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# Innovation and Improvement of Curricula for OM and IT Majors in Colleges of Business through Industry Engagement

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## ABSTRACT

**We propose innovations and improvements of curricula for majors in Operations Management (OM) and Information Technology (IT). New methodologies for optimizing curricula for OM and IT consider the latest needs of employee markets served by these two majors. A holistic, learning-centric approach seeks to increase the capacity of OM and IT students to achieve the future they want. Overlooked subject areas for these curricula often include soft skills, change management, systems thinking, and testing, among others. We use the paradigm of the supply chain to suggest how industry engagement can influence OM and IT curricula. Such content could then be expanded over more than just four collegiate years by including OM and IT course content in high school curricula. We suggest a methodology for employer-driven valuation/grading of every potential and actual course in the OM and IT curricula. We take a holistic, systemic view that will help stimulate and pilot new ideas for OM and IT curricula.**

**Keywords:** *curricula, curriculum design, information technology operations management, project management*

## 1. INTRODUCTION

Information Technology (IT) and Operations Management (OM) professionals constitute one of the greatest cadres of knowledge workers in modern organizations today. Knowledge workers, in general, comprise over half of the US workforce (Laudon and Laudon, 2011), which include both OM and IT professionals. IT professionals are developers, programmers, systems analysts, database administrators, data and business analysts, web designers, cybersecurity analysts, and network specialists. OM professionals include supply chain designers, purchasing agents, layout and job designers, supply chain analysts, logistics analysts, operations research analysts, inventory specialists, forecasting analysts, capacity planners, aggregate planners, and process analysts, among many others.

A culture of Continuous Improvement (CI), as discussed in the literature review, should be fostered within Higher Education Institutions (HEIs) through accreditation and merit incentives. The Association to Advance Collegiate Schools of Business (AACSB, 2018) is encouraging this very thing today. AACSB accreditation standards require accredited business schools and those aspiring to receive accreditation to follow certain standards relative to the curriculum content of the degree programs (AACSB, 2018). Further, all business schools accredited by the AACSB need to demonstrate CI in multiple aspects that, include Engagement, Innovation, and Impact (AACSB, 2018, 2019). Overhauling OM and IT curricula can be accomplished as part of the "innovation" initiative to meet the relevant requirements under the AACSB accreditation standards for business schools.

The way most high-level, white-collar work gets done within these two disciplines (OM and IT) is by use of projects (Larson and Gray, 2021). According to Peters and Waterman (1982, 2012), projects are the frameworks through which white-collar work gets completed. So one suggestion is, how about a required course in project management (PM) for all OM and IT majors?

According to a recent survey conducted by the ACM/IEEE Computer Society in their 2017 Guidelines for Undergraduate Programs in Information Technology, the most important IT-related subject or topic was PM. PM outpaced seven other domains that the survey participants ranked with a 78% appeal. The third item on the list was 'soft skills' with a 64% appeal. According to the ACM/IEEE-CS 2017 Computing Curriculum Guidelines, the emphasis on soft skills corresponds directly to the top skillset that industry professionals envision as most important—PM, as PM requires excellent interpersonal, team, and communication skills. "Project managers are valued more for these qualities than their technical skills. Industry thinking is that an adaptive individual can learn any required technical skills." (Association for Computing Machinery (ACM) and the IEEE Computer Society (IEEE-CS), 2017, p.19).

The 2017 IT Guidelines go on to say that the use of internships and work-study programs is very useful for IT

majors. In this regard, the 2017 IT Guidelines suggest that a strong industrial/professional advisory board is one way to open doors with industry because members of that board will develop a bond with the program. Academic IT programs should seek all avenues of engagement with industry so their graduates have greater chances for employment and promotions beyond employment. Additionally, according to the 2017 IT Guidelines, students must be adaptable and flexible (Association for Computing Machinery (ACM) and the IEEE Computer Society (IEEE-CS), 2017).

Most IT and Management Information Systems (MIS) programs teach their students how to do software development, while most real-world IT projects involve software maintenance, where the IT professional starts with existing code and makes modifications to it. That person spends more time reading and understanding the existing code than writing code and far more time testing the change that was made. Lemoncelli (2017) called for more immersive degree programs in which the students start with an existing legacy code (utilizing an industrial partner) and proceed from there. Behara and Davis (2015) suggested that such immersive curricula can assist with combating disruptive innovations and technologies, a subject about which we will have more to say later. As recommended by the 2017 ACM/IEEE IT Curriculum Guidelines, there should be extensive use of internships and cooperative work-study (co-ops) arrangements where students work for a semester and then take courses for a semester.

Another problem with business school curricula at state-supported HEIs is that some states have a limiting requirement in terms of semester hours. We must get it done in 120 semester credit hours or less, say. Students attempting hours more than their degree program requirements may be charged the non-resident tuition rate for those hours. If the curriculum already has 120 credit hours within it and we require an additional 3-hour course in soft skills or testing, say, then some other 3 credit-hour course has to be removed, or the tuition for those additional hours will go up to the non-resident rate at state-supported HEI's.

So how well do the employers of our students think we are doing? Articles in the Harvard Business Review (King, 2015) and elsewhere identified a significant gap between how well educational institutions believed they were doing in providing qualified graduates to firms hiring them and how well those same firms believed the educational institutions were doing. While 96% of the colleges and universities believe they are doing a good job of satisfying the needs of the industry, only 11% of the firms surveyed concurred with them (King, 2015). Of course, this was an across-the-entire gamut of possible disciplines and majors, not just business majors or, for that matter, OM and IT majors. But it may be indicative of a larger problem here. Perhaps, it is time to reconstruct/redesign these OM/IT curricula based on employer-perceived value added.

In the next section, we provide a literature review, and this is followed by design-related suggestions for re-invented or updated curricula. We look closely at lower division courses and how we could incorporate additional soft-skills content there. Additionally, we present a methodology for direct engagement with the industry—employers, former students, etc. Finally, we conclude with appropriate remarks.

# 2. LITERATURE REVIEW

In this part of the paper, we allude to the literature on business education in general to provide a structure for business school curricula and the content of OM, IT and PM curricula in particular.

## *2.1 A Brief Review of Business Education*

Venkataramanan and Ernstberger (2015) presented a brief history of how undergraduate business education has evolved. Colby *et al*. (2011) called for a rethinking of undergraduate business education by partnering with liberal arts programs to integrate liberal learning principles into the business curriculum. Brint *et al*. (2009) further challenged educators to directly confront important concerns head-on through thematic bundles of courses. The proposal developed by Venkataramanan and Ernstberger (2015) responded to the calls of both Brint *et al*. (2009) and Colby *et al*. (2011) by first modifying the current curriculum blueprint for business schools to allow for thematic bundles of courses to be readily incorporated. A thematic bundle of coursework in the form of a minor in analytics and liberal learning is then described in which societal value creation is coupled with the fundamental philosophy of maximizing shareholder wealth. Graduates with this credential in liberal learning will be better prepared to meaningfully launch their careers, and business schools will help fulfil the pivotal role of the modern university in society by once again embracing the principles of the original founders of business schools (Venkataramanan and Ernstberger, 2015). Chandler and Teckchandani (2015) recommended pairing Liberal Learning Philosophy with Social Constructivist Pedagogy. They suggested such a pairing will cultivate more critical thinking and creativity in their classrooms to prepare students for the problems they will face in today's complex and global world.

According to Hays *et al*. (2007), introductory OM textbooks usually include a number of largely disjointed topics, which leave many students (and their instructors) without a coherent framework for understanding the field. As a result, the importance and sequencing of topics vary between courses and instructors. We searched the Internet for recommended OM curricula and found only the OMBOK Framework within APICS (2011). We specifically looked at the content within the APICS (American Production and Inventory Control Society), POMS (Production and Operations Management Society) and INFORMS (The Institute for Operations Research and the Management Sciences) websites and did not find a specific recommended curriculum either for the OM undergraduate major or for one at the master's level. There is no explicit recommended curriculum within OMBOK (APICS, 2011), just the OMBOK Framework. There does exist the ACM/IEEE 2017 IT Curriculum Guidelines, however. As we shall observe later in this article, these guidelines are quite specific to the point of suggesting actual courses that should make up such a curriculum.

Lutz *et al*. (2014) performed a content analysis of a large sample of OM course syllabi to identify the content of both undergraduate and graduate OM courses, and the relative importance attached to particular topics. Gaps between topical coverage and what industry experts have identified as important knowledge, skills and abilities were

also identified (Lutz *et al*., 2014). Vanteddu and Somarajan (2012), through assessment of student performance, demonstrated the effectiveness of the application of CI theory for teacher-centric processes, particularly in attaining student learning-related goals by the adoption of Deming's Plan, Do, Check and Act (PDCA) cycle (Deming and Walton, 1988) to one of the quantitative methods courses that they taught. Carnovale *et al*. (2016) proposed DMAIC (Define, Measure, Analyze, Improve, Control) as a tool for CI in online program design. The impetus behind this study was to suggest that applying the principles of CI to pedagogical assessments can foster institutional commitment and enhance the process by which universities assess student performance. Sandman (2014) studied the learning styles of 1,100 business students and found that preferred learning styles may depend more on the course than the major, indicating that students have adaptive learning styles.

Hanna and Barman (2014) discussed a strategy of flipping the classroom, and a change of focus from effective teaching to assurance of student learning, to create an opportunity to address societal pressures through mass customization (MC). They used three elements of MC (elicitation, process flexibility, and infrastructural logistics) and four approaches to MC (collaborative, adaptive, cosmetic, and transparent) to develop and discuss a blueprint for MC in higher education. Wilson (2011) suggested MC of the course content of individual core courses by giving students the flexibility to choose what content they will study. Wilson (2011) also suggested MC by giving students schedule and course-length flexibility. Parast (2010) investigated the effectiveness of a case study on student learning. Seven measures were developed to assess different aspects related to student learning. The study contributed to an understanding of the effectiveness of case studies for the improvement of learning outcomes of undergraduates in OM.

Students should be tested to determine their personality strengths and weaknesses taken in relation to their career goals. Then a specific MC program of learning can be created and customized for each student. For example, assume an entry-level student aspires to be a project manager but evidence, through testing, weakness in leadership and problem-solving. Then an MC curriculum can be created specifically for that student to address these deficiencies. Such a student would take courses in leadership and problem-solve with many other students showing similar deficiencies.

What is presented here can help prevent disruptive innovation (Behara and Davis, 2015) from having a deleterious impact on non-differentiated programs in OM and IT. It is vitally important that undergraduate business educators understand the disruptions they are experiencing in order to navigate through them (Behara and Davis, 2015). Disruptions can come from Massive Open Online Courses (MOOCs) that have democratized higher education while simultaneously impacting the traditional high-tuition-based revenue model used in conventional higher education. This high-tuition revenue model is getting higher at a rate that far exceeds annualized increases in the cost of living (The Economist, 2014). Still, more disruptions can come from employers who can literally search the globe for knowledge workers, putting higher education in the USA in competition with the rest of the world. Behara and Davis (2015) further alluded to community colleges and private schools developing four-year business programs that are more focused on specific employers; that is, they have closer relationships with the industry. This, again, can be construed as potentially disruptive to traditional programs offered by major state universities.

A very interesting paper on learning through doing is Akpan's paper (2016) on the efficacy of a consulting practicum course or seminar for enhancing students' readiness for a professional career in IT. Each student team has a mentor and a real external client. Through interaction with the client, the student team diagnoses the client's problem and arrives at a prescriptive software solution with the help of the mentor. Such a course helps students acquire the essential practical skills and experience to enhance career readiness and ensure a smooth transition from college to employment. As is always the case, the success of such a course will depend upon the delivery and execution of the course itself. Sroufe and Ramos (2015) discussed problem-based learning courses and how such learning can be designed and delivered in a collaborative way. In some respects, the Sroufe and Raos (2015) article resembled the Akpan (2016) article because it involved interactions with an external industrial client.

Fadel *et al*. (2015) wrote a tome on Four-Dimensional Education in which they discussed what competencies the 21st Century learner will need to succeed. They provided an organizing framework that can help prioritize educational competencies and systematically structure the conversation around what individuals should learn at various stages of their development. Their contribution lies not in presenting yet another one-size-fits-all list of what students should learn but in defining the dimensions in which educators, curriculum planners, industrial partners and learners can establish what should be learned in their context and for their future. Fadel *et al*. (2015) made a strong case for relevance in the curriculum.

## *2.2 A Brief Review of the Business School Curricula Structure*

Most business school curricula (which subsume OM and IT curricula) are divided into two sections—lower-division content and upper-division content. The lower-division content is largely devoted to required courses—history, communication, political science, economics, physical science, etc. The upper division emphasizes technical and discipline-specific content. Behara and Davis (2015) alluded to the problem of not having an integrated curriculum involving the liberal soft-skills lower-division courses and the discipline-specific upper-division technical courses. To suggest how enduring and pervasive this problem is, Behara and Davis (2015) referred to an earlier work by Gordon and Howell (1959), who called for more effective liberal studies content in undergraduate business education to develop in students the capacity to appreciate, understand, enlarge upon and use what they learn in these lower-division courses. Chew and McInnis-Bowers (2004) called for a blended approach that attempts to overcome the superficial divide through integrated courses. This paper proposes a blended curriculum that is more integrative of the content in the two divisions that make up the undergraduate program. Starting with soft competencies in the lower

division, the upper division would then make use of those competencies. It is the contention of this paper that all of this should happen with the assistance of industrial partners.

### *2.3 A Brief Review of OM, IT and PM Curricula Content*

Many business schools house the OM and IT majors within the same department, often called the Decision Sciences Department. Moreover, because of the relevance of PM to both OM and IT, we include it here, acknowledging that a major in PM is not something that appears very often. Because of the commonalities between these disciplines, we treat them together. A consideration of OM content reveals many topics in common with the Guide to the Project Management Body of Knowledge (PMBOK Guide) that are referred to as 'knowledge areas.' The ten PMBOK Guide (2017) knowledge areas are scope, time (schedule), cost, quality, communication, human resources, risk, procurement, stakeholders, and integration. For example, quality, human resources (and team dynamics), procurement, and risk, as well as cost and time (scheduling), are topics (knowledge areas) common to both OM and PM disciplines. Marder *et al*. (2021) implemented agile PM principles in both undergraduate and graduate marketing courses and found that they benefited students in terms of psychological safety, team performance, group learning, interpersonal communication and creativity while also lowering the social loafing issue.

Likewise, as we consider IT we find that these topics (quality, human resources and team dynamics, procurement, and risk, as well as cost and time) are fundamental to an understanding of IT. A course module covering each of these topics could precede introductory courses in IT, OM or PM. Perhaps we should consider organizing OM and IT around knowledge areas and sequencing those knowledge areas so that the fundamental/core knowledge areas are taught first. We should be looking for a common core of topics suitable for OM, IT and PM. If the bodies of knowledge for OM and IT were organized in a manner like that of the PMBOK Guide, it would be easy to see the common components, modules, or processes among these disciplines and then teach these as part of the common core at an early stage in the curriculum among the lower division courses. PMBOK Guide (2017) consists of ten knowledge areas, and, as we have already seen, many of these knowledge areas are common to OM and IT as well.

## 3. REQUIREMENTS FOR OM, IT AND PM CURRICULA

So what are the requirements for a re-invented curriculum that supports OM, IT and PM? Only the recruiters/employers and former alumni of these programs (these majors) can tell us for sure (Pang *et al*., 2019). These requirements will differ from one program to the next, depending upon the needs of the specific employers recruiting from a program. Below are some qualitative considerations.

### *3.1 Qualitative Assessment: Soft Competencies, Skills*

There is a significant need for teaching the soft skills associated with these majors. OM and IT students need more polish and professionalism in their writing and presentation competencies. They need more understanding of all the soft competencies. Employers want team players who are flexible, good communicators, good problem solvers, have confidence and are creative thinkers (2017 ACM/IEEE Computer Society Guidelines). Soft competencies give us a competitive edge, both personally and corporately.

While universities are well adept to teach IT hard skills, they are often at a loss in teaching or dealing with soft competencies. From an industry hiring perspective, the candidate with stronger soft competencies will likely obtain the position. While colleges and universities can teach courses that will help develop soft competencies, companies are less capable of doing so. However, companies can easily teach or train someone with a missing technical skill. Students and teachers should understand this reality.

Bailey (2014) surveyed more than 300 industry professionals to identify the most important non-technical competencies for success in technical jobs. The ten soft competencies ranked highest were problem-solving, teamwork, listening, the ability to adapt to new technologies and languages, time management, the ability to transfer knowledge to application, multi-tasking, verbal communication, visualize and conceptualize, 'be the customer' mentality (Bailey, 2014). Pang *et al*. (2019) used a questionnaire to sample 289 full-time employees of various organizations regarding hard and soft skills. Of the 26 competencies they considered, the five top competencies were in order of first to fifth: 'ability and willingness to learn,' 'teamwork and cooperation,' 'hard-working and willing to take on extra work,' 'self-control,' and 'analytical thinking' as the top five (Pang *et al*., 2019).

Larson and Gray (2021) referred to soft competencies as the sociocultural dimension of PM and referred to the technical dimension as the 'science' part and the sociocultural dimension as the 'artsy' part. Larson and Gray (2021, p.18) wrote, "to be successful, the project manager must be a master of both." Organizations are looking for the best mix of technical, soft and business skills. The need for these non-technical skills is so great that some IT companies indicate that they will hire individuals with minimum technical skills so long as they demonstrate solid soft and business skills (Bailey, 2014).

### *3.2 OM and IT Courses Involving Hard and Soft Competencies*

Below are the technical courses proposed by the 2017 ACM/IEEE IT Recommended Curriculum. **Table 1** lists the technical courses the ACM/IEEE IT Guidelines 2017 consider important. **Table 2** presents a list of possible upper division technical courses in OM. A study by Akalin *et al*. (2016) indicated that supply chain management (SCM) courses are not replacing OM courses in business school undergraduate curricula, as over 70% of 443 AACSB-accredited business schools offer courses in OM and/or OM and SCM jointly.

**Table 1** Some Technical Course Modules Suggested by ACM/IEEE IT Guidelines 2017

| ACM/IEEE IT Curriculum Guidelines 2017—Proposed Courses | |
|---|---|
| - **Applied Networks and Networking** | - Integrated Systems Technology |
| - **Web and Mobile Systems** | - Cybersecurity Principles |
| - **Information Management** | - Project Management Principles |
| - **Software Fundamentals** | - Cloud Computing |
| - **System Integration and Architecture (4 hours of testing)** | - User Experience Design |
| - **System Administration and Maintenance** | - Data Scalability and Analytics |
| - **Software Development and Management** | - Cybersecurity Evolving Challenges |
| - **Social Responsibility** | - Internet of Things |
| - **Virtual Systems and Services** | - Mobile Applications |
| | - Platform Technologies |

**Table 2** Possible OM Upper Division Specialty Courses

| | |
|---|---|
| - ERP Architectures and Systems | - Procurement and Supplier Management |
| - Forecasting | - Project Management |
| - Information Technology for Supply Chains | - Queueing Models and Systems |
| - Inventory Models and Systems | - Quality Management and Lean Six Sigma |
| - Supply Chain Structure and Resiliency | - Service Management |
| - New Product Development | - Supply Chain Analytics |
| - Operations Management and Health Care | - Sequencing and Scheduling |
| - Operations Management Practicum | - Sourcing and Supply Chains |
| - Operations Research Applied to Operations Management | - Supply Chain and Operations Strategy |
| - Process Design, Selection, Improvement | - Total Quality Management |
| | - Transportation and Logistics Management |

The OM and IT technical courses are complementary and synergistic in that OM majors may be interested in some of the IT courses and vice versa. For example, Ben-Daya *et al*. (2022) and de Vass *et al*. (2021) reported on the impact of the Internet of Things on SCM, an important component of OM. It is well known that for decades, IT has been used to innovate, measure, improve, automate and integrate the processes within OM and SCM.

### *3.3 What Content Would Comprise the Soft Competencies Component of any OM and IT Curriculum?*

Various authors have different ideas about what would constitute 'soft skills.' Larson and Gray (2017, 2021) suggested leadership, problem-solving, teamwork, negotiation, politics and customer expectations as high on the list of important soft competencies. Exhibited in **Table 3a** is a list of important soft competencies found in the ACM/IEEE Curriculum Guidelines (2017). In **Table 3b** is a list of additional soft competencies desirable for OM and IT majors identified by Bailey (2014), as determined from surveys of over 300 IT industry professionals.

**Table 3a** Components of the Soft-Competencies Segment of the Curriculum (ACM/IEEE IT Guidelines: Information Technology Curricula 2017)

| Soft skills (competencies) that employers want—in the order they have prioritized |
|---|
| 1. Acting as a team player—team dynamics, team motivation, team building |
| 2. Flexibility |
| 3. Effective communication—good listener, great presenter |
| 4. Problem-solving and resourcefulness |
| 5. Accepting feedback |
| 6. Confidence |
| 7. Creative thinking |
| Additionally, to delegate, offer effective criticism, have effective interpersonal competencies, could be included. |

Still, the lists in **Table 3a** and **Table 3b** do not come close to an exhaustive list of soft skills/competencies. Missing are emotional intelligence, good interpersonal skills, positive work ethic and attitude, etc. Some scholars have identified a total of more than 30 soft competencies/skills (Bailey, 2014).

**Table 3b** Further Identifying Soft Competencies (Bailey, 2014, p.7)

| Interpersonal Abilities | Personal Attributes |
|---|---|
| - **Listening** | - Optimism |
| - **Understanding self & others** | - Responsibility |
| - **Empathy** | - Sense of humor |
| - **Leadership** | - Integrity |
| - **Negotiation** | - Time management |
| - **Decision-making** | - Motivation |
| - **Ability to teach** | - Common sense |
| - **Works well with diversity** | - Self-esteem |
| - **Managing customer expectations** | - Professionalism |

Voogt and Roblin (2012) compared international frameworks in terms of their recommendations for 21st-century competencies for knowledge workers and found a lot of commonalities. The frameworks converged on a common set of competencies: collaboration, communication,

information and communication technology (ICT) literacy, and social/cultural competencies (including citizenship). Most frameworks also mentioned creativity, critical thinking, productivity, and problem-solving. These competencies are very much in line with the findings in the ACM and IEEE Curriculum Guidelines (2017) and the findings of Bailey (2014).

Referring to soft skills that employers want (**Table 3a**) specifically, we must ask, where in the curriculum do our students receive instruction in acting as a team player, in flexibility, in problem solving and resourcefulness, in confidence and creative thinking? To know that an exercise like what is suggested in the section on 'Transitioning' is needed to give each instructor in the curriculum a holistic view of the total process so each instructor knows how his/her portion of the curriculum fits within the total. Indeed, as we shall see, such an exercise will reveal gaps in the content of the curriculum. This is true even if there are no 'customers' as we have defined them that show up for the exercise. Thus, the exercise to be discussed in the next section (Transitioning to a curriculum…) is useful to the instructors involved even if there are no 'customers' in attendance, especially if there have been many years since such an exercise has taken place. With a culture of cooperation and collegiality in place, instructors will be willing to adjust the content of their courses to include many of the topics mentioned above if it becomes apparent because of the exercise that important topics are missing.

What would a soft-competency-driven curriculum look like? What would comprise a common core for OM and IT Majors? We have proposed in **Figure 1** one of many possible architectures that would provide stronger support for soft skills.

What **Figure 1** suggests is that soft competencies, systems thinking, visioning, learning, lean, problem-solving, ethics, team dynamics, quality issues, basic process concepts, and PM, are all common to either/any of the OM or IT curricula.

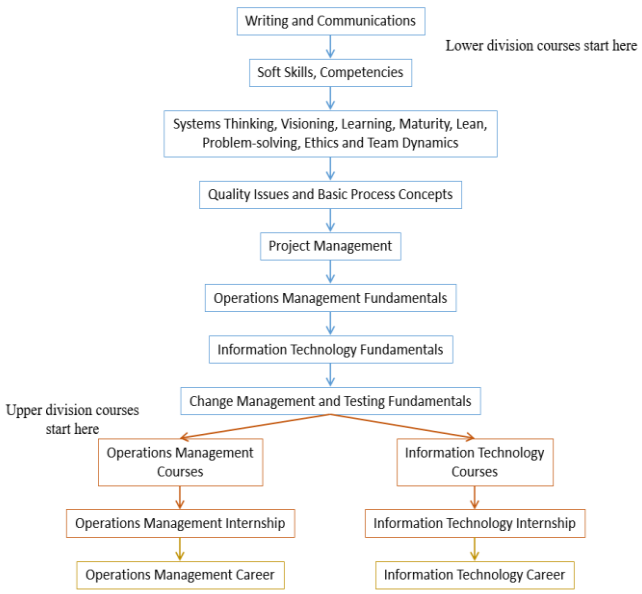


**Figure 1** A Common Core for OM and IT Majors

### *3.4 Transitioning to a Curriculum that is Focused on the Needs of Corporate Employers*

Madan and Gnanendron (2020) created a data-driven approach to curriculum design and course planning that uses enrollment data along with PM methodology. According to Huizinga *et al*. (2014), teachers lacked curriculum design expertise. By providing tailored support to teachers, the design process and the quality of the resultant design materials are expected to improve (Huizinga *et al*., 2014). Moreover, Toor *et al*. (2020) reported that medical school faculty lack training in how to develop curricula. Consistent with prior national data, they learned that almost all faculty lacked exposure to formal training in curriculum development. As alluded to earlier, Fadel *et al*. (2015) made a strong case for relevance in the curriculum. The only way to get relevance in the curriculum is to listen to the employers who hire our students and to listen to former students who have been through the curriculum. We propose a curriculum design method that requires participation from employers and former students. Given our own experience in leading change management relative to curricula, we suggest the following methodology.

Step 1: Identify who your main recruiters and employers (industrial partners) are. Employers are arguably the primary experts on what competencies are most needed in the workplace (Pang *et al*., 2019). These people can tell you what your 'product' should possess in terms of skills and competencies. As educators, we should understand there are many other components to our customer base—students, parents, the community at large, etc. But primarily, it is employers/recruiters who can tell us what they want in a recruit. It is also alumni who have 'walked through' the entire curriculum, are products of it and have experienced the applicability of what they learned. There are at least two different alumni perspectives that would be useful here. Alumni who have been out of the program for just two years will have a short-term perspective. Alumni who have been out of the program for ten or more years will bring a longer-term perspective. These alumni hold positions in the industry as managers/professionals in PM, OM, or IT.

Step 2: Invite the employers/recruiters and alumni to a day-long advisory board meeting on campus. Alumni are often quite willing to participate and 'give-back' to their alma mater. They will be recognized as official Advisory Board members and will receive certificates of board membership and appreciation at the conclusion of the day. We want the participants to have a sense of ownership in the curriculum. The best time to do this is late in the spring semester, on Dead Day. Do this on Dead Day so all of your teachers, instructors, lecturers and professors who teach in the OM/IT curricula can attend as well. For employers/recruiters and alumni that cannot attend, make the meeting available for them to watch online.

Step 3: Invite all the course teachers, instructors, lecturers and professors teaching within the OM and IT curricula and have each of them discuss/present (one by one) the content of their courses. You will be amazed to learn what your colleagues are teaching to the students! You may even see where there is redundancy or where omissions occur despite what the course descriptions say. Opportunities for closer

coordination and collaboration will emerge. If this were the only result of such a course content expose, it would be well worth the effort.

Step 4: Break the day up into workshops sessions. You can review the lower division courses in the morning and the upper division courses in the afternoon, for example.

Step 5: Review the entire curriculum with the recruiters/employers and course instructors. Each lecturer, each instructor, and each professor will give a 10-minute synopsis of the content of each course they teach in the curriculum. Get the recruiters/employers to suggest courses that are not in the curriculum with a view to future knowledge and competency needs.

Step 6: Have the recruiters/employers fill out a questionnaire after every session. Immediately after each presentation, the recruiters/employers should grade each course in terms of their perception of value added on a scale of 0 to 100. Have them comment on the appropriateness of each course and how its content could be made more relevant.

Step 7: At the end of the day, the recruiters/employers will have a holistic view of the entire curriculum and proposed courses. Have them regrade every course in terms of value-added--every course already in the curriculum as well as every course contemplated. Have them do this with a view to both the present and the future—two-to-five years out. From the data collected, calculate an aggregate scalar grade or value for each course. A Delphi technique could be applied here in which employers/participants grade every course, see the results in aggregate, and then regrade as necessary to come to a consensus. Alternatively, a survey instrument can be developed and transmitted to selected employers/participants who could not attend the day-long session, enabling every course in the curriculum to be evaluated and graded by as many stakeholders as possible. Following Nordin and Sundberg (2018), the traditional question in curriculum theory has been what knowledge is of the most worth. Step 7 will answer that question.

Step 8: It will then be up to the curriculum designers to decide what content gets included and what content gets excluded. This problem can be solved as an integer programming model in which the sequencing of courses and other requirements become constraints. The value-added or overall grade associated with each course is determined by the employers/recruiters and former students. The objective function coefficient used with each course decision variable is determined by the overall grade derived from the employers/participants. Each decision variable is itself a binary variable where a value of one means the course gets included, and a value of zero indicates the optimization algorithm did not choose the associated course to be a part of the curriculum. Prerequisite constraints, as well as other restrictions and requirements, can be included within the model. Minimum and maximum student credit hour constraints could also be easily included. Such models can be terrific aids to curriculum design, but the ultimate decisions rest with the curriculum designers.

This exercise is precisely what the 2017 ACM/IEEE Curriculum guidelines call for. Information that is crucial to the many decisions about what to include and what to exclude from the curriculum will be forthcoming from the model, but the users of the model (the curriculum designers) have the final say.

### *3.5 Expected Impediments/Obstacles*

There are plenty of impediments to changes proposed to an existing curriculum. It means some instructors must do new lesson plans for new content: new class schedules and syllabi, new tests, new lecture materials, new PowerPoints, etc.—the list goes on. Besides, all change is psychologically resisted. Many business school cultures do not reward people who invest time and effort in changes to the curriculum. Faculty are rewarded for their research, their teaching and their service. Changes to the curriculum are included within the teaching or service categories in terms of merit, but after teacher evaluations (and research), in importance, if such changes get any consideration at all. Each faculty member has control of the content within the courses s/he teaches nothing else. Coordination with other faculty members teaching within the same curriculum is voluntary. Many faculty members are too engaged in their research and their classes. Perhaps, no one has the big picture; no one takes the holistic view, and no one is the designated champion (owner) of the process known as the curriculum. The curriculum is the process by which we add value to our product. Barnett *et al*. (2001), for example, asserted that the curriculum remains one of the most important products that higher education offers to society at large.

As stated elsewhere, many states also impose a maximum credit hour limitation for undergraduate degrees (Brint *et al*., 2009) at their respective state-supported universities. Most states limit the number of semester hours within any given major for which they will pay a portion of the tuition to something like 120 or 126 semester hours. What this means is if a new course is to be included, an existing course must be removed. Otherwise, the student pays much higher tuition for credit hours taken over the limit.

Still other limitations are the many undergraduate courses mandated by states. For example, the State of Texas has the following mandated curriculum requirements shown in **Table 4**.

**Table 4** Components and Requirements of the Core Curriculum for All College Graduates in Texas (Beginning Fall 2014).

| Transcript Code | Component Area | Required Semester Credit Hours (SCH) |
|---|---|---|
| 010 | Communication | 6 SCH |
| 020 | Mathematics | 3 SCH |
| 030 | Life and Physical Science | 6 SCH |
| 040 | Language, Philosophy and Culture | 3 SCH |
| 050 | Creative Arts | 3 SCH |
| 060 | American History | 6 SCH |
| 070 | Government/Political Science | 6 SCH |
| 080 | Social and Behavioral Sciences | 3 SCH |
| 090 | Component Area Option | 6 SCH |

Source: Texas Higher Education Coordinating Board (2019)

This reduces by 42 the number of Semester Credit Hours (SCH) available to teach the major. Many students regard these mandated courses as a waste of time because the

courses lack relevance to their major and/or the courses are redundant with courses they have taken in high school.

Thus, curriculum design has been likened to that of filling a knapsack because there is only so much volume and weight in a knapsack. If one new course becomes a part of the curriculum, another (with a low valuation or grade) has to go out. By way of implication, this means an optimization model, specifically a mathematical (integer) programming model, can be formulated and solved for an optimal solution, as previously mentioned in Step 8. The constraints will bring into the formulation hard and fast requirements as well as the sequencing of the courses. Giving consideration to all the complexity entailed, an optimal solution is not likely to be one that can be 'eyeballed', i.e., one that can be determined visually and manually. Given the constraints involved, it may not be possible to get all of this content into the undergraduate OM and IT curricula, so that brings attention to our suppliers, the high schools. Could they possibly help? This is the subject of the next section.

### *3.6 Using the Supply Chain Paradigm*

In addition to collaborating with our customers (recruiters/employers), we should be collaborating and communicating more closely with our suppliers (high schools). Deming and Walton (1988) suggested only a few suppliers and a close relationship with them. We may never get to only a few suppliers, but we can certainly work more closely with a few of the many high schools we receive students from. When working with only a few high schools, it is possible to build learning relationships with them in which new and innovative high school curricula are tried. The main benefit of having strong, reciprocal supplier relationships with our high schools is getting better-prepared students.

Much of the lower-division undergraduate curriculum may be a repeat of what is already done in many high schools. According to the College Board (2014), the number of advanced placement credits awarded to high school graduates doubled between 2003 and 2013, a trend likely to continue. A survey of 289 undergraduates taken by the authors of this paper in OM and PM classes revealed that nearly 83% felt there was at least some overlap and redundancy in the lower division classes vis-a-vis the high school classes. However, even more, startling was the variance in the responses. Some 17% felt there was no overlap at all, 55% felt there was some overlap, 22% felt there was significant overlap, and 6% felt there was very frequent and substantial overlap. There is a very high degree of variability in the incoming knowledge content of the product (the students) coming out of our high schools. Some students have seen much of the lower division content through advanced placement (AP) courses but, for whatever reason, are not allowed to test out of those courses with College Level Examination Program (CLEP) exams. Meanwhile, other students saw no overlap at all. We should be doing better at eliminating this form of redundant waste by allowing students to 'skip' out of certain courses but then putting them into more advanced courses. This is where the concept of MC (Hanna and Barman, 2014) can play an important role. Each student pursues a curriculum that is uniquely suited to him or her based on their proposed major, their high school grade transcripts and the competency testing they may have taken.

Likewise, some students saw significant overlap, repetitiveness, and redundancy among the courses they took at just the undergraduate level. Over half of the surveyed students indicated there was at least some overlap and redundancy between and among the college courses they took as lower-division undergraduates. This is, again, another form of redundant waste that can be removed by better coordination among instructors and the courses they teach. Thus, this is another reason for having a day set aside for a course content expose.

Many students saw no relevance to their career goals of some lower division courses they were required to take. Electives in the arts and sciences were frequently marked as a 'waste of time.' Courses in history and English were perceived as redundant with courses they had previously taken in high school but were also perceived as irrelevant to their business curricula and overall career objectives.

In the business world, rather than invest in assets (both fixed and variable), many firms have found ways to use the assets of suppliers through outsourcing, subcontracting, and resource sharing. This creates a supply chain that reduces the financial risk of any one firm. Perhaps, such a strategy could be employed by higher education as well through the utilization of assets in high schools and junior colleges.

Following Deming and Walton (1988), we should select only a few high schools while continuing to accept qualified students from all high schools. We should build learning relationships with the selected high schools in which pilot experiments are tried, measuring before and afterwards to ascertain whether the pilot was successful or not. For successful pilots, we might consider endeavouring to institutionalize across all our high school suppliers. Such an approach would be consistent with the AACSB concept of CI. Finally, we envision an academic supply chain that goes from an AS-IS state to a TO-BE state like the one shown in **Figure 2** below.

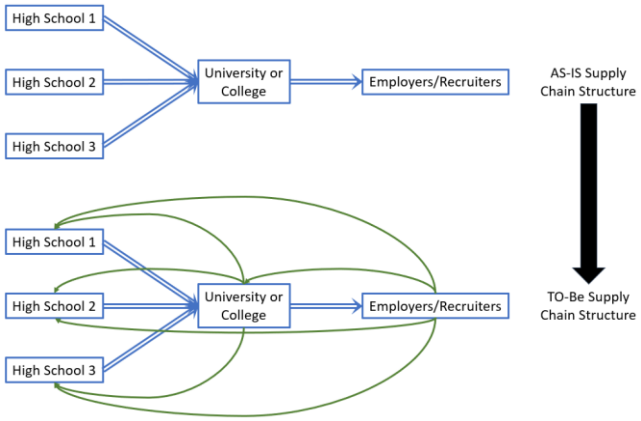


**Figure 2** Moving to a Collaborative/Communicative Academic Supply Chain Structure

As can be seen in **Figure 2**, the opportunities for increased channels of feedback and communication are substantial. The blue double lines are flows of students moving left-to-right. This is what exists, currently. The green lines moving right-to-left are information feedbacks. This is what should exist in the future.

# 4. DISCUSSION

This article is about taking a holistic view of our OM and IT curricula. It is about being customer-focused and stakeholder-driven. Delivering a product that more appropriately meets the needs of the industrial marketplace while eliminating waste, repetitiveness is one focus of this paper. This article is about integration, creativity, collaboration, cooperation, and communication among all of the constituencies and stakeholders. It is about putting in place a process for curriculum design and improvement of OM and IT curricula leading to CI. It is not about prognosticating 'one-size fits all' curricula for majors in OM and IT.

First, a merit system that rewards contributions to the curriculum are needed. Such a system does not have to interfere with the traditional merit system already in place. The basic idea here is not to take any merit away from the traditional values of research and teaching but to raise the incentive for faculty to be more focused on the very process that adds value to our students. A startling discovery alluded to by Voogt and Roblin (2012) was that educators do not seem to be very interested in 21st-century competencies. Such a small culture change might be a great motivator that will encourage OM and IT faculty to develop more of a concentration on OM and IT curricula.

Second, the one-size fits all mentality needs to be shredded. Universities that are located in heavy manufacturing areas would need to focus more on the needs of those employers, whereas most OM curricula would be focused on services. Likewise, the 'finishing touches' of any OM and IT curriculum need to be more focused on the needs of the specific employers and recruiters who hire those same OM and IT majors.

Third, consideration should be given to the formal definition of knowledge areas within OM and IT so as to structure them after the way the Project Management Institute structures its Body of Knowledge, known as the PMBOK Guide. When we look at PMBOK Guide (2017), we see knowledge areas that are common to OM and IT. Part of the reason for this is the way the white-collar work in OM and IT gets done…in projects. We should teach PM concepts before getting into the core of the OM and IT curricula. Project concepts are the big-picture view of what life as an OM or IT professional is like. Teaching this first helps the student to understand how the details fit within that larger context. If we teach the PMBOK Guide (2017) concepts first, we don't have to teach our OM, and IT majors about scope, time (schedule), cost and quality again. Likewise, we may not have to teach our OM, and IT majors about stakeholders, procurement, risk, communications and human resources again. Those concepts already would have been covered in the PM course, which is the proper context for such content. Thus, a constructivist pedagogy may be used in which student learning is built upon the knowledge areas created within PMBOK Guide (2017). One result of this approach is less redundancy in course content within the curriculum, leaving more room for more content that has not been covered.

PMBOK Guide's (2017) way of identifying and documenting knowledge areas as collections of processes creates chunks of knowledge that can be individually addressed. This structure allows us to see more clearly the overlap between knowledge areas in PM as compared with knowledge areas within OM and IT. Processes can be established for each and every knowledge area in OM and IT just as they have been within PM.

Fourth, more consideration should be given to soft competencies and how to develop these. Currently, OM and IT curricula teach oral and writing communication competencies in the lower division courses. These and other lower division courses should have their content expanded to cover more of the soft competencies, like learning how to learn faster, collaborating/cooperating as a team player, being proactive/taking the initiative, negotiation, problem-solving and so forth.

# 5. CONCLUSION

At times it seems like we cannot get this done; there are just not enough credit hours to work with, given the credit hour limitations that we have. Those who teach the writing and communications courses will say the courses are already full of content; there is no room for more material in those courses. Some, however, feel that much of what we do in the first year of our four-year curriculum is redundant with what has been covered already in high schools. The concepts of lean systems would suggest that this redundancy is a waste. This raises a huge question: Are we coordinating and collaborating with our suppliers and the high schools? We should not expect the students to complain about redundant college course content that they had already mastered in high school—this is an easy course for them. However, perhaps, we should work with our suppliers, the high schools, to do things differently, so the students can get more of the soft competencies and technical skills included within their majors—at the high school level. Just as in any supply chain, the manufacturers work with their suppliers, indeed even certifying them. This enables them to ship a better-quality product to us, their customer. Often, we hear complaints to the effect that the high schools did not do a good enough job, so we have to cover and teach the material again. This is inconsistent with the concept of a certified supplier.

What was presented here can help prevent disruptive innovation (Behara and Davis, 2015) from having a deleterious impact on the non-differentiated programs in our state-supported HEIs. Also, the methodology presented solves the problem (Behara and Davis, 2015) of not having an integrated curriculum involving the liberal soft-skills lower-division courses and the discipline-specific upper-division technical courses that comprise the undergraduate business curriculum

It is apparent that there are a lot of opportunities to get improvements in our OM and IT curricula. We must be willing to try, test and measure/assess new and innovative approaches, with the help of industry, and to institutionalize where possible. It's Deming's (Deming and Walton, 1998) PDCA wheel again and again.

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