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Integrated supply matrix management

A TQM approach for curriculum development

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Abstract *Outlines the total quality management approach used to develop and sustain an undergraduate curriculum in supply management. Illustrates the importance of identifying the primary customer, and using the customer's needs as the foundation for a curriculum. Examines the importance of empowering faculty and students to create leadership and advance the curriculum. Finally, discusses ways in which faculty, students and business leaders use these three elements to improve the curriculum.*

Introduction

The business environment is changing. Emerging trends, such as increased global competition, new product and process technologies, increased concern for environmental impact, demands for more efficient and effective business processes, growing demand for quality and convenience and the diffusion of new information and communication technologies are influencing management strategies and tactics. Traditional management approaches that optimize specialized functional performance do not adequately address the challenges of today's competitive business environment. This is especially true in supply management where the focus is shifting toward the development of fast and flexible supply chains with renewed emphasis on quality, cost and convenient availability.

In a manufacturing organization, supply managers are responsible for the efficient and effective flow of materials from suppliers, through manufacturing, to the customer. This responsibility crosses many traditional functional boundaries. To be effective, supply managers must be able to translate an engineer's technical specifications, and marketing's customer requirements, into a set of performance characteristics. These provide the foundation for selecting and managing commodity suppliers, logistics providers and the manufacturing process to create a supply matrix that enhances the firm's ability to create value. Further, supply managers must be able to manage the information technology necessary to communicate with suppliers, logistics providers and manufacturing management, to coordinate the flow of materials through the supply matrix. For each of these roles, a functional understanding of engineering, purchasing, logistics, manufacturing, marketing and information technology is essential for effective supply management.

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The evolving strategies and tactics demanded by the new business environment force supply managers to become more creative and sophisticated in their approach for assuring consistent availability of quality materials and services on a timely basis at a competitive cost. To address the educational challenges created by the business environment, and particularly the educational challenges of supply management, Western Michigan University (WMU) faculty and business leaders in supply management undertook a collaborative initiative. Their goal was to create, and support, a university program to equip students to meet the challenges created by the new paradigms of supply management. The result of this initiative is the integrated supply management (ISM) major, offered through the combined efforts of the management, marketing and industrial engineering departments at WMU.

The design and implementation of the ISM major used a total quality management (TQM) approach to curriculum development. This approach is not new for universities. However, using TQM approaches in university settings can be difficult if faculty and administrators find little reason to change. When this is the case, the impetus for change must come from outside the university environment, especially from primary external customers, such as the business community (Hebert *et al.*, 1995). The purpose of this paper is to review the steps used to design and implement the ISM major, and illustrate the ongoing partnership of the business community, faculty, and students.

TQM in industry

Boaden (1997) attempts to synthesize academic and practitioner perspectives on total quality management to develop "a set of common themes which define TQM. . ." She concludes that TQM involves:

- customer focus, with emphasis on the customer-supplier relationship;
- the commitment of everyone (in the organization) to quality improvement, especially managers;
- training and education considered as an investment;
- the involvement of everyone in the organization in quality improvement;
- a focus on processes;
- the use of teams and teamwork;
- the use of appropriate tools and techniques, reviewed regularly;
- goal-setting, measurement and feedback for all aspects of the business;
- continuous improvement as a philosophy;
- a change in the culture of the organization; and
- the inclusion of quality principles into product and service design.

Boaden further asserts the "motivation and rationale behind certain practices" is just as important "as the practices themselves, which are more subject to changes in fashion. . ." Ultimately, Boaden declares the "key issue" in the

effective use of total quality management is to understand the "distinction between principles (i.e. beliefs or tenets) and practices (things that organizations do that display and embody their beliefs)."

TQM in academia

Research into the application of TQM concepts in universities focuses on five topics:

(1) application of TQM principles to university administration, e.g. Billing (1996), Morris and Haigh (1996), Coate (1990), Stuelpnagel (1988), Likins (1993), Solomon (1993), McNeill (1993), Swift (1996), Kanji and Tambi (1999), Moreland and Clark (1998) and Hughes *et al.* (2000);

(2) application of TQM principles to the management of college courses, e.g. Lozier and Teeter (1996), Goh (1996) and Potocki *et al.* (1994);

(3) introduction of TQM courses into university curricula, e.g. Froiland (1993), Kendrick (1993), Barrier (1993) and Hebert *et al.* (1995);

(4) use of TQM concepts to develop responses to competitive threats facing universities, e.g. Bonser (1992), Chen and Rodgers (1995), Massy (1996), Cyert (1993), Burkhalter (1996), Gore *et al.* (1998), Muse and Burkhalter (1998), Comstock and Vernon (1998), Schonberger (1995) and Sag *et al.* (1995); and

(5) use of TQM for curriculum innovation, e.g. Kleindorfer (1994), Koch and Fisher (1998) and Divoky and Taylor (1996).

Hebert *et al.* (1995) identify TQM as a "solution to the problems facing US institutions of higher education" since TQM is "recognized as a management approach that improves organizational efficiency." They identify four areas in which universities can apply TQM:

(1) improvement of university operations and administrative functions;

(2) integrating TQM into the curriculum;

(3) use of TQM as a classroom teaching method;

(4) use of TQM to manage university research activities.

Hebert *et al.* (1995) surveyed 1,000 business school faculty belonging to the Academy of Management's organizational behavior division. The purpose of the survey was to learn:

- whether business faculty members perceive external pressure on their schools to adopt TQM;
- the perceptions of business school faculty members regarding their most important customers;
- the extent to which business faculty and administrators are aware of TQM principles; and

- whether business school faculty members feel TQM is, or should be, integrated into the curriculum.

Hebert *et al.* (1995) found only 34 percent of respondents indicated their university had formally adopted TQM as a quality improvement strategy and only 29 percent indicated the creation of a formal TQM implementation plan for administering the business school. They found a significant correlation between the perception of external pressure to adopt TQM and the integration of TQM subject matter into the curriculum. Hebert *et al.* (1995) also found faculty perceptions of integrating TQM into the curriculum focus on integrating quality management ideas into the "core business curriculum," introducing TQM through continuing education courses, or adding a "TQM course" to the business school curriculum. According to Koch and Fisher (1998):

> Many institutions of higher education have committed themselves to TQM programmes [sic]. Thus far, however, the results are somewhat pedestrian, and include reformation of campus copy centers, better bill collection and check writing, more efficient handling of admissions and financial aid applications, and more productive scheduling of physical plant jobs.

Koch and Fisher (1998) acknowledge the importance of such accomplishments because of their "potential to release badly needed resources for other important tasks within the institution and probably result in increased student satisfaction."

However, Koch and Fisher (1998) express skepticism about the efficacy of TQM in a university setting for three reasons:

> First, the magnitude of resources (especially employee time, which most campuses ignore) required to generate these advances has typically been large. Second, these advances might well have been obtained by other methods quite unconnected to TQM. Third, there is a noticeable absence of things academic in these beneficent developments.

They go on to state that:

> ... the most significant long-term internal problems facing US [sic] higher education today relate to academic philosophy, standards, and practices ... Hence, the non-academic focus of TQM dramatically reduces its significance and impact in the world of higher education (Koch and Fisher, 1998).

Finally, Koch and Fisher (1998) maintain, "Very few TQM-oriented campuses have utilized the process to change the fundamental nature of their academic life or curriculum." As an exception they note that Babson College "... in 1993 invited a wide range of its constituents, including members of the business community, to a three-day session designed to result in an overhaul of its curriculum." However, Koch and Fisher (1998) conclude: "the focus of TQM has been on the nonacademic side of institutions": they cite other research to support this position.

Divoky and Taylor (1996) suggest a "framework, based on TQM concepts, which can be used to examine and evaluate an educational curriculum ... [yield] a clearer picture of what the curriculum is currently providing and those areas

where focused change may be needed." Divoky and Taylor (1996) adopt a "process management" perspective for evaluating curricula, focusing on "customer requirements, measurements, and on-going design improvements." They identify five steps in their process view of education: processing customer requests, defining specifications and requirements to meet customer requests, procurement of necessary resources, transformation, and packaging and delivery.

Divoky and Taylor (1996) present a six-step framework for evaluating educational curricula: develop metrics, establish baseline performance, entitlements, establish benchmarks, application of process improvement tools, and monitor and reiterate. They describe the objective of the entitlement step as efforts "to determine the level to which defects can be reduced or total cycle time can be shortened." They define "defects" in a university setting as: " ... student-products that do not meet the industry-customer's specification ... " Divoky and Taylor (1996) conclude:

> The basics of process management include processing customer requirements, applying measurements to the process and product characteristics, and pursuing on-going design improvements. The tools and guidelines for these activities are available and are being applied to manufacturing and service-oriented industries. Recently, literature has increased on the application of these TQM ideas to education processes.

Application of TQM principles to curriculum design at WMU

This section explores the TQM principles and practices used to develop the ISM major at WMU. Further, the TQM practices used to manage WMU's ISM program are discussed. WMU faculty emphasized several TQM principles in developing the ISM curriculum, including: a customer focus (emphasizing customer-supplier relationships), the involvement of everyone in the ISM program in quality improvement, process focus, continuous improvement as a philosophy, a change in the culture of the organization, inclusion of quality principles into the product (curriculum) and service (program) design.

In applying TQM concepts to curriculum design, the customer-supplier relationship refers to the relationship between the university and faculty (supplier) and corporate recruiters (customers) of program graduates; a process focus refers to the emphasis on the curriculum and the student's educational experience both in, and outside, the classroom; change in the culture of the organization refers to abandoning typical ideas about curriculum development and the recruiters' role in curriculum development; continuous improvement as a philosophy refers to the faculty's commitment to ongoing curriculum revision incorporating insights from alumni and recruiters; and inclusion of quality principles into the product (curriculum) and service (program) design refers to the faculty's commitment to ensure the curriculum and program conform to specifications, defined as satisfaction of recruiter, student, and governmental requirements.

Customer focus

The criteria for the Malcolm Baldrige National Quality Award (National Institute of Standards and Technology, 1993) establish that the customer

judges quality. Quality systems must address all product and service attributes that provide value to the customer and lead to customer satisfaction and loyalty. However, within a university setting, identifying the "customer" is difficult, since diverse constituents consider themselves customers. Students want a valuable degree, and supporting program, that creates a competitive advantage for them as they begin their professional careers. Their parents want value for their tuition dollars and class schedules that will permit timely matriculation. Since WMU is a state-supported institution, it also has the State of Michigan as a customer that wants an efficient organization that provides education and expands knowledge. Employers want well-educated individuals that can easily enter their workforce with minimum orientation and training.

The designers of the ISM major decided that their primary customers were the "employers" or potential employers of the graduates. Given the significance of manufacturing in Michigan's economy, the designers of the ISM major decided to concentrate on manufacturers as their principal market. They concluded that if the desires of the primary constituent group could be satisfied, all other constituent groups' desires were obtainable. For example, if industry could hire well-educated graduates:

- students would perceive value in their degrees;
- their parents would perceive value since industry employed the graduates; and
- the State would obtain an educated workforce.

This approach is similar to the one suggested by Turney (1991) that classifies customers as primary and secondary users of the product or service.

The ISM faculty attempts to identify ways to change the current program of activities and events to enhance the students' learning experience. In addition, the faculty regularly meets with employers, graduates and interns to identify and understand changing industry's requirements for entry-level employees. The ISM faculty holds such meetings with major corporations in the USA, Latin America and Europe. At times, the ISM faculty coordinates student field trips with these meetings.

During one such meeting, the ISM faculty learned leading supply management practitioners believe the profession lacks qualified minority candidates. The faculty encouraged student leaders among ISM majors to develop a student-mentoring group. The idea of the student-mentoring group is that students more experienced in the ISM major, and the field of supply management, act as guides for students entering the major. The Executive Council coordinated workshops so the ISM students could learn more about mentoring. The Executive Council also challenged the ISM students to identify minority students interested in the ISM major, and to help them assimilate into the curriculum. These modest efforts have increased the number of minority students now majoring in ISM. However, it is more important that these efforts have shown all ISM students their responsibility for helping others.

Focusing the ISM curriculum on the manufacturing sector also meets the needs of other constituent groups. This not to say the internal customers, students and faculty, are ignored. For real-time information exchange students and faculty connect via electronic mail. Additionally, ISM faculty use the curriculum's Web site, www.hcob.wmich.edu/ism, to share comments and recommendations with anyone interested in supply management.

Curriculum design process

Once the designers identified the manufacturing sector as the primary customer, they conducted a Delphi study. According to Weaver (1988), the use of Delphi study techniques for curriculum development has several advantages: the ability to obtain opinions from a selected group of experts, repeated polling of the Delphi Panel stimulates interaction between faculty and experts, individual polling of the Delphi Panel reduces the risk that a minority of the group will dominate the Panel's consensus, repeated polling gives Panel members a sense of involvement and ownership of the curriculum and enlarges the support base for the curriculum within the social and industrial communities of the Delphi Panel members. "The results you obtain in a Delphi study represent a firm, locally valid basis on which you can build a relevant curriculum" (Weaver, 1988). Further, Schwartz (1982) states that use of the Delphi technique in curriculum development can "improve the communication links between practitioners and educators" over such traditional methods as "advisory committees," "roundtable discussions" or surveys.

The Delphi study focused on identifying "the skills and competencies needed by graduates being hired for entry level positions in purchasing and materials management positions" (Reck *et al.*, 1992). The criterion used to select participants for this study was their practical knowledge of purchasing and materials management decision making. The participants' management level, time spent at that level, and reputation of their employer for effectiveness and efficiency in supply chain management, established their practical knowledge.

A total of 50 managers were selected to participate in the Delphi study and 23 agreed to participate. The Delphi study participants represented seven major industries: furniture and appliances; chemical and rubber; fabricated metal; electronics; paper; transportation; and communications. The annual sales revenue of these firms varied from less than $100 million to more than $1 billion. The number of purchasing managers varied from less than five to several thousand.

For every firm represented in the Delphi study, purchasing's position in the participant firms' management hierarchy fell into either senior or middle management. Purchasing's position in the management hierarchy was defined by the organizational level of the senior purchasing executive in relation to the chief executive officer. Senior management was defined as one or two management-levels below the chief executive officer. Middle management was defined as three or more management-levels below the chief executive officer.

As part of their investigation of purchasing and materials management skill sets, the ISM program designers conducted a survey of secondary sources. This survey generated a preliminary list of 190 purchasing and materials management skills and competencies. Based on the results of the literature review, the ISM program designers developed a questionnaire for the 23 participants in the Delphi study. In the first round of the ISM Delphi study, WMU faculty asked participants to comment on the relevance of the 190 purchasing and materials management skills and competencies, but not on their relative importance. To enhance internal validity, the data collection tool used in the first round of the Delphi study included open-ended questions so participants could add skills and competencies to the original list.

A total of 233 purchasing and materials management skills and competencies emerged from the first round of the ISM Delphi study. Participants providing additional skills and competencies (in response to the open-ended questions of the initial survey) were contacted to provide explanations of their rationale for including these additional skills and competencies. A second questionnaire was developed and circulated to Delphi study participants. To give the Delphi Panel additional insight, the second questionnaire included descriptive statistics generated by the first round of the Delphi study and explanations for the inclusion of the additional skills and competencies. The second questionnaire employed a five-point Likert scale for the participants to rate the relative importance of each purchasing and materials management skill and competency. As in round one of the Delphi study, the second questionnaire included open-ended questions so participants could add skills and competencies they felt were relevant, but not included in the list. Based on the second questionnaire, the ISM program designers developed a prioritized list of 266 skills and competencies needed by purchasing and materials management executives.

Using the results of round two of the ISM Delphi study, six members of the Delphi Panel worked to analyze and categorize the purchasing and materials management skills and competencies identified by the full panel. This group identified as salient 89 of the 266 purchasing and materials management skills and competencies generated by the second survey. The six-member team arranged these 89 skills and competencies into 17 groups and seven general categories, including: contracting, materials specification, inventory management, transportation, quality assurance, manufacturing systems and production management.

Based on the Delphi study, the ISM program designers reached the following conclusions:

- a degree in supply management should have a business orientation with exposure to areas such as materials specifications, logistics, manufacturing and purchasing;
- effective supply managers must examine each decision in the larger context of the material supply process; and

- every decision in material supply has a technical component, whether it deals with product, service or process.

At the conclusion of the ISM Delphi study, the six-member team visited the WMU campus to meet the ISM program designers and help create the ISM curriculum. These executives contributed to the development of a mission statement for the ISM curriculum:

> To prepare and motivate students to integrate business and technological concepts for a successful career in supply management.

The executives also identified four goals for the ISM program:

(1) To apply the concepts, techniques, and practices of procurement, logistics, operations management, and customer satisfaction to business situations in global markets (goal 1 reflects the need for students to have detailed exposure and skills in all business areas that directly affect the flow of materials into, through and out of a manufacturing company).

(2) To demonstrate the use of engineering and quality principles as they apply to product development, design, and manufacturing (goal 2 reflects the desire that students have knowledge and skills of the technical concepts that affect the performance of a material supply system).

(3) To develop and use information systems and technology for integrating materials activities, problem solving, and evaluation (goal 3 reflects the desire that students can use information and technology to integrate the decision making of the various components, whether internal or external, of a manufacturer's material system).

(4) To demonstrate an ability to integrate materials, logistics, operations, and technology concerns into a comprehensive decision making process to maximize customer value (goal 4 reflects the desire that students view all decision as part of a larger material supply process).

Using the skills and competencies identified in the ISM Delphi study, and syllabi and descriptions of courses available throughout the university, the six-member team worked with WMU faculty to select the courses to include in the ISM curriculum. Using existing courses created both benefits and problems. An important benefit was that expeditious implementation of the new curriculum was possible, since neither new courses nor additional faculty members were required. A major problem, however, was that the curriculum crossed departmental and college boundaries thus creating coordination and priority problems. To mitigate the boundary problem, 50 business executives provided letters of support for the curriculum. The left-hand column of Table I outlines the original 1992-1993 curriculum, before any continuous improvement efforts.

Finally, the six-member team contributed to the naming of the curriculum. The group acknowledged that names like "purchasing and materials management" or "logistics management" carried preconceived notions and did

1992-93 curriculum	1999-2000 curriculum
Required business courses	*Required business courses*
Purchasing management	Purchasing/supply chain management
Business logistics	Business logistics
Marketing and sales law	Marketing and sales law
Production management and control	Production process management
Materials management strategies	Manufacturing strategy
Integrated materials systems	Integrated supply matrix systems
Applied process reengineering	Applied process reengineering
Required engineering courses	*Required engineering courses*
Fundamentals of electronics and machines	Fundamentals of circuits and electronics
Engineering graphics	Engineering graphics
Quality assurance and control	Quality assurance and control
Manufacturing productivity techniques	Manufacturing productivity techniques
Process and materials in manufacturing	Process and materials in manufacturing
	One of the following electives
	Introductory C/C++
	Computer science I
	Fundamentals of electronics and machines
	Introduction to manufacturing
	Work analysis and design laboratory
	Advanced quality management

Table I.
The integrated supply (matrix) management curriculum

not describe the curriculum's true nature. Additionally, the team rejected the use of the term "supply chain management" since, they felt, "chain" emphasizes individual links, not an integrated flow of materials and information. The team selected the name, "integrated supply management" as the best representation of the nature and emphases of the curriculum. In recent years, some practitioners in the USA have begun to associate the term "integrated supply management" with the management of inventory by a third-party. To avoid confusion regarding the program's scope and focus, the name of the curriculum has been changed to "integrated supply matrix management." The process for this change is presented below in the continuous improvement section.

Leadership

Once the ISM program was approved, the six members of the team joined individuals, representing different industries throughout the USA and Europe, to form the ISM Executive Council. The industries, from the USA and Europe, represented in the ISM Executive Council are:

- Amway Corporation, Ada, Michigan.
- Andersen Consulting, Chicago, Illinois.
- Borg Warner Automotive, Muncie, Indiana.
- Caliber Logistics, Inc., Plymouth, Michigan.
- Crowe Chizek and Company, LLP, Grand Rapids, Michigan.

- DaimlerChrysler Corporation, Auburn Hills, Michigan.
- Deere & Company, Moline, Illinois.
- Deloitte & Touche Consulting Group, LLC, San Francisco, California.
- Ernst & Young, LLP, Detroit, Michigan.
- Ford Motor Company, Dearborn, Michigan.
- GM Powertrain Division, Pontiac, Michigan.
- Harley-Davidson Motor Company, Wauwatosa, Wisconsin.
- Haworth, Inc., Holland, Michigan.
- IBM Global Services, Chicago, Illinois.
- John Deere Dubuque Works, Dubuque, Iowa.
- Johnson Controls, Inc., Holland, Michigan.
- Kellogg Company, Battle Creek, Michigan.
- Lucas Aftermarket Operations, England, UK.
- Parker Hannifin Corporation, Otsego, Michigan.
- Perot Systems, Dallas, Texas.
- Perrigo Company, Allegan, Michigan.
- Pharmacia and Upjohn, Inc., Kalamazoo, Michigan.
- Saturn Corporation, Spring Hill, Tennessee.
- Stryker Instruments, Kalamazoo, Michigan.
- Volvo Aero Corporation, Trollhattan, Sweden.

The Council is one means for ISM faculty to monitor the needs of the primary customers. The Council meets twice a year. Its principal responsibilities are to:

- set the overall direction of the ISM program;
- evaluate the relevance of the curriculum and course content;
- promote the program and identify career and internship opportunities; and
- mentor students.

Leadership of the ISM curriculum rests with three interrelated groups: the Executive Council, faculty, and students. This is an unusual structure: however, it is necessary because the ISM major is an interdisciplinary curriculum offered by the WMU College of Business, in cooperation with the WMU College of Engineering. The ISM administrative structure is truly a "virtual department." This type of leadership structure creates "stewards" and "champions" for the ISM curriculum. As stewards, the three leadership groups are committed to serving the customers, rather than assuming power: this situation supports the notion suggested by Senge (1991). The Executive

Council and faculty determine the infrastructure changes needed to serve customers better. As champions of the ISM program, the three leadership groups function in the manner suggested by Stalk *et al.* (1992).

The ISM Executive Council provides guidance for the leadership of the ISM program: the Council assumes this role since it is the established link to the business community, the primary customer of the ISM program. The Council reviews, for relevance and appropriateness in preparing students, all new instructional methods and topics. In an academic environment, the key to continuous improvement of a degree program is that everyone responsible for curriculum development and course content, listens to, and acts on, the recommendations and advice of their primary customers.

Faculty members from both the College of Business and the College of Engineering provide program leadership. This leadership approach may seem untenable because of different points of view and expectations for the program. However, the faculty is bound together by a common vision, to offer an undergraduate degree that exceeds industry expectations. The "virtual" status of the program, and the relationship between the Executive Council, the ISM faculty and the students supports the success of a nontraditional leadership approach. However, this nontraditional leadership did not occur overnight.

ISM students also provide *ad hoc* leadership for the curriculum. The students do not just "absorb" knowledge. They also "provide" knowledge. Many ISM students undertake internships during their matriculation and, in the classroom, the ISM faculty draws on that experience to illustrate concepts. This helps to illustrate classroom pedagogy through the students' experience to support students' critical analysis of concepts and examples. In addition, encouraging students to contribute in class insights gained from internship experiences shows the importance of internships to students who have not yet participated in one. Additionally, ISM students provide leadership outside the classroom. The mentoring program noted above, was a student initiative, which the ISM faculty and the Executive Council encouraged and supported.

Continuous improvement

The ISM curriculum has undergone continuous improvement since its inception. Based on the Delphi study, the originators of the ISM program concluded that a responsive and pragmatically useful curriculum must be "dynamic" not "static"; this belief was founded on the certainty that the business world constantly changes. The right-hand column in Table I shows the current curriculum, and when compared with the left-hand column, one may note several major changes.

The original (1992-1993) ISM curriculum did not allow for elective courses. However, electives became necessary when consulting firms started recruiting ISM graduates for entry-level positions. To satisfy the need for electives, the Executive Council suggested several changes in the curriculum. These changes allowed ISM students to complete the curriculum as originally designed, or opt to take a specialized computer programming course requested by the

consulting firms recruiting ISM graduates. The Executive Council also recommended other electives, to prepare students for other professional opportunities.

Course delivery methods have also undergone continuous improvement. Originally, the ISM faculty relied mostly on lectures to deliver course content. Now, since many ISM students engage in internships, the ISM faculty emphasizes Socratic methods of teaching and discovery. In many ISM courses, faculty present students with problems or situations, then, through a series of questions, students discover the root cause of the problem or situation, and develop possible solutions.

Based on a meeting between ISM faculty, students and Executive Council members, a course emphasizing the single-minute-exchange-of-die (SMED) system was developed for the ISM curriculum. SMED is a Japanese process for reducing manufacturing setup times. Students in this course map an operation's process, then systematically look for ways to reduce setup time and improve process performance. Recruiters have commented positively on this course, including that the course gives students important skills for making strategic contributions to the firms that employ them. Student comments on the course focus on its role in helping them understand that business activities are processes that managers can systematically improve.

Another improvement in the curriculum is the introduction of the "supply matrix" concept. The traditional view of the supply chain is of linear flows of materials and information between supply chain members. However, research in logistics and supply management suggests the supply chain concept is too restrictive. Ferrin (1994) suggests that supply chains are really collections of "micro-channels" with linkages across, and along, "micro-channels." Hines (1995) finds Japanese firms using "network sourcing" through an "array of sources" for materials.

Based on such scholarly research, and discussions with business leaders and the Executive Council, ISM faculty recognized the shortcomings of the supply chain concept. They realized supply management practice more closely correlates to a structure ISM faculty called a "supply matrix." The ISM faculty defined a supply matrix as a network of intersections among all members providing and using materials and information to satisfy the demands of the ultimate customer.

By providing close to real-time information to all members of a supply matrix, each member can use current, nonfiltered information to accomplish its function. Supply matrix structures depend on nonlinear availability of information among the matrix members, rather than sequential flow of information between consecutive links in a supply chain (Gentry, 1999). Logistics and supply activities must occur as rapidly as possible to satisfy, at competitive costs, customer demands for tailored products and reduced order cycle times. For logistics and supply processes to function quickly, yet efficiently and effectively, information necessary for planning and decision support must be instantly available to any organization in the supply matrix.

To reflect awareness of supply management's nonlinear character, the leaders of the ISM program changed the curriculum's name from "integrated supply management" to "integrated supply matrix management."

ISM faculty coordinate continuous improvement efforts among the Executive Council, recruiters and students. The ISM faculty's receptiveness to suggestions and comments made by constituent groups contributes to curriculum improvement. These efforts are similar to the suggestion of Reddy and Berger (1983), that world-class quality performance is the result of understanding the factors that determine quality and performance.

Empowerment and teamwork

The ISM Executive Council, faculty and students rely on empowerment and teamwork to design, implement and deliver the ISM curriculum. The originators of the ISM curriculum incorporated into the program three levels of teamwork:

(1) vertical teamwork;

(2) horizontal teamwork; and

(3) inter-organizational teamwork (Dean and Evans, 1994).

The design of the curriculum allows for vertical teamwork between professors and students. The ISM program does not require students to participate in any extracurricular activities, such as, internships, study abroad programs, or membership in profession associations. This empowers students to make decisions they believe will satisfy the needs of the ISM Program's ultimate customers. Since the students choose the activities in which they participate, they take ownership of the activity and promote it to new students. However, the ISM faculty encourage student participation through the recognition of student accomplishments during Executive Council meetings, and by posting student accomplishments on the ISM Web site. This helps develop a strong culture and sense of community among ISM students. Additionally, the ISM program provides students with financial and technical support for their involvement in extracurricular activities.

The ISM program also uses horizontal teamwork, within student groups, the Executive Council and among faculty. The involvement of a cross-section of the recruiter group is necessary to support effective development and improvement of the program and curriculum. An underlying theme in the ISM curriculum is that all business activities are part of a larger process and managers must learn to think in this way. This theme is the result of the inter-organizational teamwork that supports continuous improvement in the ISM program. The theme of the ISM curriculum enables ISM students to study a specialized curriculum. Simultaneously, they gain general skills beneficial to a variety of functional activities within different organizations.

Conclusions

Supply management practitioners have recognized the advantages of the ISM curriculum (Anonymous, 1992). This effectiveness is a result of listening and responding to the needs of the organizations recruiting and hiring ISM graduates. The concept of satisfying the needs of customers is a cornerstone of total quality management. However, applying these concepts in a university setting can be very difficult. To apply TQM concepts to curriculum development effectively, the faculty must, besides educating students, facilitate interaction between industry and students.

The experience in developing the ISM curriculum at WMU empirically demonstrates the efficacy of applying TQM concepts to curriculum development. The WMU experience establishes using Delphi techniques to develop curricula, "stimulates interaction between faculty and experts," creates "a sense of involvement and ownership of the curriculum" among key constituent groups, and "enlarges the support base for the curriculum within the social and industrial communities." Further, the growth and success of the ISM program at WMU clearly show the use of Delphi techniques as a curriculum development tool does in fact provide "a firm, locally valid basis on which you can build a relevant curriculum."

The process employed at WMU to develop the ISM curriculum focused on "processing customer requests" and "defining specifications and requirements to meet customer requests." This emphasis closely parallels the Divoky and Taylor framework, substantiating its validity.

Finally, the WMU experience shows that TQM concepts can be effectively applied to the "academic philosophy, standards, and practices" of a university "to change the fundamental nature of [its] academic life or curriculum." Further, the WMU experience demonstrates that such an application of TQM concepts in a university can be accomplished without the expenditure of a large "magnitude of resources."

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Preparation of logistics managers for the contemporary environment of the European Union

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Keywords European Union, Logistics, Skills, Education, Management

This study reports and analyzes a questionnaire administered to US and European logistics managers soliciting their perceptions regarding changes in background and skill preferences for logistics managers operating in the new European Union environment. The combined sample of respondents appeared to indicate the importance of being a manager first and a functional/technical specialist second. While no statistically significant differences between the two subgroups were found with regard to background preferences, there were eight statistically significant differences between the two subgroups with regard to preferred skill requirements in the contemporary environment. Possible explanations for this phenomenon are suggested. Finally, implications of the survey findings for employers, practitioners, educators, and students are discussed.

Logistics education: achieving market and research driven skill development

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Keywords Education, Research, Case studies

Rapid changes in practice and further developments of research in logistics challenge educators to further upgrade their courses. This paper makes a case for a stronger focus on integrating hot topics and research skill development in logistics courses. Methods for improving market and professional relevance of courses, as well as, improve research skills of students are presented. Results from a market and literature survey of topics in logistics, used to identify market relevant topics, are presented. Approaches to research skill development are suggested, including in-company projects and mini-research projects. And most importantly, a case is presented of a course where market and research driven skill development was combined successfully. The format for the course is specified and evaluated.

Integrated supply matrix management: a TQM approach for curriculum development

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Keywords Universities, Colleges, Curriculum, TQM

Outlines the total quality management approach used to develop and sustain an undergraduate curriculum in supply management. Illustrates the importance of identifying the primary customer, and using the customer's needs as the foundation for a curriculum. Examines the importance of empowering faculty and students to create leadership and advance the curriculum. Finally, discusses ways in which faculty, students and business leaders use these three elements to improve the curriculum.

Collaborative learning in logistics and transport: the application of 3WIM

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Keywords Logistics, Problem-based learning, Learning styles

The article reports on the development of a collaborative learning method in two master's level courses given as part of a logistics track within an international business degree programme. The method, termed the three-way interaction method (3WIM), combines traditional case teaching and problem-based learning through high intensity three-way interaction between student groups. The method involves one group taking the role of problem-solvers (presenters/consultants), another group taking the role of decision-makers (company executives/board of directors), while the third group evaluates the performance of the other two groups (skill development/quality improvement). As usual in collaborative learning, the 3WIM is student-driven, so the tutor takes on the role of a facilitator rather than the main disseminator of knowledge. Comparing the course evaluations of the previous approach to learning and the 3WIM, a statistically significant improvement was detected in satisfaction among students. What is more, the method solved other problems, such as increasing the intensity of the learning experience, reducing passenger tendencies and absences.

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