Journal of
INDUSTRIAL TECHNOLOGY

Volume 17, Number 1 - November 2000 to January 2001

Proposal For Taking The Industrial Technology Profession To The Next Level: Assessing Core Knowledge Through Online Methods

By Dr. John W. Sinn

KEYWORD SEARCH

Administration
Curriculum
Higher Education
Leadership

Non-Refereed Article

The Official Electronic Publication of the National Association of Industrial Technology • www.nait.org

Dr. John Sinn has been at Bowling Green State University since 1984 where he is founding Professor of the Applied Quality Science curricular option and founding Executive Director of the Center for Quality Measurement and Automation (CQMA). His scholarly work has been in the fields of quality and metrology, primarily oriented toward manufacturing. He also has professional interests in technology as general education, change, electronic delivery of information and education and the preparation of technologists as leaders. Collectively he has published or co-published over 50 papers in various journals.

Proposal For Taking The Industrial Technology Profession To The Next Level: Assessing Core Knowledge Through Online Methods

By Dr. John W. Sinn

The National Association for Industrial Technology (NAIT) has strong, emerging, accreditation and certification programs in place. Through the efforts of many over the past 25+ years NAIT is blessed with foundational programs from which to move forward. Perhaps no other professional entities provide defining evidence of our past, and strong commitment to the future, as do accreditation and certification efforts. This is true for several important reasons. Accreditation and certification:

1. Speak to content and process, the discipline of who and what we are as a profession;
2. Underscore our technical management core knowledge niche which differentiates us from, but also uniquely binds us inter-disciplinarily to, other professions;
3. Require all to pause and review our collective "portfolio" of work and progress; and,
4. Assess our discipline, Industrial Technology, in collective ways essential for success in academe.

This is even more compelling when the Research Committee is introduced as an entity responsible to help set the broad agenda for defining and interpreting our future. When linked with The Journal of Industrial Technology (JIT), as a recorded portfolio of the past, it shows a turbulent but essential period of figuring out who we are. Recent shifting of the JIT to an electronic format make assessment opportunities using the accreditation and certification "NAIT portfolio" even more intriguing.

This suggests, and perhaps anticipates, a relationship between and among the NAIT Accreditation, Certification, and Research Committees. The relationship is inherent, by definition, in the discipline of Industrial Technology. Relationally these entities might appear as shown in figure 1.

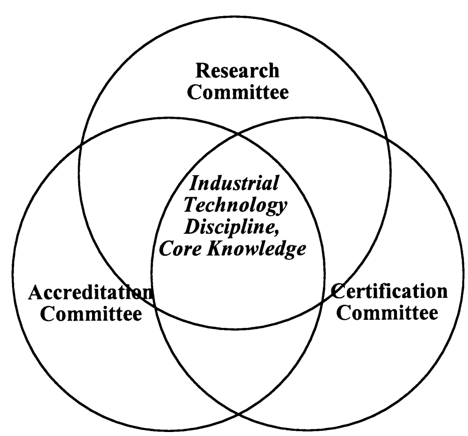
The diagram depicts a relationship which suggests equal but articulated responsibility for "growing" the Industrial Technology discipline. As suggested above, these entities, based on their active interaction with the professorate, students and all other elements of the profession, must provide the lead in developing discipline. Giving definition to NAIT technical management core knowledge is heavily reliant upon the interactive relationship lodged in accreditation, certification and research processes.

Several Important Assumptions

Significant influences impacting the Industrial Technology profession must be acknowledged and articulated for all to better understand and address. These are summarized as assumptions that have both direct and indirect implications:

1. Assessment in higher education will become increasingly pervasive and connected to quality functions, defining customer and supplier relationships;
2. Electronic course delivery, and related non-instructional systems, will impact virtually everything we do and are about in substantial ways over the next several years;
3. Traditional geographical boundaries and parameters for educational institutions will increasingly change to rely upon

Figure 1. Industrial Technology discipline, core knowledge relationships, as reflected in JIT.



consortial relationships of many from different locations;

4. We must become increasingly well thought out, focused and disciplined, and relevant in what we do, who we serve, what our key principles and functions are; and,
5. Our major customers, students and industries, will demand increasing flexibility and accountability, laptop and wireless technologies, and other significant paradigm shifts.

These are the basis for this proposal, and significantly, the need for our profession to move forward to achieve new levels. Yet perhaps the single greatest assumption being articulated and addressed is the need to have agreed-upon and written content defining our core knowledge in a disciplined manner. This has been written about previously by the author in 1989, 1994 and 1998 (a), and the need remains.

The Next Level, Challenges and Opportunities

While NAIT has a long history of successes, to remain viable we must plan for the future. The future, with new and higher levels of successes, holds challenges and opportunities related to:

1. Electronic technologies for instruction and interactive conferencing techniques;
2. New, enhanced accreditation methods via electronic assessment, portfolios, and virtual visits;
3. Seamless assessment of students and programs tied to actual course performances and deliverables;
4. Teamwork in articulated courses based on applications of actual principles in industrial projects;
5. Consortium relationships using teams of global faculty to guide the process and delivery;
6. Seamless transfer relationships between two and four year institutions and programs;
7. Seamless undergraduate and graduate programs for five year combined BS and MS degrees;
8. Emphasis on non-traditional student needs, facilitating the same, interactively with industry;
9. Advisory committees to influence and validate total teaching and learning processes;
10. Non-degree granting industrial partners growing core knowledge for technical management;
11. Applying principles learned in actual industrial projects as the classroom; and,
12. Building quality standards into our product, emphasizing quality principles in all that we do.

The future will require increased reliance upon electronic delivery and systems, changing everything (Crow, 1999; Daniel, 1997; Perley and Tanguay, 1999; and CHEA, 1999). What NAIT must do, as we move to the next level, is facilitate the above in a flexible and anticipatory mode, guiding the Industrial Technology profession, as in the past, addressing emerging challenges and opportunities.

Whether addressed in traditional or electronic methods, one of the key areas requiring attention is technical management core knowledge as the fundamental discipline of Industrial Technology. This must be done in a shared relationship between the Research, Certification and Accreditation Committees of NAIT as pivotal sub-groups within the broader body.

Disciplined Paradigms for Technical Management Core Knowledge

Based on its generic principles, “common ground” areas of certification and accreditation processes are technical management core knowledges. Acknowledgement of common ground inherent in core knowledge, done in the past in broad principle statements, is a new paradigm. The new paradigm focuses on opportunities and challenges for the future, aimed at strengthening NAIT as an organization, and the entire Industrial Technology profession.

Essential paradigm shift “questions” may be, can we:

1. Agree sufficiently on actual content and process unique to Industrial Technologists, enabling and empowering a profession to speak with increased focus?
2. Generate texts to guide faculty and others as we define our “common ground” at higher levels?
3. Innovatively lead in defining how to do conventional hard copy texts, simultaneously planning for, and generating, electronically down-loadable content from the web?
4. Continue to define unique elements, particularly via technical project based applied research in courses, to integrate our industrial services better to those we serve as primary customers.
5. Define a seamless, global, process for teaching and learning via courses with built in assessment elements, driven by, and connected to, accreditation and certification?
6. As a profession, link all of this as a “unison” research agenda for the future, and collectively agree to undertake a project for addressing all of the above?
7. Enter into an arrangement systematically focused on “growing intellectual capital” in disciplined ways for our future and for those yet to come?

The bottom line is, as a profession, can we accept the need for such a broad based and “concurrent” future? Are we ready, and sufficiently “disciplined”, to guide our collective professional energy, via research, accreditation and certification processes, to strive for higher levels of intellectual growth? Are we ready to take NAIT, and Industrial Technology as a profession, to the next level?

The Proposal: Content and Process for Technical Management

The proposal is to start with an existing, pre-defined, system of content and process, refine it further in modest ways, and establish user's groups on a voluntary basis to further validate and grow the system. NAIT would set the actual agenda, through its Board of Directors, and be the principle guides of the project. Ultimate deliverables resulting from the proposed project would be enhanced written materials in various formats that define technical management core knowledge.

The proposed project, potentially eventually engaging all in the profession, would be done in a shared manner among Research, Accreditation and Certification Committees. Interaction with publishers in our field, and others interested in being potential provider partners of the materials, as they are being validated and further developed, would be a key part of the plan. One such example, already aligned with the important effort, is the OWLS Group within Ericcson, Inc. OWLS stands for Online Wireless Learning Systems, an innovative approach to streamlined teaching and learning. More can be learned by visiting the Website for OWLS, www.owlsnet.com.

The immediate short-term goal would be getting NAIT on board, collectively, for continued development and validation of tools designed for technical management by Industrial Technologists. The tools, in five groups of eight each, are used as tutorials for faculty, students and industrial persons and they would continue to define our discipline based on:

1. Primer Tools: Technology systems and Industrial Technology introduced
2. Cultural Tools: Core values for technological empowerment and change
3. Data Tools: Statistical process control improvement systems
4. Documentation Tools: Technical management systems—Kaizen in action
5. Synchronous Tools: Leadership for Kaizen and future planning

Based on 40 existing tools (further described in the next section) provided by the author, organized according to the above five areas, the tools would be further developed through user's groups at various sites. The longer term goal of defining Industrial Technology as a discipline, around its technical management core knowledge, would be achieved by the relationships inherent in the following multi-phased plan, to be put in motion at the annual 2000 NAIT conference:

Phase I (Fall, 2000, primarily at conference). This initiates the process, in motion at the current time.

1. Proposal is shared with profession via the JIT, as an editorial, and perhaps in other ways.
2. NAIT Board of Directors and committee chairs are presented the proposed plan.
3. A booth would be set up with vendors, to encourage participation in the project.

Phase II (Winter, 2000; spring, 2001). This is initiated after the fall NAIT conference as follow through.

1. Work with potential publishing partners for marketing and distribution, and edit materials.
2. Continue to identify a small number of user groups who could initiate the process for fall, 2001.
3. Seek external funds, and partners, to support the effort, collectively, and to develop systems.

Phase III (Summer, 2001). As the project matures, and intensifies, one of the critical parts will be to identify systems for maintaining and completing actual documents and materials.

1. Prepare mutually beneficial contractual relationship outlining copyright, royalties and ownership (a portion of funds generated will go to NAIT Foundation, and faculty at user group sites).
2. Continue developing user group prototyping sites around the country.
3. Continue development of web-based systems, down-loadable user group materials.

Phase IV (Fall, 2001). Phase IV will grow the system based on documented materials and systems, bringing others into the fold as users, researchers and developers.

1. Conduct tutorial for interested faculty, students, and others at NAIT fall conference.
2. Pursue user's groups, particularly from Research, Certification and Accreditation Committees.
3. Provide a vendor's booth at the 2001 NAIT conference, to disseminate project information.
4. With publishing partners, announce series of text-based materials in various formats and media.

Phase V (Spring, summer, 2002—and beyond). Phase V, year 2002, provides project continuation, maintaining and incrementally growing technical management core knowledge systems.

1. Build in feedback from user groups, as improvements in core knowledge and the system.
2. Print prototype hard-copy materials for broader dissemination beyond initial user groups.
3. Continue preparing tutorial systems for NAIT membership use, at conferences and in other ways, to disseminate core knowledge, grow users, enhance communications among constituencies.
4. Continue development of electronic media systems for technical management core knowledge.
5. Continue developing partnerships for funding and other support and enhancements to systems.

Industrial Technologists' Toolkit: An Overview Of The System

The basis for moving forward to define technical management core knowledge would be the Industrial Technologists' Toolkit For Technical Management (Sinn, 2000). This defines knowledge and systems for Industrial Technologists focused around technical management core knowledge. Key features of the five part series include:

- tools are individually referenced, fully digitized, systematized for interactive use via the net

- technical management issues, team-based "hands on" problem solving, "Kaizen" and change focus
- teams and individuals incrementally grow system, "train trainers", home grown, modified locally
- approximately 1000 pages total of "long form" text for total of 40 tools, 8 in each part of series
- "short forms" with bulletized, graphical definition, in Power Point (currently being updated)
- employee involvement and participatory teams, for global competition, leadership growth
- ISO, QS and Baldridge total quality relationships built in seamlessly to the system

The toolkit was developed with 100's of industrial projects, and used in various academic and non-academic courses (Mead, et al, 1994; Sinn and Shipman, 1997). It is a philosophical model for technical management, problem solving and improvement (Barker and Sinn, 1997). The technological change model is a basis for disciplined change (Sinn, 1997 a and b; 1998 a and b), shown in figure 2:

The outer ring area functions as the broadest of culture, or general infrastructure, required to conduct technical management functions in organizations. These define requirements for an organizational culture, or team, as a disciplined system. As technological functions require several sub-systems to form a system, this helps explain technical management, projects and applied research.

The three inner circles are significant for several reasons. First, they provide technical teams as the driving force in organizations. Surrounding technical teams, connected and interrelated data, documentation and synchronous leaders are presented. Teams, data, documentation and synchronized leadership are required to understand and do technical management. Problem solving leads naturally to teaching and learning based on team projects. This causes change, requiring trust, and growth for all, a basis for ongoing improvement through empowerment and knowledge (Sinn, 1995).

Working outward from the center, interacting with the broader outer circle and infrastructure, the model represents additional important elements of the change-oriented technical management culture. The change process depicted can facilitate growth and development of new technological systems and leadership, juggling issues and responsibilities simultaneously to "get the product out the door". The model also provides the basis for five tools, introduced earlier, organized as the toolkit system.

Primer Tools (1-8): Technology Systems And Industrial Technology Introduced

The first set of tools introduce and overview Industrial Technology and the toolkit system. This helps persons understand technical management core knowledge by briefly studying each element.

1: "Technical Foundations For Industry And Technology"
2: "Materials And Processes"
3: "Process Engineering, Design And Innovation"
4: "Cost Analysis And Productivity Improvement"
5: "Maintenance, Safety And Training"
6: "Quality Systems"
7: "Automation And Computer Integration"
8: "Technology, Service And Management"

Cultural Tools (9-16): Core Values For Technological Empowerment And Change

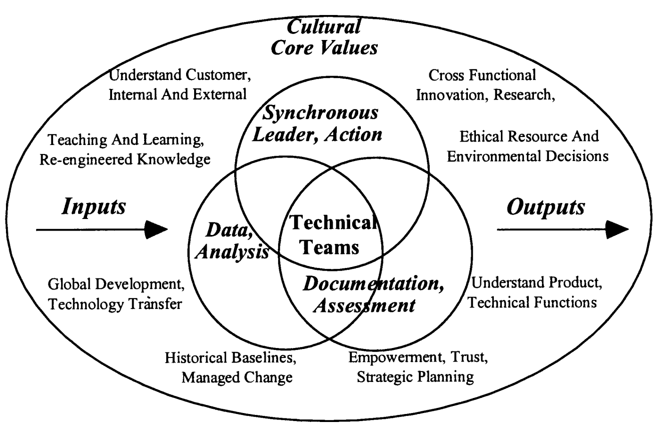
These tools provide definitions and orientation to technical management in a change context. Cultural tools explain why and how to change within broader market forces, internal and external, as:

9: "Core Technological Values And Foundational Cultural Definitions"
10: "Disciplined Culture For Change: Conducting And Managing Projects"
11: "Evolution Of Significant Developments And Core Values Of The Technological Culture"
12: "Data And Documentation For Problem Solving, Decision Making, Change"
13: "Planning And Evaluating Change: Technology Transfer, Global Development"
14: "Political Correctness And Ethical Issues: Core Values And Civility"
15: "Environmental And Resource Core Values"
16: "Synchronous Leadership: Managing And Servicing Product And Process For Change"

Data Tools (17-24): Statistical Process Control Improvement Systems

These tools focus on data for improvement and enhanced decision making in technical management. Problem solving via systematic data applications, process improvement addressed in:

Figure 2. Technological change model.



17: "Documentation For Quality And Productivity Improvement: Kaizen Foundations"
18: "Statistical Definitions And Concepts For Data Based Improvement And Solutions".
19: "Attribute Data, The Obvious Starting Point"
20: "Variable Data, Comparisons To Attribute Charting And Short Run Systems Introduced"
21: "Basic Measurement, Geometric Relationships And Broader Issues"
22: "Gage Repeatability And Reproducibility (R & R): Inspection And Measurement Improvement"
23: "Capability Analysis, Evaluating Charts And Quality Characteristics: SPC In Transition"
24: "Design Of Experiments (DOE), Finite Element Analysis(FEA): Robust Problem Solving"

Documentation Tools (25-32): Technical Management Systems, Kaizen In Action

These tools build on data and cultural concepts via documentation for analysis and problem solving in technical management. Systematic analysis of information is focused on Kaizen techniques through:

25: "Data, Basis For Kaizen, Quality Planning, Systems Development"
26: "Basic Economic Considerations, Cost Related Documentation Kaizen Systems And Relationships"
27: "Ongoing Process Control Plan (OPCP), Standard Operating Procedures (SOP) For Kaizen: Macro And Micro Infrastructure For Understanding Process"
28: "Kaizen Foundations For Systemic Data Driven Process Variation And Waste Reductions"
29: "Synchronized Production Techniques: Japanese Kaizen Best Practices, Failsafing, Benchmarking"
30: "Failure Mode and Effects Analysis (FMEA) And Quality Functions Deployment (QFD): Robust Kaizen Documentation For Problem Solving"
31: "Total Productive Maintenance, Safety, Ergonomics: Re-engineered Synchronous Work Environment"
32: "Leadership And Supervision For The Future: Strategic Planning, And Evaluation"

Synchronous Tools (41-50): Leadership For Kaizen And Future Planning

These tools help grow talent to lead new product development and robust technical management systems for the future. Building on existing data and documentation systems, synchronous tools are:

33: "Growing Talent, Knowledge Workers And The Technological Learning Organization"
34: "ISO/QS 9000, Quality Launch Systems: Supplier Relationships Guiding Our Synchronous Future"
35: "Technical Material And Process: Innovation, Change, And Applied Research For Launch Systems"
36: "Launch Data, Documentation, Advanced Quality Planning: Emphasis On Production Qualification"
37: "Robust Design, Reliability And New Product Development"
38: "Automation And Enhanced Communication Systems For Data Acquisition, Documentation And Changing Quality Relationships
39: "OPCP, FMEA, QFD: Synchronized Documentation Systems For Advanced Problem Solving"
40: "Advanced SPC, Reduced Variation And DOE As An Improvement System"

Longer forms offer an extended and expanded body of knowledge and short forms are Power Point presentations for quick overviews. Applications give users a place to apply theories and information through blank forms and examples to help teams and individuals improve and solve technical problems.

Instructional Strategies, Broad Relationships To Core Knowledge, Assessment

The course instructional strategy must engage students in activities appropriate to the mission. These activities must undergo similar paradigm shifts to include critiquing of content and process; industrial project and applied research focus; and, electronic delivery presentations, chats and other methods (see note 2). Instructional strategies engage students in teams as the primary driver, focused on robust critiquing, analysis and synthesis functions. Major projects are articulated with information addressed in other critiquing aspects, as assessment question/functions. Projects assess technological systems, recommending change and improvements, and increasingly are based in actual industrial environments (Olson and Sinn, 1999). Multiple electronic presentations in long (standard text) and short form (Power Point) occur with all contributing equally, clearly identified, in WebCT (WebCT, 2000).

Course activities are assessed using criteria and systems clearly linking core knowledge. This focuses on content and process using practices consistent with quality systems and customer demands expressed in Baldridge criteria (NIST National Quality Program, 2000). Formats are increasingly electronic and flexible, digitized for delivery at various sites and geographies based on customer demands. Quizzes and other activities include team startup activities, chats, and other observations by faculty, all electronically assessed and communicated routinely. Software and hardware must be similar to that used in industry to permit teams of students, faculty and industrial mentors to communicate the way work is done by all (Lingappan, 2000). An example course assessment matrix is shown in figure 3.

The matrix demonstrates complexities in assessment, driven by teams immersed in technical management core knowledge, defining how Industrial Technologists work as professionals. Team work is posted at webct, points assigned, and feedback offered in the matrix. Numerical indicators (not grades) are tracked and posted regularly in webct, and ultimately converted to grades.

Other broad relationships are noted in seamless assessment systems engaging students throughout the degree. Focused on flexibility and accountability, an electronic checksheet enables tracking by faculty, students and staff. Electronically transportable for all, it presents new opportunities in better transferring students from the two year community college systems into a four year environment, and meeting other non-traditional needs and demands (MacRitchie and Sinn, 1997).

Designed to be interactive, and updatable by students, for self-tracking automated advising, this is one example of how electronic systems will change all we do. A third broad assessment relationship is the four year collegial model for students. This provides the opportunity for all work to be cumulatively tracked and assessed from initial recruitment through post-graduation as an alumnus as shown in figure 5.

Figure 3. Matrices and electronic systems for assessing student team performance.

Assessment Areas	*Sub Assess*	*Sub Assess*	*Sub Assess*	*Sub Assess*	
Summ./Synthesis(4 poss.)	Issues, syn. = 1	Teich/tool art=1	Acc. of summ. = 1	Det, analysis = 1	4.00
Actual Points Awarded					
Teams abstract major issues in the six required critique readings reflecting: • toolkit (lecture) reading and any related required reading analyzed for compatiblity with the tool; • development of accurate and detailed summaries, synthesizing key issues in Toolkit and other required readings; • compatibility articulated and integrated in all critique elements, major assignment phases; and, • designed to engage one-two team persons for each critique.					
Info. Reviews (7 poss.)	Articulation = 1	Diversity = 1	Bibliography = 2	Det, analysis = 3	7.00
Actual Points Awarded					
Teams review multiple diverse information sources, using information analysis forms, reflecting: • articulation, integration in all critique elements, major project phases, via data and documentation valuing systems; • development of bibliographical citation systems referencing all abstracted work; • synthesized in a cumulative data and documentation listing to support, address phased major project; and, • four-six information reviews completed for each critique, engaging three-five persons.					
Assess/Questions/Apps (9 poss.)	Proj. art. = 1	All persons = 2	Basis in forms = 4	Det, analysis = 2	9.00
Actual Points Awarded					
All persons do technological assessment question/applications/functions from readings to assess technology based on: • a question/toolkit application/function for each person on team, tied to information reviews and readings; • integration of question/functions reflecting Toolkit applications and data and documentation forms in projects; • pro-technology and anti-technology position arguments for each question/function; and, • detailed analysis and objectivity in application documentation forms, basis for all assessment positions taken.					
Team Assess. Sy. (5 poss.)	Point/crit. mat. = 1	Other teams = 2	Written comm. = 1	Diff. ratings = 1	5.00
Actual Points Awarded					
One to two persons develop or maintain systems to assess all team efforts for participating persons: • a point system, in Excel or other "matrix" form, keyed to criteria consistent with assessment system in the course; • a group written self evaluation as "where we are" with all aspects of our work; • members may receive different scores based on levels and quality of participation; and, • teams evaluate their work internally, and other teams externally with similar systems.					
Pres., Mgmt. (5 poss.)	Rot. task mat. = 1	Pres. qual. = 2	Coop/comm = 1	Art/int/forms= 1	5.00
Actual Points Awarded					
Team systems for presentation and management, developed and maintained by one or two persons, reflect: • quality of professional presentation details, content, writing style, format, total assembly; • articulation and integration with all other elements in critique and broader project, reflected in forms, matrices; • cooperation, communication and collaboration, via data and documentation, at appropriate professional levels; • matrix management system routinely rotating team members in all functions, showing who did what.					
Other opportunities for improvement:					
Team Assessed:	**Assessor: JWS**	**Work Assessed:**		**Date:**	**/30**

Figure 4. Electronic checksheet for on-line advising and quality assessment.

Quality Systems Major (Quality Engineering Specialization)
Planning And Assessment Checklist

Coop Ed./Project (11-12 hours)			Gen. Ed. Courses**** (15 hours)		
Required	**Other?**	**Date?**	**Required**	**Other?**	**Date?**
TECH 289			*Hum & Arts*		
TECH 389			*Hum & Arts*		
TECH489/402			*Soc & Beh Sci*		
Quality Systems Focus (12 hours)			*Cult Div in US*		
Required	**Other?**	**Date?**	*Gen Ed Elec*		
QS 416			**University Courses (29 hours)**		
QS 417			**Required**	**Other?**	**Date?**
QS 426			**ENG 112**		
QS 427			**PHYS 201*** **		
Technology Focus (33 hours)			**PHYS 202*** **		
Required	**Other?**	**Date?**	**IPC 102**		
MFG 112			**MATH 128**		
MFG 220			**MATH 131**		
MFG 235			**ENG 388**		
MFG 340			**Business Courses (21 hours)**		
MFG 329			**Required**	**Other?**	**Date?**
MFG 428			**MGMT 300**		
ETC 441* *			**MGMT 441**		
DESN 131*			**MIS 200**		
DESN 204			**OR 380**		
ETC 196			**STAT 211**		
TECH 302* **			**STAT 212**		
1. DESN 104 may be required* 2. PHYS 202 before ETC 441.**	3. Gen ed requirements.*** 4. One international course .****		**STAT 414**		

Quality Indicators Shown Below are to be assessed at regular intervals. Red indicators are assessed by College records office. Blue are assessed by faculty and student in regular advisement activities such as student professional organization. participation.

Y/N?	*Date*	*Initialed*	*Date*	*Initialed*	*Student Plan Status/Notes?*
Penalty Hrs:			1st-Reg:		
Gen Ed Hrs:			1st Sem:		
Last 30 BG:			30 Hour:		
Articulated:			60 Hour:		
Matriculate:			90 Hour:		
Grad Hrs:			Grad Int:		
Portfolioed:			5 Yr Sur:		

Faculty: Student: Date Started:

Student organizations, advisory committees, selected course work, co-op's and other elements of the total system are electronically configured in portfolios on-line, permitting additional opportunities for accreditation and certification at the collegial or institutional level. The three systems (see note 1) are also oriented to new paradigms in assessment, offering opportunities for different on-line approaches for accreditation and certification and new ways to configure the university of the future.

It is also clear that broad and complex relationships exist around technical management core knowledge, tying all entities together, requiring collective action as proposed. All elements of the system are connected through the common ground afforded in core knowledge as illustrated in figure 6.

Figure 6 underscores complexities and necessities of keeping the profession healthy and viable. Technical management involves virtually all elements in the profession in various ways, all important to our collective future. It is critical that we move to the next level. One method for doing this, while not quick, simple or easy, is to take actions through various committees and leadership functions as outlined in this proposal.

References

Barker, W., and Sinn, J. W. Tools for technologists: A case study in team-based technical problem solving. Journal of Industrial Technology. Volume 13. Fall, 1997, No. 4, pp. 3-8.

Crow, S. Virtual universities can meet high standards. Chronicle of Higher Education. Volume 66. October 29, 1999, pp. B5-B6.

CHEA Update Number 2: Distance Learning In Higher Education. Council on Higher Education for Accreditation (CHEA), Washington DC, June, 1999.

Daniel, J. S. Why universities need technology strategies. Change. Volume 83. Summer, 1997, pp. 11-17.

Lingappan, A., Brown, A., Waggoner, T., and Sinn, J. W. Online templates for ISO 9000-based standard operating procedures. Journal of Industrial Technology (online at nait.org). Volume 16-1. Spring, 2000.

MacRitchie, G., and Sinn, J. W. 2 + 2 Enhancement Process. Quality Progress. Volume 31. Spring, 1998, No. 1, pp. 55-58.

Mead, D., Haren, D., and Sinn, J. W. Bowling Green State University, CQMA: Technology transfer in northwest Ohio. Journal of Industrial Technology. Volume 10. Spring, 1994, No. 2, pp. 39-44.

National Institute of Standards and Technology. National Quality Program. http://www.baldridge.org. Accessed April, 2000.

Olson, D., and Sinn, J. W. Update on applied quality science at BGSU, student-based research for technology transfer: Critical element for technologists. Journal of Industrial Technology (on-line). Volume 15-4. September, 1999. http://www.nait.org. Accessed April, 2000.

Figure 5. Broad quality assessment system for collegial academic environment.

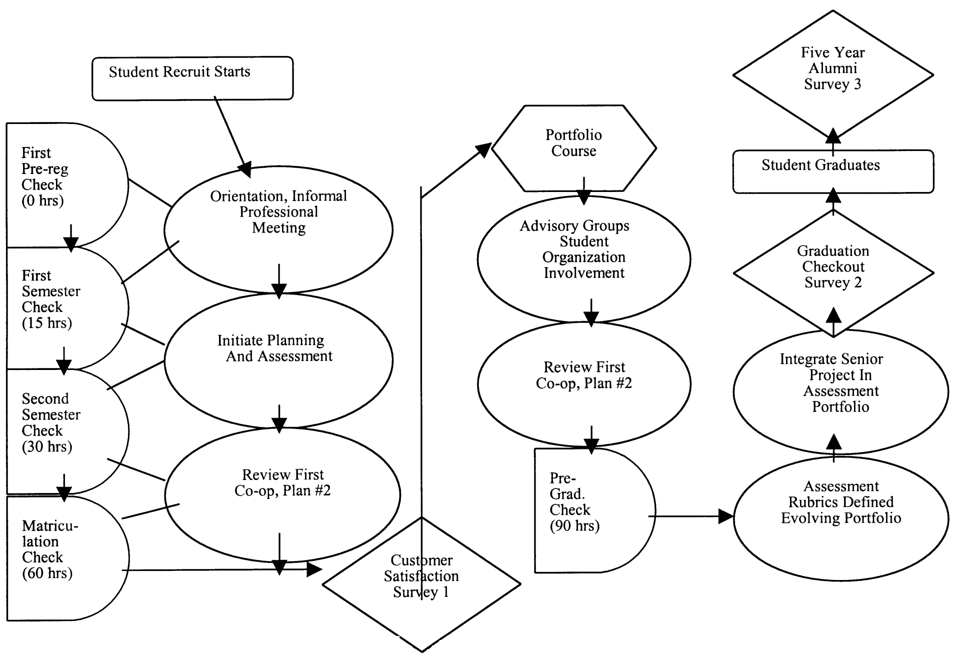
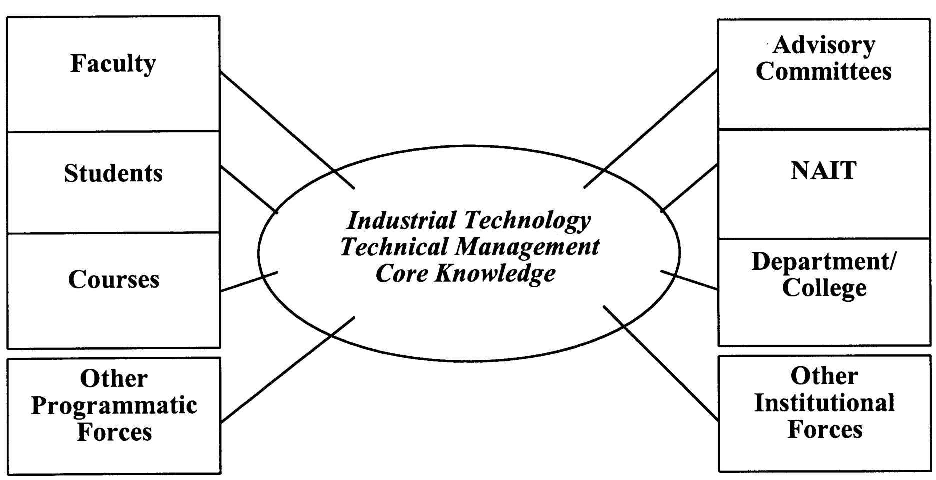


Figure 6. Complex entities and relationships bound by core knowledge.



Perley, J., and Tanguay, D. M. Accrediting on-line institutions diminishes higher education. Chronicle of Higher Education. Volume 66. October 29, 1999, pp. B4-B5.

Sinn, J. W. The Industrial Technologists' Toolkit For Technical Management. Fall, 2000. www.owlsnet.com

Sinn, J. W. The need for a defensible content base for industrial technology: An editorial. Journal of Industrial Technology. Volume 6, Number 1. Winter, 1989, pp. 6-8 and 34-35.

Sinn, J. W. Leadership, discipline, and pushing the envelope: The future of industrial technology—an editorial. Journal of Industrial Technology. Volume 10, No. 3. Summer, 1994, p. 37-38.

Sinn, J. W. Reinventing education to grow future talent. mfg.: The Brown & Sharpe Measuring Systems Group. Volume 2, Issue 1. Spring, 1995, p. 41.

Sinn, J. W., and Shipman, M. Technology transfer, CQMA, and the future. Journal of Industrial Technology. Volume 13, No. 1. Winter, 1997, pp. 40-45.

(a) Sinn, J. W. Can a graphical model help explain technological change? mfg.: The Brown & Sharpe Measuring Systems Group. Volume 4, Issue 2. Summer, 1997, p. 38-39.

(b) Sinn, J. W. Universal performance behaviors: What ought to be the technologist's toolkit? Journal of Technology Studies. Volume 23, No. 2. Summer/Fall, 1997, pp. 58-60.

(a) Sinn, J. W. Discipline, research, future conversations with friends: Can we move quickly to determine core knowledge? Journal of Industrial Technology. Volume 14, Number 4. Fall, 1998. pp. 11-14.

(b) Sinn, J. W. Content to achieve Industrial Technologist performance behaviors. Journal of Technology Studies. Volume 24, No. 1. Winter/Spring, 1998, pp. 38-41.

Waggoner, T. C., Sinn, J. W., Kennedy, E., Zargari, A., and Corbett, R. Automating a liberal education technology course: Preliminary foundation for redesign. Journal of Industrial Technology, Vol. 13, No. 1. Winter 1997, pp. 35-39.

Webct 2000. General information available online: http://about.webct.com. Accessed April, 2000.

Notes

1. These ideas were presented in a paper by the author currently being considered for publication in the Journal of Technology Studies. Title of the original draft was "Electronic course delivery questions and issues: Context Of Future University?" Several of these ideas were documented in a draft paper under development, titled, "Evolving a web-based liberal education upper level course in technology: An update for the future". This is co-authored by Wagonner, T., Petretich, C., Stitt, B., Mitchell, T., and Peterson, D..