10-2002

A Quality Major: Some Doctoral Programs Are Beginning to Offer a Specialization in Quality

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THE SCHOOL OF Technology at Indiana State University (ISU) received approval from the Indiana Commission for Higher Education in 1998 to offer a doctorate in technology management. The program is unique because it consists of a consortium of seven member universities, with ISU being the degree awarding university. The consortium members include:

- Bowling Green State University (BGSU).
- Central Missouri State University (CMSU).
- East Carolina University (ECU).
- Texas Southern University (TSU).
- University of Wisconsin-Stout (UW-S).
- Indiana State University (ISU).
- North Carolina A&T (NCAT).

The technology management doctorate prepares technological leaders for public and private sectors. Graduates will have developed skills in research procedures, acquired expertise in selected technological processes and become well-equipped to provide service and expertise to the industrial and educational communities based on specialized studies.

Each university in the group has a unique philosophical approach to technology management. This adds depth, quality and diversity to an innovative and future oriented program. All this is done within the general programmatic context of a technological core of knowledge, research skills and tools, and a concentration called a technical specialization.

Another unique aspect of the consortium is that it communicates and conducts a lot of the

course work electronically. The majority of the degree work is done online, and various technologies are used to enhance the flexibility and overall experience for students, the majority of whom are nontraditional practitioners in the different fields of specialization (see "Online Methods," p. 26).

The program has a residency requirement that provides opportunities for students to become involved with their colleagues and better acquainted with the broader community of scholars. (While students are connected to one of the consortium campuses, calling it their "home" campus, they do not necessarily live there in the traditional sense. Residency does, however, require two one-week on-campus seminar sessions across the degree experience.) It combines academic preparation with reflection on scholastic work while developing an intellectual perspective about the issues and problems in a specific discipline of study. In addition, residency provides an opportunity for networking and social bonding among students.

There are five technical specializations associated with the degree program: construction management; digital communication systems; human resources development, industrial training and development; quality systems; and manufacturing systems. Each specialization is led from a consortium university, all of which are coordinated through ISU.[1]

Quality systems specialization

The mission of the quality systems specialization (QSS) is to train professionals for leadership roles in quality. The primary QSS focus, while oriented to technology management, is increased customer satisfaction in the public and private sectors for industrial and service applications.[2]

BGSU is the lead university for the QSS; though CMSU, ISU, UW-S and NCAT also offer the specialization. The QSS is based on several elements that reflect the advanced study of quality:

- Several of the consortium institutions involved in the QSS have ASQ student branches, and all faculty are members of ASQ.
- Quality projects are pivotal to the delivery and integration of content and process in the QSS.
- Laboratories to support graduate programs in quality provide excellent applied research opportunities.
- Each institution has unique relationships with various industries via advisory committees developed through years of involvement and practice.

Structurally, the QSS has been designed to address three categories of thought and action:

- Quality culture.
- Quality systems.
- Quality leadership.

These three areas are addressed through courses, applied research and project experience via electronic delivery systems. Each category addresses important elements of the curriculum and provides critical components in the delivery and structure of the QSS.

Quality culture courses integrate cultural aspects, such as total quality, change and organizational development. Quality systems courses challenge students to configure a vision of what quality systems for improvement should be. Quality leadership courses provide advanced challenges and opportunities that involve data merging, documentation, new product development and organizational reengineering challenges. The categories and related courses are shown in Table 1.

TABLE 1 Quality Systems Specialization Courses In Content Organizer Categories

Quality culture	Quality systems	Quality leadership
QS 702: Quality Change Culture	QS 727: Documentation Based Process Improvement	INMGT 796-700C: Strategic Concepts in Quality
ITE 79X: Improving Human Performance in Organizations	IMT 812: Experimental Design and Process Analysis	IMT 811: Reliability, Maintainability and Serviceability
IMT 813: Quality Standards Leadership	QS 726: Quality Systems	IMT 814: Quality Seminar
	Committee approved elective	

General course information, courseware

The three courses of primary interest are QS 702, QS 726 and QS 727, which I primarily developed.

Online Methods

In accordance with recent literature,[1,2,3] and under the direction of the course instructor, various electronic methods are used to facilitate the teaching and learning processes and meet course objectives. The methods used include e-mail and WebCT.

WebCT[4] is one of several online course management tools available today and is the tool of choice at BGSU. A shell software, WebCT has numerous features, including a bulletin board, chat rooms, e-mail capability and extensive tools on course management for the instructor. At BGSU, the bulletin board and chat rooms are used to post and download files as presentations and allow students to review documents from other participants in the courses, including the instructor.

E-mail is used for basic communications. Students enrolled in the three courses (Quality Change Culture, Quality Systems and Documentation Based Process Improvement) are located all over the United States. The instructor communicates frequently via e-mail, notifying students of postings, scheduling chats and sharing other housekeeping items. Virtually all e-mail messages are disseminated to the entire class to ensure maximum communication.

WebCT's bulletin board is used to post course syllabi and all assignments and reviews. Assignment due dates vary among courses, but they are fairly far apart because the team routinely merges all its work into one document. Using the bulletin board to disseminate assignments offers several advantages over e-mail. It allows students and the instructor to download the documents at convenient times, affords the group a convenient and common storage area for all documentation and allows students to access the work of teams in other courses for evaluation purposes.

Chats are held weekly and last from 30 to 60 minutes each. They help bring the team together, provide an opportunity for constructive feedback to team members and help bring clarity and focus to the project. Through chats, the instructor is brought up to speed on the direction of the project and provides feedback and guidance. Additionally, content specific issues and opportunities for expansion of teaching and learning are addressed in some chats.

NOTES AND REFERENCES

1. American Distance Education Consortium, "ADEC Guiding Principles for Distance Learning and Teaching," 1999, www.adec.edu/admin/papers/distance-teaching_principles.html.

2. Andrew Feenberg, "Distance Learning: Promise or Threat?" *Crosstalk*, Winter 1999, www.rohan.sdsu.edu/faculty/feenberg/TELE3.HTM#Distance_Learning:_Promise_or_Threat.

3. Linda Harasim, Starr Roxanne Hiltz, Lucio Teles and Murray Turoff, *Learning Networks: A Field Guide to Teaching and Learning Online*, MIT Press, 1995.

4. Learn more about WebCT at www.webct.com.

BGSU offers the three QSS courses; the rest of the courses are offered by other members of the consortium. (See "QSS Course Descriptions, " p. 28, for a complete list of courses offered.)

The underlying principle of these three courses is to link classroom learning (in this case, web based learning) to actual field experience. This is useful for the less experienced QSS student. More experienced students can serve as leaders and grow their talents as well. This link also makes it possible to track a successful field project through the three courses and gets students to discover which model systems can be used to complete projects electronically and traditionally.

Typically, one student is stationed at the project site and can provide face-to-face contact with the project company. The other students provide support services, such as critical thinking, brainstorming, benchmarking, project management review, toolkit analysis, data analysis, and compilation and writing. This method of operation is consistent with the way work is done more and more often in today's quality environment.[3]

The courseware used in all three courses was developed by me as the Industrial Technologists' Toolkit for Technical Management.[4] The toolkit of 40 tools is organized to use data and documentation in synchronous ways to solve technical problems for quality improvement. It is available on CD through a partnership with the Online Wireless Learning Systems Group at East Carolina University.

The toolkit is on five separate CDs, each focusing on eight specific quality and productivity tools. The CDs include:

- Cultural tools: Core values for technological empowerment and change.

- Data tools: Statistical process control improvement systems.
- Documentation tools: Technical management systems—*kaizen* in action.

Each disc includes approximately 20 pages of text describing the content under study, including examples and explanations. An additional application section, where all principles presented in the text are applied via structured exercises and participants are asked to engage in customized table-formatted activities, is included with each tool. The course and project specific data and documentation from the teams are supplied and formatted using these systems.

Each team member was responsible for deciding how to apply a tool, all within the context of the broader toolkit system provided by the course instructor.

QS 702: Quality Change Culture

The QS 702 course was first conducted during the summer of 2001 with four participants. The course got students to develop a model quality system that addressed change and improvement and acknowledge that cultural change is pivotal to the improvement and implementation of a quality system. A project plan based on a technological system was identified for modeling and required analysis of current and past performances.

The team focused on developing a quality change system for a fictitious university and was required to generate:

- A problem statement, project objectives and major steps needed to accomplish the objectives.
- Historical indicators of what the system had evolved from.
- Preliminary performance quality indicators reflected in data and documentation.
- Model functions synthesized from critiques in a survey or audit of the existing system.

This was addressed in the first half of the term, after which the students prepared presentations to share their findings. The presentation phase was made up of information gathered and analyzed from three critiques based on toolkits assembled by the team and synthesized into a focused documentation system oriented around the project theme.

Then a model was structured for actual application around the technological system under study. As part of the model development and application, the team addressed the following questions and assignments in a project review and presentation:

- Why were the model systems and functions selected? What was the basis and justification (tied to information and readings) for using the infrastructural functions?
- What would the data and documentation be, and how would they be collected and organized? How could actual systems and functions be applied to illustrate the model?
- What recommendations and improvements might be brought about from analysis and assessment of data and documentation?
- What detailed technical explanation and implementation plan could be used to integrate training, leadership and strategic planning relationships with changes?

The finished project resulted in a model system for quality and change developed around the infrastructure of a generic university. The students learned that using a fictitious entity to model quality and change principles can be a good way to learn.

QS 726: Quality Systems

This course teaches the basics of a quality system by having students develop the use of statistical tools in the framework of a toolkit. It is taught via the web and involves student collaboration. Data based toolkits are taught as individual tools, then combined in the end to form a portfolio for the project.

The class, first taught in the fall of 2000, had five students. For their project, the students chose to implement a statistics oriented system at GADEP Co., an injection molding company in North Carolina. The students developed a system based on the course required toolkits, and used a Six Sigma framework, for implementation at the company site.

The objective of the project was to reduce the hot stamping defects on one production line by 50%. After selecting the project, the team collaborated on applying the tools, including statistical process control for variables and attributes, measurement system analysis, process capability analysis, experimental design and lean manufacturing. Each team member was responsible for deciding how to apply a tool, all within the context of the broader toolkit system provided by the course instructor.

After a semester of collaboration, the students transferred the information to their company contact, and the improvement system was implemented. The company generated $32,000 in annual savings and a 47.6% overall reduction in scrap due to the project. Once

again, this reality based, hands-on project indicated the project method, when used with doctoral students, can be successful.

QS 727: Documentation Based Process Improvement

Documentation Based Process Improvement was one of the first QSS courses and was offered during the fall of 1999. The hands-on course encouraged students to use various quality tools related to documentation methods and systems. The selected project involved the implementation of ISO 9002:1994 at a small plastics injection molding company, disguised as Plastics USA, near Terre Haute, IN. The company began in 1979 as a privately owned company and now employs up to 80 full-time workers running a three-shift operation.

Plastics USA looked for various products to design and produce. Its management believed ISO 9002 certification would establish credibility and a competitive niche for the company. Management was also aware certification could expand its markets as well as improve its overall quality conditions. An air conditioning equipment manufacturer, one of Plastics USA's existing customers, approved of

Quality Systems Specialization Course Descriptions

Here is a brief description of each course offered as part of the technology management doctorate's quality systems specialization (QSS):

- **INMGT 796-700C (UW-S): Strategic Concepts in Quality.** A course designed to integrate international quality requirements, national quality schemes, and industrial and commercial quality system requirements into defined quality system and process models. These models are designed to enable students to identify appropriate quality system elements and best-practice recommendations relative to specific industry and use applications. A strategic quality system vision is developed to plan, coordinate and implement business, product and service processes and to evaluate their effectiveness.
- **QS 702 (BGSU): Quality Change Culture.** See p. 27.
- **QS 726 (BGSU): Quality Systems.** See p. 27.
- **QS 727 (BGSU): Documentation Based Process Improvement.** See above.
- **IMT 811 (ISU): Reliability, Maintainability and Serviceability.** Concepts, principles and techniques used in the evaluation and assessment of reliability, maintainability and serviceability in industrial systems. Emphasis is given to theory and techniques to determine time to failure, failure rate, reliability and availability of components and systems, including strength-stress analysis, construction of reliability bathtub curves, failure mode effects analysis and fault tree analysis.
- **IMT 812 (ISU): Experimental Design and Process Analysis.** A focused course on the design and analysis of experiments for industrial applications and applied research. Topics include single factor models, blocking, factorial design, parameter design, process analysis and response surface methodology. Emphasis is given to problem modeling, implementation and output analysis in applied research.
- **IMT 813 (ISU): Quality Standards Leadership.** Management and leadership activities related to evaluating, creating and promoting quality standards.
- **IMT 814 (ISU): Quality Seminar.** In-depth critical analysis of important issues in the management of quality and the research of those issues.
- **ITE 79X (ISU): Improving Human Performance in Organizations.** This course is part of the human resources development, industrial training and development specialization and is still under development.

the company's seeking ISO 9002 certification.

The goal of the project team was to help Plastics USA with its ISO 9002:1994 implementation and recommend basic quality tools to assist it in achieving the goal. Throughout the semester, a weekly meeting was held with the company's quality manager to discuss new quality concepts and manage the ISO 9002:1994 project. After each meeting, a report highlighting new quality concepts and the progress of the project was sent to the e-team (project team).

The semester came to a close before Plastics USA became registered to ISO 9002:1994; however, weekly counseling was continued beyond the semester and into summer 2000 when Plastics USA received its ISO 9002:1994 certification.

The team did not receive any payment for services, and during the year, Plastics USA spent only $450 on internal auditor training for several employees. The registrar fee was the only other amount spent on implementation and certification.

The QSS: continuously growing

The following things are happening to continually develop the QSS:

1. An analytical review of the QSS is being planned by faculty to assess ways to improve and strengthen the specialization.
2. One course at ISU, IMT 813: Quality Standards Leadership, will move to NCAT as faculty there become increasingly active in the QSS.
3. As systems and methods for conducting projects become more robust, projects will be sought where no student is placed on site. Instead, a mentor with sufficient interest, time and information will be used to further develop the systems.
4. The question of how to link to and capitalize on existing ISO 9000 and QS-9000 documentation and data systems as part of the routine broader quality improvement system is being addressed.

A broad based project is being discussed to validate the toolkit systems and further develop core knowledge for quality and productivity improvement projects.[5]

The QSS, as part of the broader consortium at ISU, has been up and running since the late 1990s. The specialization has 12 to 15 students in various stages of matriculation, and there are 75 to 100 students in all specializations. The first QSS student to graduate was Alan Stolzer who completed his work in the summer of 2002. The other students are expected to graduate in 2003, with two to three more graduating each year thereafter. As word spreads, it is anticipated QSS enrollments could easily double. The ultimate types of research undertaken by students in the QSS will no doubt reflect the attributes of courses and projects outlined in this article.

Much about the QSS and its project method is similar to the issues and methods being developed in most organizations. The need for electronic team based project systems will become increasingly important as pressures to continue to improve without traditional teams evolve. Quality system models and electronic project based tools and techniques will continue to be addressed and experimented with as QSS students move forward.

ACKNOWLEDGMENTS

I would like to thank the following student coauthors, each of whom helped contribute to this article and participated in one or more of the QSS courses: Gregory K. Arbuckle, Duane E. Floyd, Glenn Gee, Perry Goss, Cathy Petretich, Errol Samuel and Alan J. Stolzer.

NOTES AND REFERENCES

1. To learn more about the technology management doctorate, visit www.indstate.edu/ConsortPhD.
2. To learn more about the QSS, visit www.bgsu.edu/colleges/technology/qs. Click "teaching," "curriculum changes," then "quality systems specialization (QSS) Ph.D. proposal."
3. To learn more about various project examples, visit www.bgsu.edu/colleges/technology/qs. Click "teaching," then "student projects."
4. To learn more about the Industrial Technologists' Toolkit for Technical Management, visit www.bgsu.edu/colleges/technology/qs. To view specific examples of tools, click "teaching," then "courseware examples."
5. John W. Sinn, "Proposal for Taking the Industrial Technology Profession to the Next Level: Assessing Core Knowledge Through Online Methods," *The Journal of Industrial Technology*, November 2000, www.nait.org.

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