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Operations Management Curricula: Literature Review and Analysis

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Abstract

A review and analysis of studies on the interface between Operations Management (OM) academicians and industry practitioners indicate the existence of a persistent gap between what is being taught and what is relevant to practitioners in their daily jobs. The majority of practitioner studies have been directed at upper management levels, yet academia typically educates students for entry level or management trainee (undergraduate) and mid-management (MBA) positions. A recurring finding was that academicians prefer to teach quantitative techniques while practitioners favor qualitative concepts. The OM curricula literature shows some disagreements between academicians concerning subject matter, and a wide variety of teaching opinions. This paper provides an extensive analytical review of OM curricula literature along with their respective authors' conclusions. From this analysis we suggest a customer-focused business plan to close the gap between industry and academia. This plan can be modified to account for faculty teaching and research interests, local industry requirements and institution specific factors such as class sizes and resources.

(Operations Management, Curriculum Development, Education, Course Surveys)

1. Introduction

Operations Management (OM) first became part of the business school curricula in the 1950s, where it was included in the Management department as Production Management (Meredith, 2001). Since that time OM curricula has undergone a significant

number of changes. Andrew and Johnson (1982) proposed that the first significant change occurred in the early 1960s as business schools increased the quantitative material in their curricula. This caused the curricula to become more model and technique-oriented at the expense of the established functional and descriptive approaches. This, in turn, created three divergent foci during the mid to late 1960s: (1) a strategic focus on changes in the competitive environment; (2) a sociotechnical systems focus on the behavioral aspects of production systems; and (3) a practitioner focus on computerized information systems. The 1970s saw the rise of the service industry and the need to develop new solution techniques for this industry, which resulted in a mixture of trends, foci, disciplines, and interests that created an identity crisis for production management (Andrew and Johnson, 1982). This then necessitated a name change from Production and Operations Management (POM) to Operations Management (Meredith, 2001). More recent areas of OM teaching and research now include international and environmental issues, and cross-functional topics such as technology integration, new product development and supply chain management.

This rapid development of the field of OM has led to confusion among students (our core constituency and future practitioners) as to the role OM plays in an organization. In a study of primarily undergraduates, Desai and Inman (1994) found that student bias against OM was due to the image of OM; a lack of emphasis on OM in business schools; student perceptions of careers, salary, and what OM is; and the existence of ‘quant anxiety’ in OM courses. As student interest in OM has declined, an educational gap has grown between OM academicians and industry practitioners. Hayes (2000) attributed the gap to the lack of clear limits to the field of OM, since operational functions occur in all

departments of an organization. Resolving the identity crisis of OM should be an important issue to both academicians and practitioners.

In a brief paper on the history of OM, Wilson (1995, p.61) stated, “An explicit recognition of the past is essential to a proper understanding of the present and for informed speculation about the future.” In the spirit of this quote, we begin our paper with a review of the studies that have been undertaken to determine what practitioners believe should be taught and what academicians are actually teaching.

Our research was conducted on articles published in academic journals in order to cover only the most rigorous publications. A few papers from conference proceedings and academic seminars, where available and with significant findings, have also been included. For purposes of consistency, we use the same name (OM or POM) as the author(s) when discussing their research. Our focus is almost entirely on articles related to OM curricula, but faculty in Statistics and Operations Research/Management Science are facing many of the same issues.

We present our review in a chronological order of publication date to show how topics, curriculum proposals and teaching views have evolved, and to identify trends in the results. Due to the large number of published papers we summarize the findings of many of the studies in table format and discuss the most important observations from those studies. If a study was conducted outside the United States, the country the study took place in is indicated. Otherwise, the study was conducted in the United States.

The next section provides an overview of studies on the practitioner/academic interface. This is followed by a review of the differing views on teaching OM and the factors that influence teaching OM. We then offer suggestions for a curricula renewal

and outline a proposal to bridge the educational gap between academia and industry, and increase student interest in OM as a career.

2. The Practitioner/Academic Interface

A large number of studies have been conducted on the interface between practitioners and academicians. In order to facilitate our discussion of these studies we group them into the following categories:

- Studies of Practitioner Use and Knowledge of Production Techniques
- Studies Comparing Practitioner Needs and Academic Curricula
- Studies of OM Curricula at Academic Institutions
- Operations Management Curricula Proposals
- Studies of Student Views on Operations Management

In the following sections we discuss each of these five categories of studies. For each category we summarize the studies in a table and discuss the key findings or proposals.

2.1 Studies of Practitioner Use and Knowledge of Production Techniques

The studies discussed in this section investigated the gap between the needs and usage of production techniques by production managers versus the education and training those managers had received on the techniques. The first known practitioner studies were carried out in 1961 and 1966 by the American Production and Inventory Control Society (now APICS - The Association for Operations Management) and Factory Magazine (now Modern Manufacturing). These two studies focused on what POM topical techniques were most widely addressed by practitioners and their impact on firm performance

(Wight & Christian, 1970). An important contribution of these two studies is that they formed a benchmark for all future studies on the interface between OM practitioners and educators.

Table 1 summarizes the key findings of the studies that were targeted towards production practitioners to identify if there was a gap in their knowledge or use of a decision making technique and their education or training in that technique. Three key observations can be made. The first is that all but one of the studies have been directed towards mid-management or upper level management. Only the White et al. (1988) study focused on the needs of entry-level employees that are the output of undergraduate academic programs. The second observation is that several of the studies used a biased sample (APICS, IIM). The final observation is a persistent gap between the theory and the practice of running plant operations. A gap between what practitioners used in their work environment and the availability of a tool or concept signified a lack of education in the specific techniques. It should also be noted that APICS used the information from their previous studies Wight & Christian (1970) and Davis (1974, 1975) to tailor their certification programs to the educational needs of their entry-level membership, as shown in the results of the Mabert et al. (1980) survey. One can speculate that the difference in the use of management practices between American and British owned firms identified in the Lockyer and Oakland (1983) survey was due to the educational efforts of APICS. In addition, Davis (1975) and Green et al. (1977) both observed that as firm size increased, practitioners placed more emphasis on techniques.

Bring in Table 1 about here.

2.2 Studies Comparing Practitioner Needs and Academic Curricula

In this section we review those papers that compared the skills and techniques that practitioners felt they needed to be effective at their jobs with the concepts and techniques academicians felt were important to practitioners. Table 2 summarizes the key findings of studies of practitioner needs and academic curricula. The studies by Berry et al. (1978) and Hahn et al. (1982) found that practitioners favored production concepts while academicians favored quantitative analytical techniques. This implies a gap between practitioner needs and what was being taught at academic institutions.

Though rigorously done, most of the studies were too geographically broad-based to guide an academic institution in a specific curricula development that would meet the needs of their primary constituents. Even the surveys of Fryer (1973), Ebert et al. (1998), and Basnet (2000), which were conducted to guide curricula development for their respective universities, covered too large of a geographic area. But, an important contribution of these three studies was that they compared their academic offerings to what practitioners felt they needed. Hahn et al. (1982) found that the majority of the schools they surveyed did not offer a specialized major in the Production & Inventory Management field. Support for concentrations in OM to provide breadth of subject knowledge and depth in a specific topic area were identified by both Rao (1989) and Taj et al. (1996). Practitioners also indicated that non-production skills in the areas of human resource management, communication and project management were also of importance (Rao, 1989; Basnet, 2000). Finally, the studies of Fryer (1973), Taj et al. (1996) and Ebert et al. (1998) found that practitioners felt that quality management was one of the most important topics for them to know.

From these studies it is evident that a gap still persists in what is being taught at academic institutions versus what skills production practitioners need for their jobs. But, an important contribution of these studies was that they attempted to identify changes in curricula in order to close the gap. In the next section we focus on papers that suggested topics and curricula for OM courses and programs.

Bring in Table 2 about here

2.3 Studies of OM Curricula at Academic Institutions

The studies discussed in this section focused on comparing OM curricula offered at various academic institutions. Table 3 summarizes the key findings and conclusions of those studies. Ducharme and Lewis (1987) concluded that the gap was closing between practitioners and academia due to the coverage given to APICS certification topics in the introductory POM course. Willis and Bass (1991) determined that most POM majors should be fairly familiar with APICS certification topics due to the trend to offer concentrations in advanced manufacturing strategies, and Carraway and Freeland (1989) found that graduate school coverage was more managerial and less mathematical. These findings also implied the gap was closing between practitioners and academia, since as previously discussed, practitioners favored APICS certification topics, and concepts over quantitative analysis. Both Carraway and Freeland (1989) and Raiszadeh and Ettkin (1989) noted the increased emphasis in curricula placed on service operations, and Lawrence and Rosenblatt (1992) made the first suggestion for an International OM elective course. From these studies it is clear that the topical coverage in the introductory POM course varied considerably between academic institutions, that OM topics were

expanding into service and international issues, and that a wide variety of OM electives were offered.

Bring in Table 3 about here

2.4 Operations Management Curricula Proposals

A large number of authors have made proposals for specific OM curricula and it is evident the results from previous studies has been used to shape their curricula proposals. Hahn et al. (1984), Sauers (1984) and Bandyopadhyay (1994) all advocated a balance of theory and practice in OM courses and programs. The increased importance of the service sector was recognized by Hahn et al. (1984), Armistead et al. (1986), Satir and Goyal (1987) and Harvey (1998) who suggested curricula that incorporated service concepts into existing courses or separate courses in service operations. Several authors offered curricula outlines that expanded OM into other topical areas such as strategy (Hill, 1986), emerging technologies (Satir & Goyal, 1987), and international OM (Starr, 1997; Whybark, 1997).

The first discussion of integrated course curricula was by Morris (1997) who noted that the traditional departmental organization of business schools did not facilitate the implementation of an integrated program and that faculty had concerns about instructor rewards in integrated programs. The emergence of the supply chain created a natural integration of cross-functional subject matter for the teaching of supply chain management (SCM). Curricula and suggestions for teaching SCM were offered by Closs and Stank (1999), Melnyk et al. (2000), Johnson and Pyke (2000), and Vollmann et al. (2000).

Bring in Table 4 about here

The studies discussed and the curricula proposed in the previous four sections were based on responses or views from working practitioners and or academicians. These studies do not include a key academic constituency - students. Therefore student views towards OM can provide additional insights not studied in the above papers.

2.5 Studies of Student Views on Operations Management

A survey on how students perceive the benefits of a required POM course with a manufacturing focus was conducted by Ala (1987). The key benefits identified by the author were learning POM terminology, career enhancement, and broadening of skills in order to be effective managers. The study also suggested that students were unaware of the content of POM courses before they took them. Smith and Cox (1990) took the position that manufacturing focused programs were designed by faculty without considering the student point of view of the subject material. They stressed that academia needed to make manufacturing more appealing as a career, and to teach students how to manage production processes with the use of computers.

Helms (1991) conducted a longitudinal survey of students taking a core MBA POM course taught from a strategic focus. Initial attitudes towards POM were mainly influenced by peers, co-workers, family members and teachers. Students felt POM careers were not a white-collar profession and had limited advancement possibilities. Upon completion of the course students had developed a better understanding of the POM profession, but opinions on career options did not change significantly. Desai and

Inman (1994) conducted a longitudinal study of undergraduate and graduate students taking a required POM course taught with a heavy emphasis on manufacturing and an even mix of concept and technique-oriented topics. They found that undergraduates had a more favorable impression of POM at the end of the course than did graduate students. Undergraduates who would have enrolled in the course if it were not required rose from 20.0% to 33.9%. The percentage of graduate students who would have enrolled in the course if it were not required declined from 52.2 % to 50.0%.

Another method to assess student input is through teacher evaluations, which are used to evaluate faculty performance and to assess how much students say they have learned. Biggs et al. (1991) pointed out that the Introductory OM course may be unpopular with students, and this can have a negative impact on instructor evaluations. The authors found that ratings were based more on non-learning factors such as controlling one's own class behavior, being prepared in class, answering questions and being approachable. Unfortunately, this missed the very point of an evaluation, which is to assess the ability of the instructor to help and motivate a student to learn.

Two key observations from the studies on student views of OM are that students are unaware of the subject matter taught in OM courses and that careers in OM are not appealing. The Ala (1987), Helms (1991), and Desai and Inman (1994) studies showed that the required introductory OM course is critical in helping students develop a more knowledgeable understanding of what the field of OM is about.

2.6 Observations from Studies, Reports and Proposals

The studies discussed sections 2.1 through 2.4 showed how OM curricula has evolved from an emphasis on quantitative analysis, to a balance of theory and practice. Topical coverage has expanded beyond manufacturing to include service operations, strategy, technology, and international issues. This topical expansion and the increased focus on the supply chain led to an integration of curricula for the management and control of global supply chains.

Several observations can be made from the studies on the interface between practitioners and academia. Some studies used biased samples (APICS and IIM) or samples that were too small to make broad inferences from. Also, all the practitioner surveys focused on manufacturing operations (rather than service), and almost all the surveys were directed at higher level employees such as plant managers and executives or were dominated by management as in the APICS surveys. Though most of the surveys and reports in the previous four sections were rigorously executed and analyzed, only one study (White et al., 1988) attempted to survey entry level employees, which are the positions undergraduates apply for. It is evident that the voice of the student has been almost nonexistent in studies concerning the gap between industry and academia, and no studies collected data from recent graduates who were entry-level employees.

In addition, it is difficult to directly compare all of the studies since there was little consistency in the survey questions and topics have changed over time. However, there is consistent general agreement that practitioners prefer concepts to techniques, while academicians prefer to teach techniques. While a large and persistent gap between

practitioners and academicians was evident during the 1960s and 1970s, it appears that academia made strides in closing the gap in the 1980s and 1990s.

3. Teaching Operations Management

The field of Operations Management has moved from a country-specific manufacturing focus to include Service Operations, Operations Strategy, International Operations and integrated courses where the focus is on Supply Chain Management. These changes in course offerings have evolved slowly, since the development of the curricula to teach these newer topics has been by trial and error, interdisciplinary collaboration, and continuous improvement. In the following two sections we review the academic literature that discussed views on teaching OM and the various factors that influenced OM curricula.

3.1 Views on Teaching Operations Management

As with curricula, a diverse set of views on how to teach POM have also been described. Hill (1987) emphasized POM as a dynamic field where knowledge and its evaluation to problems is applied to industry. Wood and Britney (1989) reported on the external and internal pressures for change in POM. External pressures were due to increased integration between business functions, technological advances, the rise of the service sector and practitioner needs for operational ways to achieve long-run competitive advantage. Internal pressures included broader and more relevant research, the gap between research and practice, and the need for research and teaching to be less analytical and more operational. The authors identified six future changes in POM with

operations strategy being the key area for the new POM paradigm of the 1990s.

Ducharme (1991) supported an increase in the use of both APICS topics in curricula and computers in the classroom in order to provide students with useful skills. He also acknowledged the need to market POM students to industry since personnel managers and college deans showed a strong preference for hiring engineers over business graduates for manufacturing positions. Bregman and Flores (1991) advocated a focused product life cycle approach to a portfolio of courses, where new courses are introduced as needed, existing courses are improved, and outdated courses are eliminated from the curricula. They noted that management concepts should be emphasized over techniques and that service should be integrated into OM curriculum. In Robinson et al. (1991) the CEOs of six major U.S. corporations called for an increased collaboration between industry and academia to: 1) identify the core knowledge associated with total quality; 2) develop a total quality academic research agenda; and 3) develop faculty understanding and commitment to Total Quality Management. Schools were encouraged to assess the level of quality-related course content in core and elective courses.

Two studies advocated the expansion of OM beyond its present boundaries. Singhal (1992) argued that business issues in the real world are rarely confined by rigid boundaries and that the field of POM must expand. Hayes (1992) suggested that faculty teach courses outside their areas of expertise as a way to broaden themselves and to engage in collaborative research on problems at the interface between business functions.

Harrison and Hanebury (1992) suggested a 'new perspective' (world-class organization, post-modern factory, continuous improvement system) on teaching POM courses that moved away from the traditional mechanistic focus on quantitative

techniques. They discussed the ease of teaching the traditional approach and the difficulties of teaching the ‘new perspective’ approach, and presented some possible methods for teaching the ‘new perspective’ approach. Hayes (1998) cited an agreement among seven deans that business schools needed to be market driven and to align their offerings with the needs of customers who are interested in broader cross-functional management issues. The customers are students, the companies that hire them, alumni groups that provide financial support and groups that fund research. The implications were that teaching should provide more exposure to real problems, more direct interaction with practitioners, an increase in experiential projects and the use of sophisticated computer simulation tools.

Examples of how other business functions are encroaching on the field of POM was provided by Miller and Arnold (1998) who felt the relevant unit of business analysis for POM is no longer the factory but the supply chain. Lovejoy (1998) urged OM professors to develop a theory of OM that is responsive to the multidimensional problems faced by industry and therefore is more inclusive of cross-functional issues. He defined OM as “the selection and management of transformation processes that create value for society” (p. 106) and pointed out that the theory, practice and teaching of OM are interdependent.

3.2 Factors Influencing Operations Management Curricula

A wide variety of factors that influence OM curricula has been identified in the literature. Hill (1986) noted that faculty had to balance short-term teaching commitments and administrative responsibilities with the need for long-term teaching and material development. Raiszadeh and Etkin (1989) pointed out that the makeup and background

of students, class size and availability of resources all influence teaching. Ducharme and Lewis (1987) found only 4% of the schools in their survey had a separate OM department and that at 68% of the schools the OM faculty were part of the Management Department. They also found that 83% of the schools had four or fewer OM faculty members. Although consensus on curricula can be difficult in a large department, a benefit of a large department is the ability to share teaching resources and ideas. It is unclear how this has changed over the years, but it is assumed that many OM departments are still integrated and do not consist of large numbers of faculty. Other factors that influence curricula include faculty research and teaching interests, the teaching ability of Ph.D. students, and the level of financial support and involvement from both alumni and industry.

4. Closing the Gap

Based on the review of the studies on the interface between academia and industry we know there is a gap between what academicians are teaching and what skills practitioners need to perform their jobs. Though a large variety of curriculum and teaching views have been proposed, the gap and the problem of attracting students to OM courses persist. One possible reason for the gap between practitioners and academia is that business schools usually train entry-level generalists, yet if they are accredited by AACSB or were seeking accreditation, the curricula is bound by AACSB requirements. On the other hand, Hahn et al. (1982) felt that practitioners might be biased towards APICS certification exam topics.

In order to make headway in narrowing the gap and attracting students, the field of OM should take a business approach in designing OM curricula. Adams and Giles (1986) showed both management and employees needed to be involved in the development of training subject matter, since management knew the goals of the firm and employees were aware of the skills they require. Woosley (1998) stated that the first customer is the student who must be educated, while the second customer is the company that hires these students. The following are proposals to help the field of OM take steps toward revitalizing the POM function within higher education.

4.1 The Needs of the Customer

Nearly all of the studies described above selected a narrow range of respondents from upper management. In a paper by Lee et al. (1995), a joint academic/industry investigation identified stakeholders in the field of Information Systems (IS) as IS managers, user managers, IS consultants, recent graduates and university professors. The study concluded that curricula must be designed around a clear career path for graduates, with different curricula for different paths. Likewise, stakeholders in the field of OM are practitioners at different job levels and functions, current students, alumni, consultants, and OM faculty. A survey of educational needs must be inclusive of all OM stakeholders, and should include manufacturing and service organizations, as well as for-profit, non-profit and government entities. Mabert et al. (1980) mentioned the need to assess what is important to current and future needs. Therefore we should not only attempt to determine current needs, but also consider how industry trends, particularly in technology, will affect future skill requirements.

Do we need to survey academicians? Not as frequently, because we already know what faculty are teaching, and it is more important to determine what our customers require. To our knowledge, only three studies have been published where an academic institution has conducted a survey to determine the needs of local industry (Fryer, 1973; Ebert et al., 1998; Basnet, 2000). Because there are many factors that influence curricula, educators should focus their efforts locally instead of on broad-based industry surveys that are difficult to relate to their school.

4.2 A Plan of Action

All good businesses have a customer-focused strategic plan that states the objectives of the firm and how the company intends to meet those objectives. We should consider students as “customers” and have a strategic plan for academia as well. Therefore the OM area should develop a statement of teaching objectives that is oriented toward the careers of their students, the primary educational responsibility. Hahn et al. (1984) provided an outline of program objectives and program emphasis as a guideline for developing a POM Program curriculum. Their objectives include the three distinct areas of Knowledge (Thinking), Skills (Doing), and Values and Attitudes (Feelings). Knowledge is the capability to understand problems and the tools needed to solve those problems, Skills are the ability to apply the tools in order to solve problems, and Values and Attitudes are the decision-making approaches taken in dealing with complex and uncertain situations. All three of these must be covered in the specific courses that comprise the OM curricula. Hill (1986) discussed the need for academia to define the boundaries of what we are trying to teach. In other words, there are limits to what we can

achieve with our strategic plan. Additionally, Bandyopadhyay (1996, p. 119) provided the following (modified) outline for an academic assessment model to evaluate a POM Program.

- 1) Program Objectives: specific course material and computer applications that will prepare undergraduate students for entry level OM positions and graduate students for higher level management positions.
- 2) Assessment Criteria and Procedures: a more specific outline of what needs to be taught and how it will be taught to reach the Program Objectives.
- 3) Assessment Instruments: project completion results and a survey and/or exam in the OM capstone course used to determine if students mastered the Program material. Employers and alumni are surveyed to ensure the Program material is relevant to the workplace.
- 4) Time Table: employers and alumni should receive an annual survey to measure the gap between what is being taught and what needs to be taught.
- 5) Feedback Loops: among faculty, students, employers and alumni to ensure continuous improvement in the Program.

4.3 Breadth and depth

Since non-academic OM stakeholders come from all levels and types of businesses, it will be difficult or almost impossible for academic institutions to meet all of their needs. Therefore, the institution's overall objective statement will have to be tailored to the specific stakeholders the school is educating. Woolsey (1985) reported on the 1985 APICS Academic Liaison Committee Workshop, where practitioners and educators

discussed the development of curriculum guidelines for the POM survey course and four types of degree programs. For the degree programs, technical skills were more important for two-year students, while those pursuing a bachelor's degree needed a balance between technical skills and management concepts. The Workshop concluded that an MBA student should have the same level of technical skills as undergraduate students but more managerial skills, and a student studying for a Master of Science (MS) in OM should have the same level of management concepts as bachelor's students, but more technical skills. Subsequently the participants of the 1986 Academic Liaison Committee Workshop developed a detailed curriculum and prerequisites for associates and bachelors programs in POM based on the above-mentioned 1985 meeting suggestions (Saluti and Brown, 1987).

Based on our review of the OM curricula literature we offer curricula guidelines for the following groups of 'customers' (students): two-year associate's programs in OM, undergraduate and graduate required core OM courses, undergraduate and graduate OM majors, Executive/Professional MBA (E/PMBA), and Ph.D. in OM. Progressing from a two year associate's program to the Ph.D. level, there should be an increasing level of conceptualization, and the subject matter should move from tactical operational issues to strategic thinking. Associates in OM should study techniques but also have a capstone on quality and strategy as a way to link quantitative tools. Core OM classes for undergraduates and MBAs should cover a mix of concepts and techniques that cover manufacturing, service, information technology and international topics, with MBAs receiving a greater amount of conceptual material than undergraduates. The composition of E/PMBA classes consists of working professionals with several years of significant

business experience. For this group the OM course emphasis should be on the strategic integration of OM with other business areas (finance, marketing, information technology), with a focus on problem identification, analysis, solution generation, and impact across the organization. However, course coverage should also include techniques since studies showed that barriers to the use of techniques were a lack of knowledge of the technique (Green et al., 1977; Oakland and Sohal, 1987).

For OM majors the studies on curricula agreed that there should be a core set of courses to provide breadth and a focused set of elective courses to provide depth. The core group should include Quality, Strategy, and Technology and Trends, while the electives could be in the interest areas of the faculty, or be designed to meet the needs of the local business groups. A possible program goal for OM majors might be to prepare them to take and pass an APICS certification exam. At both the undergraduate and MBA levels, program emphasis has to move away from techniques and more towards concepts. Berry et al. (1978) pointed out that techniques are easier to teach and test for, especially in large classes. But large classes should not be an excuse to focus on techniques. Jacobs (1999) suggested using the Internet to enhance classroom discussion by sharing information with students and soliciting real time feedback. He offered tips for developing a homepage and advised new users to the Web to go slowly at first. Internet based education tools such as WebCT, BlackBoard and WebBoard can be used to facilitate classroom teaching and to communicate with students. These tools have been successfully used for large and small classes.

Ph.D. students are in the position of being both customers and service providers, since most Ph.D. students have their own classes to take and also serve as teaching assistants

for faculty and/or have their own class to teach. Hayes (1998) advocated that Ph.D. students in OM be exposed to actual problems faced by practitioners and that they use the methodologies of clinical research in studying those problems. Ritzman et al. (2000) presented an empirical study to determine the changing expectations for doctoral students. They surveyed faculty in charge of recruiting new Ph.D.s for the position of assistant professor to get a 'customer orientation' and used the same questions to poll faculty in charge of Ph.D. programs to get a 'supplier orientation.' Their results showed that new Ph.D. graduates are expected to make a faster start in both research and teaching at their new schools. Some key areas where Ph.D. students needed development were relevance in research that is connected to real business problems, teaching and research across functional boundaries, and incorporation of a global outlook. The authors also found a gap between "customer" and "supplier" orientations indicating some resistance to making substantial changes in doctoral education. Sheppard et al. (2000) provided extensive guidance to help Ph.D. students manage their careers. They advised leveraging coursework for publishing/presenting opportunities and for generating dissertation ideas. Though the Ritzman et al. (2000) and Sheppard et al. (2000) papers were not specific to OM, they do provide insights that are applicable to OM Ph.D. students.

OM curricula will be constrained by a number of school-specific factors such as academic calendar (semester length), number of courses in the major, the number of OM faculty, the organization of faculty departments, AACSB requirements, the attitudes of curriculum committees toward OM education, class size, school populations, and the number of OM majors. Regardless of the constraints, it is important that instructors engage the students in the subject matter by making it relevant to the job market and to

OM in their daily lives. This is especially important since students have misconceptions as to what OM is until they take their first course. The Internet should be used to increase avenues of communication with students, and to provide students with information and links on careers and to professional organizations such as APICS The Association for Operations Management, The Institute for Supply Management and The American Society for Quality. Meetings should be held with advisors to educate them on what the OM function does in industry, so they can accurately advise students on careers and the benefits of studying a major or even a minor concentration in OM. Industry also needs to work towards narrowing the gap and generating student interest. Helms (1989) suggested that to revitalize the POM function, corporations need to include OM in strategic planning and to rely on OM for long-term competitive advantage.

The inroads of Management Information Systems into the field of OM were first identified in the 1979 APICS survey analyzed by Mabert et al. (1980). Meredith (2001) discussed the adoption and growth of computer technology in business schools, and recommended that OM incorporate more IS technology into courses as a way to attract students. While a variety of user-friendly decision-making software is included in nearly all current OM textbooks, these are not full-scale industry applications. Therefore industry support is needed to obtain industrial level software utilized by practitioners as well as the training to teach the package.

Internships and projects with both large and small local companies can also help students gain real world experience and potential job offers. Alumni should be invited back to campus to discuss not only how they apply OM topics in their job functions, but also to discuss OM career opportunities in their company and industry. OM faculty can

engage industry and students by offering special seminars or programs on emerging trends in OM or on current faculty research (consulting opportunities here). The goals of these sessions should be to provide a forum where students can meet practitioners, to demonstrate what the academic institution has to offer industry, and to determine what operational problems local companies are dealing with. Faculty and their students can also get involved with local quality award programs, and if such a program is not in place, then faculty could initiate one. Bringing other departments into a quality awards program can provide opportunities for the exchange of research and teaching ideas, and help spread the workload.

5. Conclusion

This paper has provided an overview and reference point on the research that has occurred concerning the OM curricula gap between industry and academia, the evolution and content of OM curricula, the various views on teaching OM, and the factors that influence OM curricula. Suggestions have been made for closing the gap and stimulating the interest of students in the OM field. These include guidelines for breadth and depth of curricula, curricula focus, barriers to change, and a business-like plan of action to accomplish the goal of matching curricula with the needs of various groups of students - our customers. These suggestions can be selectively applied in specific cases due to the large number of constraints that affect courses and OM faculty at different educational institutions. However, OM faculty need to determine what their stakeholders current and future educational needs are, and this should be an ongoing process with feedback loops for continuous improvement.

We also need to measure what we are doing in the classroom and the effectiveness of curricula in preparing students for entry-level positions and careers in OM. This will become even more important as the numbers of courses offered over the Internet are increased. We need to measure student satisfaction, learning and attitudes toward OM, and the extent that OM is integrated with other fields. The creation of the *Decision Sciences Journal of Innovative Education* (*Decision Line*, July 2000, p.19) indicates the importance of rigorous research on pedagogy in business related fields.

Integrated courses are the trend in academia; therefore we need to continue to expand the boundaries of OM to cross business functions for teaching and research, and for identifying operational synergies between business functions that companies can exploit for sustainable competitive advantage. We also need to expand our coverage of IS technology in order to draw students to OM courses and to better prepare them for OM careers. The challenge for OM faculty will be to keep up with the changes in technology so that students will be on the cutting edge and therefore highly marketable. To do this, we need to stay in constant touch with our industry partners and alumni.

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Appendix

Table 1. Studies of Practitioner Use and Knowledge of Production Techniques

Author(s)	Sample	Key Educational Findings and Conclusions
Wight & Christian (1970)	Full *APICS membership (managers)	Both surveys indicated a large gap between the theory and the practice of running plant operations, indicating a lack of knowledge of scientific techniques. Growing use of computers.
Davis (1974, 1975)	APICS membership (managers)	Trend towards the use of formal procedures instead of judgmental techniques; simple techniques over sophisticated mathematical techniques; increased computer usage. As firm size increased, practitioners placed more emphasis on techniques.
Green et al. (1977)	Fortune 500 VP for production	Gap in the knowledge or proper use of quantitative techniques indicating a shortcoming in the teaching of quantitative techniques. As firm size increased, practitioners placed more emphasis on techniques.
Adams & Giles (1979)	Foremen, plant manager, personnel manager	Personnel managers gave significantly lower importance rating all 5 production topics than plant managers and therefore are unable to accurately assess the training needs of production foreman; plant managers must take an active role in designing training programs.
Mabert et al. (1980)	APICS membership (manager, supervisor)	Compared to Davis (1975) all topical areas showed an increase in the importance rating, with biggest gains in strategy and human resources. APICS is meeting the primary educational needs of membership, but topics related to career advancement not adequately covered.
Lockyer & Oakland (1983)	Industrial Institute of Managers (IIM) membership (manager, director)	Low knowledge and usage of production techniques attributed to a low level of educational qualifications, indicating a gap between education and practice. American owned companies utilized management practices and computers more frequently than British owned companies.
Wild (1984)	Production managers	Managers placed greater emphasis on the use of judgmental rather than analytical decision making procedures. No conclusions by author for this gap.
White et al. (1988)	Production control supervisors	75% of employee time spent on master scheduling, shop floor control, inventory control and materials requirements planning (APICS certification topics). Supervisors felt education should focus on these areas for entry level production control positions.
Berry & Lancaster (1992)	Operations managers	Practitioners felt that twice as much course coverage should be given to concepts as to quantitative techniques. Introductory POM course needs to be more relevant to actual business practices.

* APICS The Association for Operations Management

Table 2. Studies Comparing Practitioner Needs and Academic Curricula

Author(s)	Sample	Key Findings and Conclusions
Fryer (1973)	South Carolina (SC) firms, Chief Executive Officer	Topics of quality, production costs, purchasing, scheduling and capacity of greatest importance. Minor gap between practitioner needs and academic curriculum at University of SC.
Berry et al. (1978)	Production managers and *AACSB member schools in 11 southeastern states	Practitioners favored production concepts while academicians favored quantitative analytical techniques. Practitioners often are unaware of the technique. For academicians, techniques are easier to teach and more easily tested for knowledge skills. As firm size increased, practitioners placed more emphasis on techniques.
Hahn et al. (1982)	APICS survey results from Mabert et al. (1980), schools that had introductory and advanced OM courses	The majority of the schools did not offer a specialized major in the Production & Inventory Management field. University faculty favored theoretical and technique-oriented courses. APICS members felt process and problem oriented topics were most important. Practitioners focus on topics that are highly related to their current job and future career path, with a bias to specific topics required for the APICS certification exams.
Rao (1989)	1989 APICS Academic / Practitioner Operations Management Workshop	Practitioners need breadth of subject knowledge as well as the ability to communicate with both internal departments (marketing, accounting) and external groups (vendors, logistics providers). The ability to motivate people, manage projects and work on interdisciplinary teams was identified as key attributes needed by practitioners in the future.
Taj et al. (1996)	Universities that offer undergraduate OM or industrial management (IM) major, senior executives	Industry executives ranked strategy first followed by operations planning and control, and quality management. Concluded that OM and IM programs should be tailored to a concentration, in order to give students both breadth of subject knowledge and depth in a specific topic area.
Ebert et al. (1998)	Romanian industry	Respondents ranked manufacturing strategy and quality as the top two needs, gave low ratings to interdepartmental work teams and worker involvement in problem solving. Gap between course content and the educational requirements of industry. The University of Sibiu is moving towards a more participative method of classroom instruction and the integration of Marketing, Production and Engineering.
Basnet (2000)	Production managers, all Production Management educators in New Zealand	Practitioners in New Zealand felt there was a significant practical relevance of production management techniques taught in academia, but there was room for improvement and gave significantly lower importance to quantitative techniques than did academicians. Human resource issues need more coverage in production management courses.

* Association to Advance Collegiate Schools of Business (AACSB)

Table 3. Studies of OM Curricula at Academic Institutions

Author(s) or Reference	Key Findings / Conclusions
Galloway & Eldridge (1981)	Prerequisite content was heavy on computer, statistical and quantitative methods and that due to these requirements, students did not take the introductory POM course until their junior or senior year. By this time most students had already committed to a different major for their degree.
Ducharme & Lewis (1987)	81% of the schools had a required POM course, with 45% of the coverage spent on the APICS certification topics of Inventory Management, MRP, Capacity Management, Master Planning, and Production Activity Control. Concluded that the gap was closing between the profession and academia in at least 75% of the responding schools.
Raiszadeh & Ettkin (1989)	Diversity in teaching methodologies and topics created an identity crisis on what POM is and what should be taught. Almost all schools reported some type of emphasis on service operations. 86% percent of the respondents had a Ph.D., but only 24% of those had a terminal degree in OM.
Carraway & Freeland (1989)	Pedagogy at 20 top graduate business schools more managerial and less mathematical; increased emphasis was placed on service operations; high use of computers in production and inventory systems courses; cases frequently used for service and strategy electives.
Bahl (1989)	Business schools offered a wide variety of electives in graduate POM concentration programs. Operations planning & control and operations strategy were offered the most frequently. Concluded there was considerable disagreement as to what electives should be offered.
Willis & Bass (1991)	In some cases quantitative methods dominated the course coverage, and only half the schools covered all 6 APICS certification topics. Production activity control was covered by only 50% of the schools, yet in Hahn et al. (1982) 96.5% of the responding schools covered it. Due to the trend to offer concentrations in advanced manufacturing strategies, the authors concluded that most POM majors should be fairly familiar with APICS certification topics.
Lawrence & Rosenblatt (1992)	Conducted a survey of teaching practices of International Manufacturing and Operations Management in the United States and Europe. European respondents indicated that teaching international operations was already integrated in their OM courses. The authors suggested a syllabus and provided an extensive resource list for an International OM elective course.
Goffin (1998)	European schools placed a heavier emphasis on tools and manufacturing over concepts and the service sector, and that most schools were just starting to investigate integrated courses. Compared to Bahl (1989), Goffin found more agreement on subject matter among the European schools than U.S. schools.

Table 4. Operations Management Curricula Proposals

Author(s) or Reference	Curricula Proposal
Hahn et al. (1984)	Used the results from the 1979 APICS survey, to develop curricula structures and topic outlines for undergraduate POM programs. The curricula met the educational needs of APICS members and were flexible to meet a variety of academic constraints such as semester length, course credit hours, and accreditation requirements. They suggested that POM/service sector issues either be incorporated into existing courses or be taught separately, and that there was a need to have a mix between theory and practice.
Sauers (1984)	Presented a curriculum based on APICS certification topics that balanced actual practice and theory.
Armistead et al. (1986)	Proposed the integration of service operations into OM core courses, or a separate service course. Provided examples for the integration of service in a core POM course, and a course outline for a service elective.
Hill (1986)	Inappropriate to teach a full course on OM strategy to undergraduates, graduate students need an understanding of OM before they take a course on OM strategy. For an EMBA class, OM strategy would need to be integrated with other areas such as marketing and technology as a way to provide a strategic corporate overview.
Satir & Goyal (1987)	Business schools should emphasize concepts and techniques, manufacturing and service sectors, as well as the relationship between OM and other business functions. Suggested a curriculum for an advanced course to introduce emerging technologies.
Bandyopadhyay (1994)	Offered a model POM major program to develop conceptual breadth and technical depth in order to meet the increasing management needs for higher levels of conceptual, interpersonal communication and analytical skills.
Starr (1997)	Advocated the teaching of a separate International POM (IPOM) core course for MBA students. Cited International Finance and International Marketing as relevant examples. Suggested using case studies of a global nature and developing a data-base of country-specific issues as a way to gain the knowledge to teach an IPOM course.
Whybark (1997)	Supported the study of IPOM due to the lack of international exposure of U.S. managers and the AACSB mandated 'Internationalization' of business school curricula. He cited examples of European managers being forced to internationalize much sooner than U.S. managers to expand their businesses, whereas U.S. managers consider international operations to be different than domestic operations.
Morris (1997)	Discussed the curriculum and implementation of a two-semester-long integrated business common core for undergraduates. This program used a comprehensive case and was team-taught by faculty from various departments. Implementation of an integrated course required faculty to be well rounded in all business functions and have consensus on content. Noted the organizational streamlining of business schools into traditional departments (Accounting, Marketing etc.) did not facilitate implementation and that many faculty had concerns about instructor rewards in integrated programs.
Harvey (1998)	Described a service operations course based on an in-depth service field project where lectures and course material were structured to aid students in their projects. Students had to link concepts from other courses in order to complete a meaningful project. Teacher's role changed from lecturer to consultant and coach.
Closs and Stank (1999)	Discussed the need for managers to understand the integration of operations within the organization and between supply chain partners. The authors provided an outline for a Supply Chain Management (SCM) major and detailed syllabi for two SCM courses.
Melnyk et al. (2000)	Described the evolution of the SCM program at Michigan State University that integrated the Logistics, Purchasing and Operations Management groups. The authors provided insight into how faculty from different departments worked together and with practitioner groups to develop the SCM program. Students took common introductory and capstone courses and elective courses from two of the three groups as a way to provide subject matter breadth and functional depth. Undergraduates were expected to be "toolsmiths" while MBAs were "concept masters"; a curriculum was suggested for both.

Johnson and Pyke (2000)	Identified the integration of Marketing, Research and Development, Manufacturing, and Logistics as the key unifying themes behind SCM curricula and practice. The authors provided a list and discussion of 12 topical areas within the supply chain and an extensive list of cases and news clippings to teach these areas. Topics and cases used in supply chain classes taught at eight universities in the U.S. were also described.
Vollmann et al. (2000)	Identified and discussed four major issues and related cases for teaching SCM to executives: flawless execution of operations, the change of focus from supply to demand, outsourcing and supply base development, and partnership implementation.