicated works

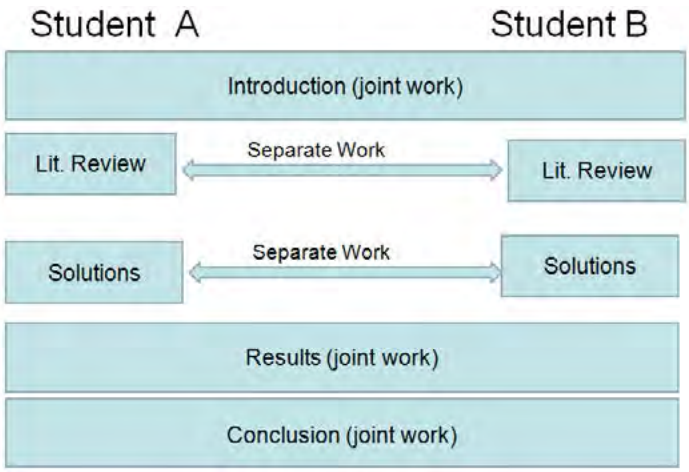
The minimum number of literature citations is minimum 10 with the following conditions:

- number of books and non-scientific/commercial/ web sites: maximum 50%
- number of reputable scientific/technical journals: minimum 50%

Team Tasks Breakdown

While some sections of the projects are developed by the team as a whole, some of the other sections are completed by individual team members. This arrangement allows a) to assess the performance of individual student's performance in a team, b) to promote the contribution of each student to the project development, and c) applying a fair grading by the instructor. Figure 3 shows the breakdown of the tasks for the five main phases of a project; Introduction, Literature Review, Solutions, Results, and Conclusion. Each student in the team shows his/her contribution to the project independently for the Literature Review and Solutions phases. As the project approaches to final phase, the separate students' works are consolidated and organized by the team led by a coordinator.

Figure (3): Project Tasks Breakdown: Joint Tasks and Individual Tasks



Creativity/Critical Thinking Skills

Although some projects may have to be evolved around a single solution, students are instructed to develop alternative solutions (Fig. 4). This approach promotes creativity, critical thinking and decision making practices through a project. Besides, there is always a chance that there may be better solutions if one looks for alternatives [5]. The required minimum number of solutions depends on the number of students in a team, typically 4 for 3-student projects and 5 for 4-student projects. Figure 5 shows the solution development and screening process in ITP senior projects.

Figure (4): Alternative Solutions for a Solar-Powered Distillation Project

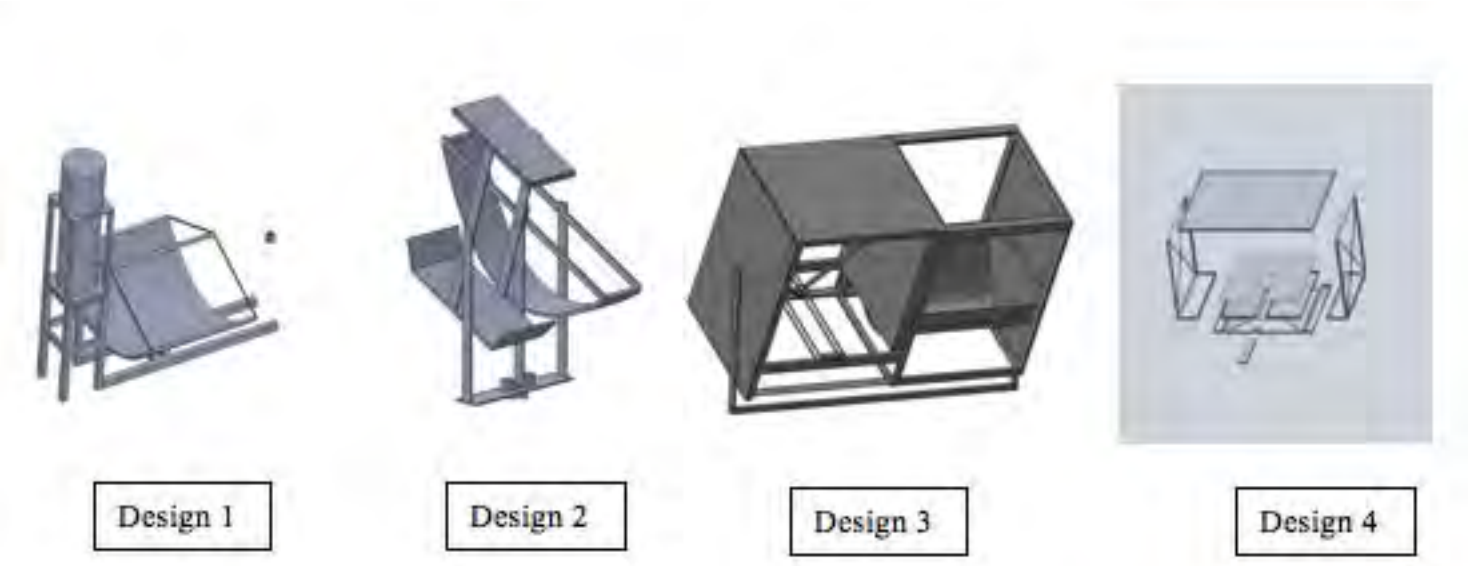
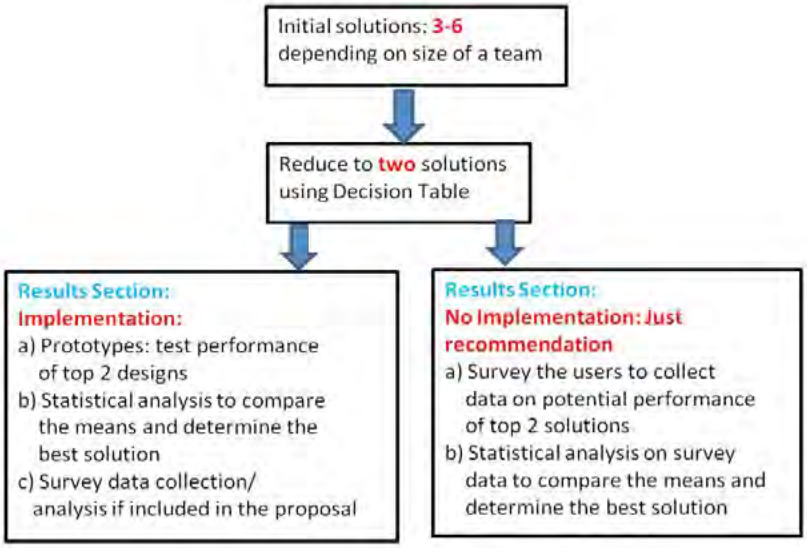


Figure (5): Project Solution / Results Development Guideline



Decision Making Skill

Pugh matrix has been commonly used for evaluating alternative concepts and selecting the best one. Figure 6 shows an example of Pugh matrix used in a product development project.

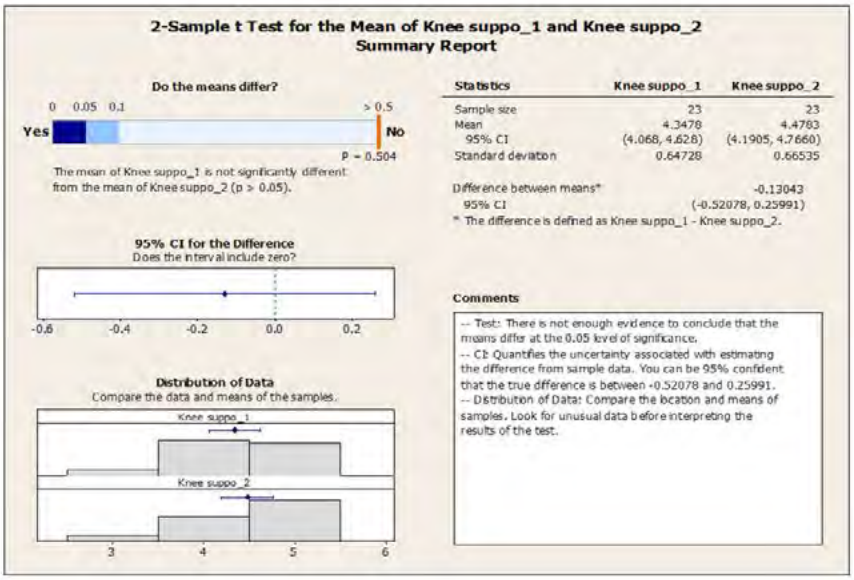
Figure (6): Ideas Screening Matrix

		Concept		
Criterion	**Weight**	**I**	**II**	**III**
Adaptable to multiple models/makes	4	+	+	+
Portable	4	+	+	s
Compact & Lightweight	4	+	+	s
Easy to use	3	+	-	+
Effective at charging	4	+	s	+
Fast at charging	3	+	-	+
Inexpensive	3	+	s	s
Safe for devices	2	+	+	+
Weather resistant	2	+	+	+
Made of eco-friendly material/processes	1	+	+	+
Total +		10	6	7
Total -		0	2	0
Overall Total		10	4	7
Weighted Total		**30**	11	19

Application of Statistics

Often senior projects involve using numerical data for comparing alternatives, e.g. two product designs, two layout designs, two packaging designs. To make a rational conclusion with supporting data, and producing a viable project solution, statistical testing and analysis are required for all projects. For each case students identify important factors, parameters, variables (control, independent) for comparing alternative solution (Fig. 7).

Figure (7): Two-Sample T Test Example



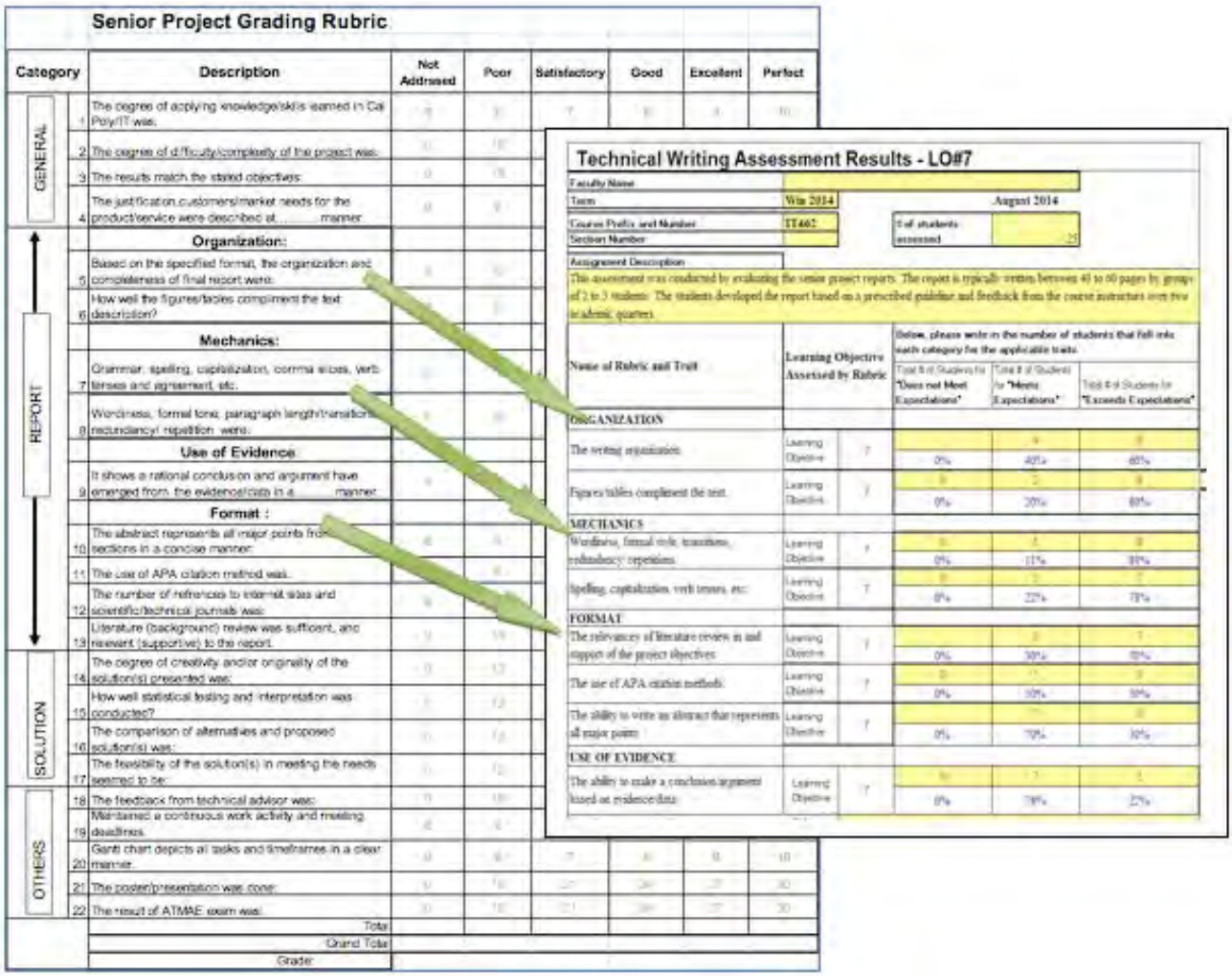
Grading/Assessment

Typically, there is a significant degree of subjectivity in determining grades in senior project/design courses. To assist quantification of student performance, we developed a grading rubric (Fig 8). The rubric is structured based on three major categories of "General Metrics", "Report Writing Metrics", "Solutions Metrics". Each category is comprised of several grading metrics. For example, in Solutions category; the degree of creativity, quality of statistical analysis, comparison of alternatives and feasibility of solution are evaluated. For each rubric metric, a six-level grading scale is applied. A grading weight is embedded for all metrics to differentiate the significance of each one. For example, feedback from industry sponsors has higher grading weight than writing an abstract for the project by factor of three.

For each team one rubric is filled in by the instructor, unless there is a tangible variation in team members' performance that warrants separate rubric for one or team members. As explained earlier, the performance of each student is identifiable on two sections, Literature Review and Solution sections. Two other documents that assist the instructor is fair grading are the results of a confidential peer-review survey and weekly project logs.

While the senior project course supports several program learning objectives (LO), two of these objectives are assessed in this course. Those are LO#1 (Fundamentals of management, technology and applied engineering) and LO#7 (writing skills). As one of the requirements of passing the course, an online exit exam is taken by the students which is administered by Association of Technology, Management, and Applied Engineering (ATMAE) during final week of the course. The results are used for assessing the program LO#1. The LO#7 is assessed using a 22-criterion rubric shown in figure 8. As can be seen, the grading rubric feeds in writing assessment rubric.

Figure (8): Grading and Assessment Rubrics Mapping



Senior Project Grading Rubric

Category		Description	Not Addressed	Poor	Satisfactory	Good	Excellent	Perfect
GENERAL	1	The degree of applying knowledge/skills learned in Cal Poly/IT was:						
	2	The degree of difficulty/complexity of the project was:						
	3	The results match the stated objectives:						
	4	The justification customers/market needs for the product/service were described at ..... manner						
REPORT		**Organization:**						
	5	Based on the specified format, the organization and completeness of final report were:						
	6	How well the figures/tables compliment the text description?						
		Mechanics:						
	7	Grammar, spelling, capitalization, comma errors, verb tenses and agreement, etc.						
	8	Wordiness, formal tone, paragraph length/transition redundancy/ repetition were:						
		Use of Evidence						
	9	It shows a rational conclusion and argument have emerged from the evidence/data in a ..... manner						
		Format :						
	10	The abstract represents all major points from sections in a concise manner:						
	11	The use of APA citation method was:						
	12	The number of references to internet sites and scientific/technical journals was:						
	13	Literature (background) review was sufficient, and relevant (supportive) to the report.						
SOLUTION	14	The degree of creativity and/or originality of the solution(s) presented was:						
	15	How well statistical testing and interpretation was conducted?						
	16	The comparison of alternatives and proposed solution(s) was:						
	17	The feasibility of the solution(s) in meeting the needs seemed to be:						
OTHERS	18	The feedback from technical advisor was:						
	19	Maintained a continuous work activity and meeting deadlines.						
	20	Gantt chart depicts all tasks and timeframes in a clear manner.						
	21	The poster/presentation was done:						
	22	The result of ATMAE exam was:						
		Total						
		Grand Total						
		Grade						

Technical Writing Assessment Results - LO#7

Faculty Name			
Term	Win 2014		August 2014
Course Prefix and Number	IT462	# of students assessed	25
Section Number			

Assignment Description

This assessment was conducted by evaluating the senior project reports. The report is typically written between 40 to 60 pages by groups of 2 to 3 students. The students developed the report based on a prescribed guideline and feedback from the course instructors over two academic quarters.

Name of Rubric and Trait	Learning Objective Assessed by Rubric		Below, please write in the number of students that fall into each category for the applicable traits: Total # of Students for "Does not Meet Expectations"	Total # of Students for "Meets Expectations"	Total # of Students for "Exceeds Expectations"
ORGANIZATION					
The writing organization	Learning Objective	7	0%	40%	60%
Figures/tables compliment the text	Learning Objective	7	0%	20%	80%
MECHANICS					
Wordiness, formal style, transitions, redundancy/ repetitions	Learning Objective	7	0%	11%	89%
Spelling, capitalization, verb tenses, etc.	Learning Objective	7	0%	22%	78%
FORMAT					
The relevancies of literature review in and support of the project objectives	Learning Objective	7	0%	30%	70%
The use of APA citation methods	Learning Objective	7	0%	10%	90%
The ability to write an abstract that represents all major points	Learning Objective	7	0%	70%	30%
USE OF EVIDENCE					
The ability to make a conclusion/argument based on evidence/data	Learning Objective	7	0%	78%	22%

Team Code of Conduct and Ethics

To promote an ethical working environment and relationship in during all phases of the project, a "Team Code of Conducts and Ethics" is provided to students. Across all of these codes, the overarching ethical canons are: (a) do no harm and (b) do work only in your areas of competence.

Table (1): Team Code of Conducts and Ethics

1. Team members will strive for a productive and educational experience for all members as they work together to the completion of a successful project.
2. Each team member shall take on a fair share of team tasks.
3. Team members will meet all deadlines and meetings with punctuality.
4. Team members inform each other of work in progress and any change of plan.
5. Team decision making is based on consensus among team members.
6. All team members have the opportunity to voice their opinions in meetings.
7. Each team member shall take other members' opinions and thoughts seriously.
8. Team members will respect all teammates.
9. Team members will refrain from making negative comments that may be interpreted in a hurtful manner.
10. Team members will be clear about the time they can commit to the project and will honor all time commitments made to the team.
11. Team members attend meetings and complete tasks on time.
12. Team members have an individual responsibility to be aware of deliverables and meetings, as well as fulfill all responsibilities associated with them.
13. Situations and disputes will be resolves first within the parties involved. If a solution or consensus cannot be reached, it will be taken up first with the team leader, then the course instructor.
14. Failure to abide by this code of conduct and ethics will be reflected on the team member's peer review and could have serious consequences on his/her grade.

Examples of Projects

Although ITP students may choose any project as long as it meets a set of requirements, they are encouraged to work on industry/business-based (IB) projects. We believe such projects are an excellent way to familiarize students with the industrial environment and the types of problems they may face after graduation. However, taking IB projects often involves an extra workload for students including trips to off-campus sites and higher expectations of IB advisors. In fall/winter of 2014-15, out of 22 projects, 18 projects were offered to regional industries and businesses. In the following section the description of three IB projects are provided.

Measurement and Analysis of the Distribution Environment for "Small" Packages

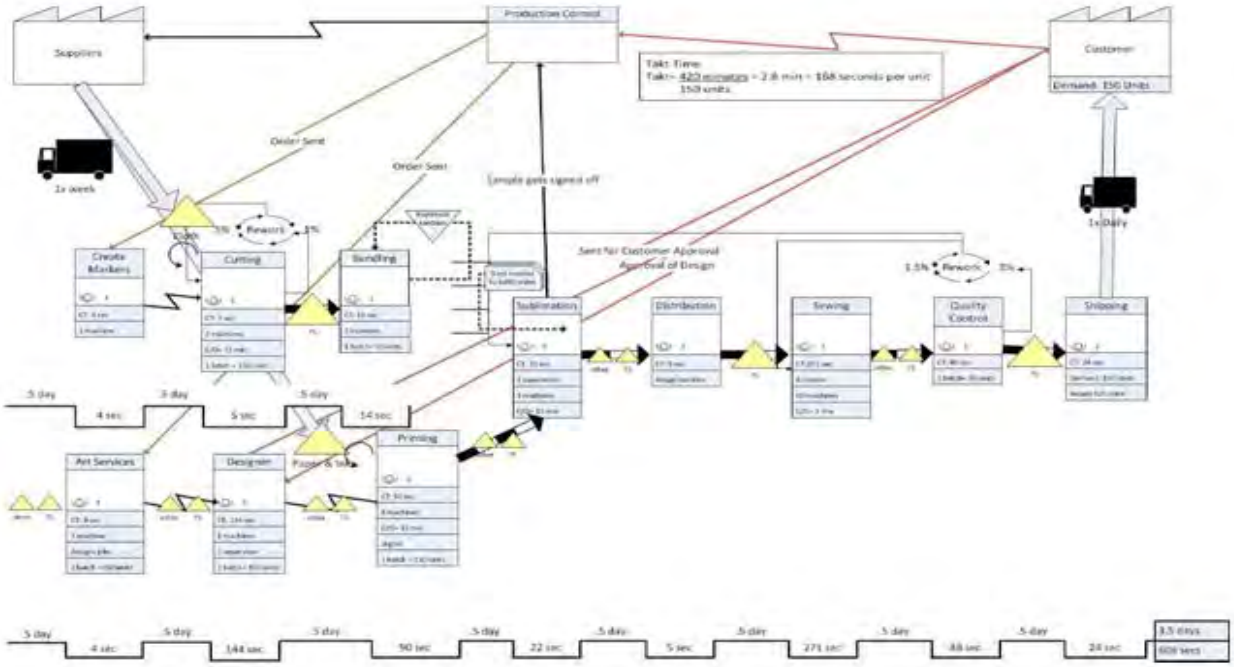
This study evaluates the performance of "small" packages within the distribution environment using field data recorders. The recorders are used to measure peak accelerations, changes in velocity, and the orientation of impact for each impact. The analyzed data can help Amazon to validate the appropriateness of their current testing standard (ISTA 3A) and optimize their package designs to better protect the package and the product inside.

Implementing Lean Packaging Methods at Lockheed Martin

This senior project provided a solution for the needs required by an aircraft manufacturer for the packaging of their components. The result involved using a new packaging solution that provides adequate product protection, reduces the time to package parts, and is completely recyclable. Keeping this packaging solution sustainable followed the company's "Go Green" program by reducing the waste generated by individual packaging.

Lean Operation Tools Applied to Custom Make to Order Manufacturing Line

In this project, students conducted lean kaizen event at production floor of a cycling apparel manufacturer. An assessment of current operational status of the shop was conducted using value stream mapping. The main goal was to improve on time delivery of products while increasing productivity. The value stream map revealed bottlenecks and potential barrier to future growth. The project proposed possible solutions and developed a future value stream map.



Summary and Conclusion

Managing industry-based senior capstone projects in an efficient and productive manner may require a pre-enrollment planning and deploying various management tools. In this study, the author presented some of the planning approaches and tools used in a senior project course including pre-enrollment plan, project deliverables options, project tasks breakdown, screening of project solution ideas and application of statistical analysis methods. A project grading rubric was presented with linkage to a program learning objective assessment rubric.

The described course management scheme is designed to provide a learning environment for the students to integrate their knowledge of management, technology and applied engineering with creative problem solving, critical thinking, teamworking, ethics and technical writing. Hopefully the process and tools described in this paper will be useful for other educators and students in managing their industry-sponsored senior projects.

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Teaching Innovations

Virtual Production Line Development

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Abstract

Automation is an area that is constantly being updated with the incorporation of new technological developments. These changes require constant training in both the academic and industrial spheres. One of the limitations of academia is the lack of infrastructure that allows the student to conduct trials in an industrial environment since both the type and number of the actuators, sensors and processors are limited to/by the infrastructure of the laboratory. For this reason, the development of a virtual production line is posed where components possess the physical and electrical characteristics of the industry necessary to simulate real behavior. With this development, people in training will be able to connect PLCs to the virtual production line by Modbus/TCP communication and program complex automation sequences in real industrial scenarios which have been virtualized. This means they will be able to modify the parameters and the sequences of control without the risk of compromising the safety of the process or personnel involved.

Introduction

The incorporation of new technologies and technological developments in the area of automation and control requires constant training of the personnel involved in such area. The majority of this training beings in the laboratories of educational institutions and training centers for automation personnel. These laboratories are where theoretical knowledge gained in the classroom is applied. Unfortunately, being limited in infrastructure, the use of those laboratories, in the best case scenarios, are restricted to only some actuators and sensors. Industry training is another source in which individual companies have their own internal training programs led by experts in the field. However, this method of training is not always successful since any error in the programming of the controllers may lead to putting personnel at risk or financial losses for the company.

Whether the training is conducted in an educational or industrial environment, the objective of the trainee is to learn and/or update their knowledge in one or several of the following areas:

- PLCs
  - Ladder diagram
  - Learn and program in commercial programming environments (AB: RsLogix, Siemens: Stp7, etc.)
- Communications.
  - OPC
  - Modbus
  - DLLs
  - Commercial protocols (DeviceNet, ControlNet, Profibus, etc.)
- SCADAS
  - Commercial (RSview32, Simatic, etc.)
  - Develop SCADA using high level languages (C#, VB.NET)

Currently, the availability of high-performance tools such as platforms for virtual developments, physics engines, computer processors and graphics processors, has contributed to the emergence of virtual applications whose purpose, unlike conventional applications, is to go beyond entertainment. This new trend known as "Serious Games" has its main action field in specialized instruction and training [1], since it takes advantage of 3D games and game engines in order to improve the realistic experience of users in different contexts, e.g. industry [2-4], health [5-7], army [8], etc.

Taking into account the necessity for quality training in the areas of automation and control as well as the exponential growth of real time 3D simulation tools, an interest for the development of virtual training environments for these areas of engineering can be seen to emerge.

This work presents the development of a virtual production line (VPL) with industrial scenarios for application in the teaching of subjects related to automation and control. With this development, educational institutions will be able to transfer practical knowledge without the need to acquire hardware. In addition, the participants will be able to automatize real lines and processes that exist currently in industry with scenarios that will also vary the complexity of the sequences according to the knowledge level of the trainee. Another advantage of this tool is that it provides the trainee with the opportunity to operate a process while simultaneously eliminating the economic and safety risks that normally exist when control parameters are altered.

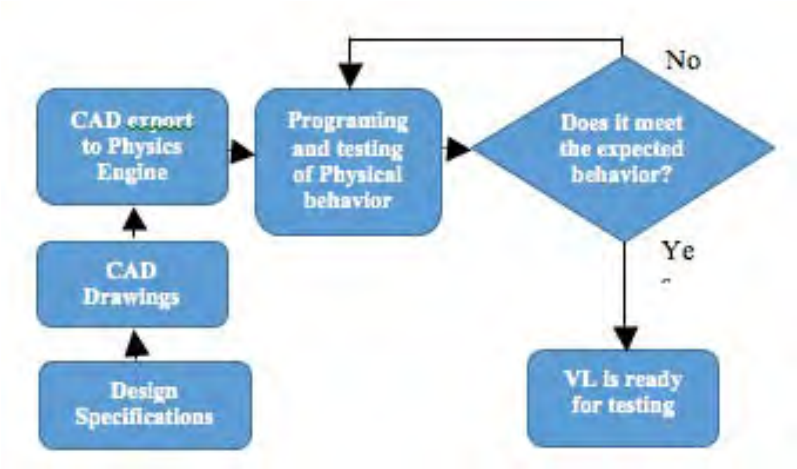
This VPL is capable of interacting with any brand of PLCs that have the capacity to communicate by Modbus/TCP. This offers flexibility in teaching courses on industrial control and automation. The goal is to create a virtual environment based on the simulation of processes where physical aspects and dynamic behaviors of real models are represented [9-13]. This includes objects, actuators, sensors and environmental factors.

This development will allow educational institutions and training centers to adjust their practical instruction with the types of controllers that exist in the market and, thus, provide more appropriate vocational preparation for their students. The PLCs can also use their real I/Os to connect with external hardware (i.e. pushbuttons, joysticks, control panels etc.) in order to manipulate mechanisms and processes inside the virtual scenario. This flexibility makes the learning process much more similar to reality.

Methodology

The methodology used in the design is displayed in Fig. 1. It begins with a series of specifications of the process to virtualize. Once the physical characteristics are obtained from the process, as well as the dynamic behavior of each of the elements such as the mechanisms, sensors and actuators and the CAD drawing of each of the aforementioned elements, the third step is to insert the CAD designs into a physics engine in order to assign dynamic behavior to each element. Finally, the performance of each element is tested to assure that its behavior is as close to reality as possible.

Figure (1): Methodology



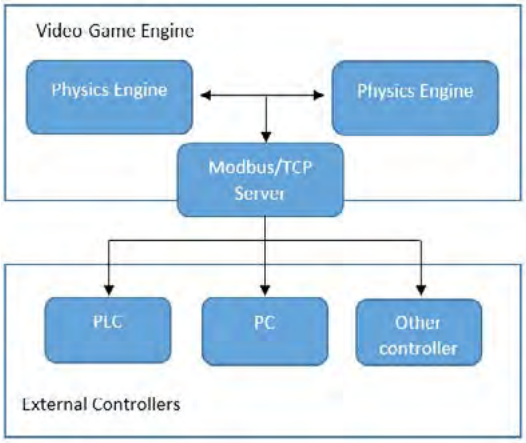
Design and Implementation

The virtual production line is built on two basic blocks of sensors and actuators which send and receive digital signals to the PLC. These signals are emulated from the virtual devices such as the motors, pistons and HMIs, etc. The behavior of these devices depends on the degree of sophistication of the model which, in general, is compared to the behavior of the real physical devices.

Architecture of the System

The communication between the VPL and the external controllers is carried out by Modbus Server protocol over TCP/IP (Fig. 2). It is through such communication that access to virtual signals from virtual sensors and actuators becomes possible.

Figure (2): System Architecture



The clients (External Controllers) send and receive signals and commands to the server and continually update the status and results of the simulation.

The simulation of the physics of the objects is carried out by a physics motor [14] independent of the server. This helps the server not to be slowed down by excessive calculations and frees it up to focus its attention on the clients.

Implementation

For implementation, the VPL of a Robotic manufacturing cell was selected. In this scenario, Serial and Delta Robots were implemented. Also, capacitive and inductive sensors and actuators such as DC motors and pistons were virtualized. Sounds were added for all of the equipment to represent the characteristics of the process and its function in order to create a virtual environment that closely resembles reality.

Other technology used is the physics engine, in this case NVIDIA® PhysX®, one of the most robust physics engines commercially available. A physics engine is computer software that provides an approximate simulation of certain physical systems, such as rigid body, soft body and fluid dynamics. This means that through a physics engine the real behavior of all embedded systems in the scenario can be accurately represented. In the case of the robotic cell, the represented physical systems are only rigid bodies. A physics engine provides the opportunity to configure many features to simulate the behavior of rigid bodies including gravity, collision detection, mass, center of mass, angular velocities and accelerations, forces, torques, etc. The above-mentioned technology together with the modeling of dynamic systems results in a set of scenarios with a high degree of realism in the behavior of all the systems embedded in the virtual environment.

Types of Training

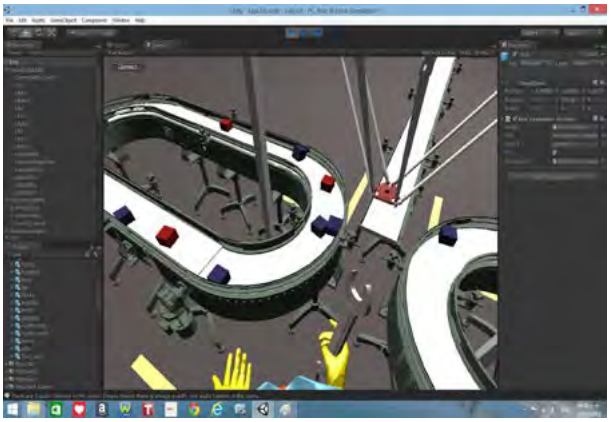
Two types of training were implemented: control room training and training inside the plant. The first consists of the recreation and simulation of the control room where the operator monitors the plant using a SCADA system and programs the PLCs. Therefore, the environment consists of the screens and controls needed to manipulate the operation of the process. It is also possible to simulate the display of the security cameras that monitor the plant (Fig. 3).

Figure (3): Virtual Control Room

The second form of training is the simulation of inside the plant itself. This mode is used when the field engineer must interact with the objects that are part of the scene such as buttons and interfaces. In this mode, the field engineer moves through the plant in first person (Fig. 4 & 5), offering the trainee the perspective of being inside the industrial environment.

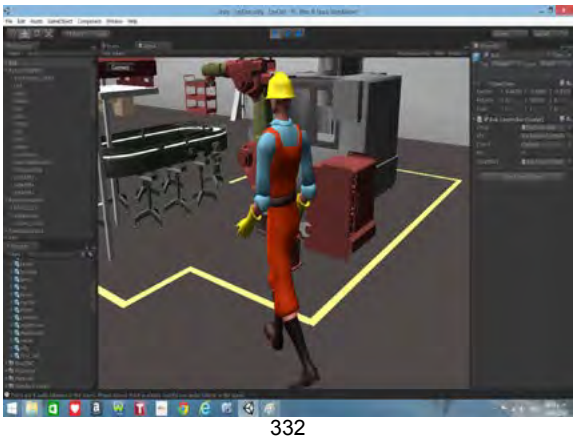
Figure (4): First Person View

Figure (5): Manipulation of Objects in First Person



The VPL allows training in both modes simultaneously. One operator can use the control room mode while a field engineer can train in a scene. It is worth mentioning that such interaction in the virtual scenario can take place via network even when the participants are located in different geographic locations all over the world. . Applying both modes together, the operator can visualize the avatar of the field engineer that is training and moving inside the scene as shown in Fig. 6.

Figure (6): Third Person View of a Graphic Client



Tests and Results

The PLC that was used to interact with the virtual laboratory was a SLC 500 which communicates by way of Modbus/TCP. The graphic model is made up of 0.8 million of polygons. Speaking in terms of physical simulation, the model is made up of 50 rigid bodies, with 40 colliders.

The software and the communication modules were executed using a computer with 6.00GB of RAM with an Intel processor i5-4210U @ 2.40GHz, Windows 8.1 64 bits.

The use of the CPU/GPU was constant and less than 21% in total. The frequency of the sampling of the signals of the model was maintained constant at 0.2 milliseconds.

Conclusions

The VPL implemented is a teaching tool that trains plant operators, field engineers, and students in a virtual environment using real controllers. This last characteristic offers the student the opportunity to learn and implement automation routines in complex processes with the assurance that they are not compromising the safety of the installations and/or the personnel involved.

Relying on system feedback, the operator can visualize the errors in the process. This, in turn, helps the trainees to make changes and modifications in the parameters so that they learn from their own mistakes.

Currently, the virtual application is under development, and the first commercial version publicly available is scheduled to launch soon. Future projects for this technological development are aimed in two directions: (i) the creation of new scenarios with more complex industrial processes will be designed, modeled and virtualized in order to offer a more complete range of tools for training, and (ii) the resolution of issues related to increasing the realistic experience of users will be added, not only from the perspective of the development of better graphics, contrast, audio, etc., but also through the incorporation of new technologies, such as virtual reality helmets, which are a very viable option for providing the user with a feeling of being completely immersed in the virtual environment.

Acknowledgment

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