NAIT Core Knowledge Courseware Research Initiative: Proposed To The Industrial Technology Profession Through The Research Division

John W. Sinn, Professor
Quality Systems Specialization
Technology Systems Department
Bowling Green State University
Bowling Green, OH 43402
jwsinn@bgnet.bgsu.edu
www.bgsu.edu/colleges/technology/qs

Fall, 2003
NAIT Core Knowledge Courseware Research Initiative:
Proposed To The Industrial Technology Profession Through The Research Division

This was first published in modified form in the January 2001, Journal of Industrial Technology. Titled, “Proposal For Taking The Industrial Technology Profession To The Next Level: Assessing Core Knowledge Through Online Methods”, it is accessible online. The purpose of the current writings are to update the profession, and provide additional perspective as well as a method and plan for continuing this work. As indicated in the earlier publication, the National Association for Industrial Technology (NAIT) has vital, emerging, accreditation and certification programs in place. 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, since 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, professionally; and,
3. Assess us, as a discipline, in collective ways essential for success in academe.

Our content and process are the discipline of Industrial Technology, specifically technical management, interdisciplinarily crossing over all other technical knowledge. Professionally, articulating and communicating the technical management core knowledge is critical not only to successful accreditation and certification, but for our very survival in academe over the long term. Industrial Technology’s existence as a discipline is contingent upon our ability to identify and define our content and process.

This is even more compelling when the Research Division, responsible to help set a broad agenda, helps define and interpret our future. This suggests, and anticipates, a relationship between and among the NAIT Accreditation and Certification Boards, and Research Division, as shown in figure 1:

![Figure 1. Industrial Technology discipline, core knowledge relationships.](image)

This shows a relationship suggesting equal but articulated responsibility for “growing” the Industrial Technology discipline. These entities, based on their active interaction with the professorate, students and others of the profession, must lead in developing discipline.

Sevente Important Assumptions, Leading Paradigms, Changes For Our Future

Significant influences impacting the Industrial Technology profession must be acknowledged and articulated for all to better understand and address. These are summarized as assumptions which have various implications, each with much more that could be written, but including only a brief explanation:
1. Assessment, realized particularly through accreditation and certification, in higher education will become increasingly pervasive and connected to quality functions, defining and driving customer and supplier relationships, and pointing toward potential programs’ existence;

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, moving all into new arenas of competition and understandings about who we are programmatically;

3. Traditional geographical boundaries and parameters for educational institutions will increasingly change to rely upon consortium relationships of many from different locations with less and less need for traditional fixed-place systems;

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, if for no other reason than to measure our successes and hold ourselves accountable; and,

5. Our major customers, students and industries, will demand increasing flexibility and accountability in all that we do, and we must be able to respond to these demands with quality and integrity in disciplined, innovative delivery modes and systems, reflective of our content and process.

This is the basis for this proposal, and significantly, the need for our profession to move forward. Yet perhaps the single greatest assumption being articulated and addressed is the need to have agreed-upon and written content and process defining our core knowledge in a disciplined manner. This has been written about previously by the author in 1989, 1994, 1998 (a), and 2001, and the need remains. 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 Division, Certification and Accreditation Boards of NAIT as pivotal sub-groups within the broader body.

Based on 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 conventional hard copy texts to guide faculty and others as we define our “common ground”, simultaneously planning for, and generating, electronic digital content from/at the web?
3. 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.
4. Define a seamless, global, process for teaching and learning via courses with built in assessment elements, driven by, and connected to, accreditation and certification?
5. As a profession, link all of this as a “unison” research agenda for the future, and collectively agree to focus on “growing intellectual capital” in disciplined ways for our future?

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?

**Industrial Technologists' Toolkit For Technical Management Courseware**

Basis for moving forward to define technical management core knowledge would be the Industrial Technologists’ Toolkit For Technical Management. This defines knowledge and systems for Industrial Technologists focused around technical management core knowledge. Called the technological change model, it is a philosophical model for technical management, problem solving, improvement and disciplined change (Barker and Sinn, 1997, Sinn, 1997 a and b; 1998 a and b), shown in figure 2:
The Toolkit is a fully interactive courseware consisting of 42 tools designed to help define technical management knowledge and systems based on:

- Digital CD for optimum flexibility via electronic or traditional delivery modes, once printed
- Lean, "six sigma" driven, embracing variation reduction using team-based "Kaizen" change focus
- ISO, QS and Baldridge total quality relationships, global "cultural" view via technical "service"
- Hands-on problem solving in real or simulated applied research projects, reflective, critical thinking
- Facilitates portfolio development and assessment, leadership, teams in learning community
- Tool applications are MS Word "table" format to illustrate key concepts and deliverables

The six part toolkit series was developed through work with 100's of industries over the past 20+ years in various settings. This explains the toolkit as a basis for structured discipline, focused around quality and productivity enhancements and related technical management issues.

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

At the center, the three inner circles provide technical services teams at the center as the driving force in organizations and culturally. Surrounding technical services teams, connected and inter-related, data, documentation and synchronous leaders are required to understand and do technical management. Problem solving opportunities lead naturally to teaching and learning based on team projects. This causes change and growth, based on ongoing improvement through empowerment and knowledge (Sinn, 1995).

Working outward the model addresses important infrastructure in change-oriented technical management cultures, bringing new challenges, both technical and human in various environments. The change process facilitates 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 six separate toolkits, organized as follows (including brief descriptors tools and sets).
**Primer Tools (1-7): Technology Systems And Industrial Technology Introduced.** The first set of tools introduce and overview Industrial Technology and the toolkit system, helping explain technical management at a rudimentary level. Primer tools are for introductory courses and persons just getting started as Industrial Technologists.

**Cultural Tools (8-14): Core Values, Quality, Productivity, Technological Empowerment And Change.** These tools provide definitions and orientation to technical management, quality and productivity, in a context of change, helping explain broader market forces. Often used as a general education course about Industrial Technology, Cultural tools assume previous industrial or technical orientation, perhaps gained through Primer tools or “on the job training”.

**Data Tools (15-21): Statistical Process Control, ”Six Sigma” Improvement For Lean Systems.** These tools focus on data for improvement and enhanced decision making in technical management. Technical problem solving via systematic data applications for process improvement and six sigma variation reduction in a lean environment are the core focus, used at about the midpoint in a four year curriculum, and as graduate foundations with additional materials.

**Documentation Tools (22-28): Technical Management Systems, Kaizen In Action For Lean.** These tools build on data and cultural concepts via documentation for analysis and problem solving in technical management. Systematic analysis focuses on Kaizen techniques for lean environments and variation reduction. These tools typically are used at about the early third year in a four year curriculum, and as graduate foundations with additional materials.

**Service Tools (29-35): Lean Systems For Non-Manufacturing Industries.** Service tools apply data and documentation principles to particularly non-manufacturing service environments for improvement via six sigma and lean for variation reduction in systematic ways. These tools are used at about the late third year in a four year curriculum, and as graduate foundations with additional materials.

**Synchronous Tools (36-42): 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, documentation and service systems, synchronous tools provide capstone experiences for the more mature learner, and as graduate foundations with additional materials.

**Instructional Strategies, Broad Relationships To Core Knowledge, Assessment**

Toolkit courseware is about both content and process, given that content is applied as part of the teaching and learning systems. Content has been explained, and the purpose of the current section is to discuss how the course instructional strategy associated with the toolkit courseware engages students in applications appropriate to core knowledge. Paradigm shifts include critiquing of content and process; industrial project and applied research; and, electronic delivery, and others (see note 1).

Instructional strategies engage students in teams, focused on robust critiquing, analysis and synthesis functions. Major projects articulate with information applied in critiques, as assessment question/functions. Teams assess technological systems, recommending change and improvements, increasingly based in actual industrial environments (Olson and Sinn, 1999). Multiple electronic presentations occur with all contributing equally. Courseware driven courses appear as shown in figure 3:

![Figure 3. General course structure for Toolkit courseware.](image)

Toolkit courseware systems are designed and built in MS Word table functions, similar to the data collection forms used to collect the research. The tables provide structure and help to facilitate a robust
communication system which can be done either traditionally or electronically. The communication in tables provides a mechanism which persons on teams can fill in and send to others on the team, and then ultimately as a collective portfolio of work, to the instructor.

Courseware tables also focus on work appropriate to the task of defining Industrial Technology core knowledge. This assumes projects are part of the system occurring through combined team effort, incrementally done primarily in electronic or traditional format. Toolkit courseware information is analyzed, applied and integrated to project deliverables via regular presentations and other ongoing evaluative methods. Multiple phased major project presentations synthesize all else studied and learned throughout the course to evolve a portfolio of student-centered collaborative work.

**Tentative Research Method Proposed**

The proposal is to start with an existing, pre-defined, system of content and process, and continuously refine it over time through user’s groups on a voluntary basis to further validate and grow the system. NAIT would set the actual agenda, through its Research Division, and be principle guides of the project. Ultimate deliverables would be enhanced written courseware materials defining technical management core knowledge. Potentially eventually engaging all in the profession, the research would be done in a shared manner among various users in the field, to include the Accreditation and Certification Boards. Interaction with publishers and others interested in being potential provider partners of courseware materials, as they are being validated and further developed, would be a key part of the plan. This includes both process and content assessment through four main areas, later presented as objectives:

1. Context of core knowledge;
2. Organization of core knowledge;
3. Process of instruction as relevant to core knowledge; and,
4. Implications of core knowledge on professional and general preparation of technologists.

Several sub-questions follow, based on four broader research area objectives, all part of a bigger plan:

**Objective 1: Assess context of core knowledge:**
1. Is the "Technological Change Model", derived around data and documentation, an appropriate conceptual model for providing the context for technical management core knowledge?
2. Is an ISO/QS overall theme, general structure for quality and productivity, appropriate as an organizational strategy for technical management content in Industrial Technology?

**Objective 2: Assess organization of core knowledge:**
3. Are the six toolkits: primer, cultural, data, documentation, service and synchronous leader, appropriate for organizing core knowledge for technical management?
4. Is the seven tool topical approach in each of six toolkits appropriate for organizing technical content, aimed at providing six courses focused on technical management?

**Objective 3: Assess process of instruction related to core knowledge:**
5. Is the CD, digitized, "electronic" process, in various formats and media, an appropriate way to deliver technical management core knowledge?
6. Is the case study simulated and/or real project applications of content, appropriate for delivering technical management core knowledge?
7. Is the team-based technical problem solving orientation, appropriate for delivering technical management core knowledge?
8. Are table formatted forms in MS Word, evolving an electronic portfolio for collecting and collaborating team-based work, appropriate for delivering technical management core knowledge?

**Objective 4: Assess implications of core knowledge on professional and general preparation:**

9. Are there implications for program levels (i.e., two year, four year and graduate programs) based on technical management core knowledge in the Toolkit?
10. Are there implications for professional and general education preparation based on technical management core knowledge identified in the Toolkit?
11. Are there implications for assessment, based on technical management core knowledge identified in the Toolkit?
12. Are there implications for how we work with other professionals, and/or our advisory committees, based on technical management core knowledge identified in the Toolkit?
13. Are there implications for how we do certification, accreditation, and other forms of assessment, based on technical management core knowledge identified in the Toolkit?

Methodologically, the 13 questions, addressing the four main objectives of the research, have been built into a set of forms for collecting responses to the ITTTM courseware. Responses in the forms are based on level and type of interaction with the courseware. The ITTTM courseware research forms, along with all other ITTTM courseware materials, are provided as a CD titled, “The Industrial Technologists’ Toolkit For Technical Management”.

Four Tutorial Orientation Presentations have been prepared in Power Point to help persons better understand the ITTTM courseware. The four Power Point presentations require a few minutes to review, for those who may wish to be involved in the research, or who are considering the same. The four presentations are titled:

1. ITTTM Introduction, Overview
2. ITTTM Content Overview
3. ITTTM Process Overview
4. ITTTM Assessment Overview

Based on review of the presentations, the research forms can be responded to in multiple ways. If only the first tutorial is reviewed, introducing the courseware, this would be appropriate for what would be termed an introductory level response. The other tutorials are congruent with reviewer and/or user responses in the forms, and these assume that additional time has been spent by the respondent to better understand toolkit content and process of use, including assessment systems built into the courseware. Thus there are three levels of response built into the research forms:

1. Introductory
2. Reviewer
3. User

Introductory level responses are demographic in nature, assisting in knowing what the respondents’ level of interaction may be with core knowledge and technical management. Reviewer level forms provide more depth of response based on further time spent by the respondent to study additional tutorials, and perhaps to review actual tools in the toolkit. User levels of response are based on the assumption that users will eventually emerge to provide highly mature responses and help guide the further development and interpretation of the ITTTM courseware.

The research forms currently reflect a clear emphasis on introductory level responses and combinations of reviewer/user since establishment of user groups is a goal of the research long term. The current emphasis, methodologically, is to gain review of the basic systems in place, determining if the
method is appropriate, and indeed if we are even asking the right questions and in the right ways? This is being done as part of a longer term plan, described in the next part of the proposal, but includes sharing the proposal, ITTTM courseware, research forms, tutorials, and other related materials with all as CD’s freely provided, at NAIT Conferences, and in other ways.

**The Broader Research Plan**

The immediate short term goal would be getting all on board, collectively, for a shared vision of the research. The longer term goal of defining technical management core knowledge, is based on broader relationships in the following multi-phased plan, begun at the annual 2000 NAIT conference:

*Phase I, foundational steps, (2000-2003).* These steps have been used to initiate the process, in motion at the current time, and for the past several years. The steps, or activities, have included:

1. Initial preliminary proposal was shared with profession via the JIT, during winter, 2001, and at NAIT Conferences in the early 2000’s via various presentations.
2. Appropriate NAIT Boards and Divisions have been, and will be, presented the proposed plan. The Certification Board was given a presentation in 2001, and the Research Division and Accreditation Board are in process. Other bodies may be contacted as needed.
3. Develop the toolkit systems in CD format for ease of sharing, cost effectiveness in product and project design, completed in about 2001.
4. A booth was set up with vendors, to encourage participation in the project based on distribution of the CD and explanation of how systems work, begun in 2002.

*Phase II, introducing the research (2003-2004).* This is being initiated at the fall NAIT conference in Nashville, and as follow through after the conference to help all understand what the research project is about, why and how it is being conducted. The purpose of this phase is to seek input on the research plan, systems for gathering data, and conduct of the research:

1. Introduce the research to the profession via a Research Division session presentation, as well as other presentations.
2. Begin identifying a small number of user groups who agree to participate in the research project.
3. Seek reviewers of the CD, getting input on systems for review and use processes, improving and validating for actual conduct of the research.
4. Meet with Dean’s of Industrial Technology programs, trying to develop appropriate curricular and programmatic relationships for possible user sites at their institutions.
5. Provide vendor booth at 2003 NAIT conference, disseminate information, identify potential users.
6. Publish the updated research proposal in the JIT.
7. Continue development of Tutorial Orientation Presentations to assist reviewers and/or users of systems to understand the research project (summer, 2003).
8. Continue development of research forms and systems for data gathering and respondent feedback (summer, 2003).

*Phase III, preliminary conduct of the research (2004-2005).* As the research matures, a critical part is to identify systems for producing actual data gathering documents, materials and systems:

1. Work with potential publishing partners for marketing and distribution, and continually edit all materials.
2. Seek external funds, and partners, to support and develop broader systems and relationships.
3. Prepare mutually beneficial contractual relationship outlining copyright, royalties and ownership (a portion of funds generated could go to NAIT Foundation, and faculty at user group sites).
4. Based on work with the Research Division, Dean’s of Industrial Technology programs and perhaps others, continue developing user groups, prototyping sites around the country.
5. Continue seeking reviewers of the systems to provide general feedback for improvement.
6. Continue developing courseware, down-loadable user group research, data gathering materials.
7. Provide Tutorial Orientation Presentations for interested faculty, students and others at NAIT fall conferences, and in other ways, seeking users and reviewers, and ways to enhance the research.

*Phase IV, conducting the research (2005-2006).* Phase IV will grow the system based on documented materials and systems, bringing others into the fold as users, researchers and developers:

1. Provide tutorials for interested faculty, students and others at NAIT fall conferences, and in other ways (online, electronically).
2. Continue to pursue user’s groups from Research, Certification and Accreditation Divisions.
3. Provide a vendor’s booth at the annual NAIT conference, to disseminate project information.
4. With publishing partners, announce series of text-based materials in various formats and media.

*Phase V, evaluating the research project, continuation, expansion (2006 and beyond).* Phase V, around year 2006, provides project evaluation, continuation, maintaining and incrementally growing technical management core knowledge systems in ways deemed appropriate based on work in progress:

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 development of electronic media systems for technical management core knowledge.
4. Continue developing partnerships for funding and other support and enhancements to systems.

The work would intentionally be designed to expand and continue to reflect changes in industry and the broader Industrial Technology profession. Projected planning through the year 2006 is done only to illustrate the first few years of the work. Future projections beyond 2006 will be provided over time.

**Getting Started, Courseware Electronic Tutorial, Researcher Considerations**

This explains how to get started as a reviewer of the courseware, and ultimately, how to engage as a user of the courseware materials for use in courses and perhaps in other ways. All information used for the tutorial and user’s research groups is provided by the author as shown in figure 4:

![Figure 4. Tutorial review process.](image)

The broader user’s group appears a bit differently, but is consistent with completion of the tutorial. The intention of the user’s groups are to actually grow the core knowledge over time based on a broader conversation engaged in by many. The ongoing user’s group appears in figure 5:
Figure 5. Ongoing users’ group procedures.

The functional system goal is to have electronic, fully transportable, courses for team functions organized at various locations to research, test and further develop the tools in a user’s group format.

The tutorial is a series of documents, both MS Word files and Power Point slides shows, which overviews and introduces the user to all core knowledge, and the user’s groups. User’s groups are designed around the six areas of Toolkit courseware, focused on core knowledge research, development and evaluation. The user's group provides an opportunity to continue the validation process started in the tutorial, at multiple sites where user’s prototype use of one or more Toolkits. As they are used, questions begun in the tutorial will be explored, and user’s can provide feedback for ongoing improvement.

User’s get a relevant, flexible and timely electronic text series which can be used as the backbone of their teaching and learning system. The core knowledge provides universal content and processes for teaching and learning, and for conduct of projects interactively. User's also gain a sense of ownership since their feedback will directly influence future directions.

All materials are digital and available electronically as a free CD provided by the author. No royalties are involved currently, although eventually students may be charged competitive fees, likely in a few years, after users’ groups have further researched and developed systems. Part of eventual royalties generated by the system at sites may also be given back to user-researcher’s at their sites, and part of the royalty may be given to the NAIT Foundation, longer term. Distribution will be done electronically via the BGSU bookstore for users’ groups with large numbers (in addition to free CD).

Tutorial and user participant prerequisite knowledge should be a basic understanding of quality and productivity in the workplace, and broad understanding of Industrial Technology. General familiarity with data and documentation systems commonly applied for improvement are reinforced, evaluated and further developed. Researcher consideration for some level and type of participation should be based on:

1. Extent of flexibility and willingness to change current approaches used in instruction.
2. Use and development of electronic systems over a distance.
3. Desire to engage in innovative teaching and learning systems.
4. Collaboration in the development and use of "high end" courseware.
5. How to do projects interactively, and "hands on", with organizations.

Individuals interested in reviewing the courseware or in forming a user's group should contact the author.

REFERENCES


NOTES

1. Many of these ideas are presented and further developed at the author’s web-based portfolio, www.bgsu.edu/colleges/technology/qs