Some Educational Issues in Operations Management and Service Systems

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Abstract--**The aim in this paper is to explore how the educational and research issues are handled in operations management and service systems in industrial engineering programs in major Turkish universities. Firstly, a review of the recent developments in the area is given. Based on this review, the performance of industrial engineering departments in major Turkish universities is assessed. The study identifies the strengths and weaknesses of the programs under study in this particular area. The paper also includes some suggestions for operations management education.**

I. INTRODUCTION

The fast changes in markets have been forcing companies to change the way operations are managed, both in manufacturing and service organizations. Globalization of the market, extensive use of information technology and information systems (IT/IS) has significantly altered the way operations management (OM) strategies, techniques, and technologies employed. Increasing importance of environmental and safety concerns, and outsourcing in managing operations have also been urging companies to update their approach to OM. Nowadays, manufacturing is seen as more of a service activity, while characteristics of service industries are changing rapidly with globalization. Furthermore, manufacturing appears to be a more investment-driven and innovation-driven industry, making service industry to play a more important role in the knowledge economy [5]. Also, a large number of studies suggest that virtual manufacturing is the way to go for the factory of the future.

It appears that the OM field evolved intellectually over the last decades, as reported by Pilkington and Meredith [18]; apparently there are more studies on strategic and macro topics rather than narrow and tactical topics. The authors also suggest that MS/OR methodology does not define the OM field any longer, and that OM is becoming a functional field of management. The recent approaches to OM in the academic world tend to view OM within a supply chain framework [9], [17] and [8]. Supply chains are systems that continuously evolve and adapt, driven by complex socio-technical interactions. Traditional approaches tend to focus mainly on technical issues and ignore the complexities involved in such systems. Systems approach to complex systems, such as supply chains, promises a greater potential in the design and operation of supply chains. For instance, Bellamy and Basole [1] view supply chains as complex networks and treat them as such. A similar study was reported by Li, Yang, et.al. [12] where the evolutionary complexity of a supply chain is seen as complex adaptive supply network. Simulation studies show that the evolutionary complexities such as emergence, quasi-equilibrium, chaos, and lock-in of complex adaptive networks can be represented relatively more realistically.

Developments in IT, globalization of markets, decentralization of operations, and environmental problems seem to be driving factors in the change to OM. In turn, the educational objectives, curricula and training need to change accordingly. As OM has evolved from mass production to mass customization, creating a significant change in OM paradigm, companies were urged to implement new operations strategies, techniques, and technologies to compete in the global market. These new approaches include just-in-time (JIT) strategy, total quality management(TQM), flexible manufacturing systems (FMS),computer-integrated manufacturing (CIM), agile manufacturing (AM), lean production (LP), business process reengineering (BPR), quick response manufacturing (QRM), and supply chain management (SCM) [5]. Furthermore, the Internet has been introducing new dimensions in the way companies operate and function in terms of acquiring resources and meeting customer expectations in the last decade or so. The question to be answered now is whether traditional OM principles and techniques, such as strategic planning, scheduling, inventory and quality control, etc. will be handled in the new enterprise environment where there are new concepts such as supply chain management (SCM), enterprise resource planning (ERP), customer relationship management (CRM), knowledge management, the Internet, outsourcing and third-party logistics (3PL), etc. This question is of course directly related to how OM should be taught at the university level.

The subject matter of this paper is the way OM is thought in industrial engineering departments in major Turkish universities. As far as the authors know, there are no specific studies on this topic. There are, however, quite a number of studies conducted on industrial engineering education, in general, including [10], [3] and [2]. The reader will find some analysis of the OM area in Lope et. al. [2].

The plan of the paper is as follows: the recent developments in OM are reviewed in the next section. This is followed by an analysis of how OM is handled in the industrial engineering curricula of six major Turkish universities, and the main findings of the work. The last two sections cover some suggestions for improvement in teaching OM, and the conclusions of the work, respectively.

II. RECENT DEVELOPMENTS IN OPERATION MANAGEMENT

Operations management (OM) can be viewed as a complex system made up of many different subsystems. The major subsystems or problem areas in OM can be listed as follows: Strategy Development; Design and Integration of Supply Chains; Planning Capacity; Locating and Designing Facilities; Analyzing and Designing Processes; Production and Inventory Management; Planning and Scheduling Operations; Project Management.

Design, installation, operation and maintenance of such complex systems may be viewed as socio-technical systems or socio-technical constructs. In general, industrial systems or organizations of modern society are complex and dynamic sociotechnical systems (STS); they have multiple interacting parties and multiple goals. They contain uncertainties in relation to complex technology and the environment that are tightly-coupled. Most of these systems are highly complex, uniquely dynamic, and have to exist in a constantly changing environment; they must adapt to this change rather quickly. The daily activity and strategic control and steering of these systems or organizations are based on partly implicit norms, values and conceptions. Hence, control and management of such systems are far more difficult than controlling physical systems [24].

It is important to recognize the recent internationalization of OM. With multinational corporations and other international agencies making new investments throughout the world, initiating start-ups, entering into joint ventures, or acquiring existing organizations, operations are becoming more internationalized. These developments create new questions on how technology transfer will take place and how the resulting global supply chains will be managed [19]. Hence, it is becoming more important to teach international aspects of OM, paying specific attention to cultural diversity and ethics.

The question of teaching OM is obviously related to education of engineering and management. Wei [25] points out that engineering education has traditionally concentrated on preparing students for professional careers in manufacturing and construction, and suggests that the engineering curricula has to be redesigned with strong links to service sector. Similar ideas are expressed by Sunthonkanokpong [23]. He thinks that the roles of engineers must change along with the changes in the socio-technical aspects of work. He also identifies the following issues in his study: the globalization of industry and engineering practice; the shift of engineering employment from large companies to small and medium-sized companies; the growing emphasis on entrepreneurialism; the growing share of engineering employment in nontraditional, less technical engineering work; the shift to a knowledge-based "services" economy; increasing opportunity for using technology in the education and work of engineering. In addition, he argues that the following engineering skills will be required in the future: lifelong learning; ability to frame problems and putting them in a socio-technical and operational context; being dynamic/agile/resilient/flexible; having high ethical standards and a strong sense of professionalism; good communication skills with multiple stakeholders; possessing strong analytical skills; exhibiting practical ingenuity; possessing creativity, and business and management skills; leadership abilities; developing strategic alliances based on core competencies; leveraging the role of information technology and systems; having a global perspective.

In the past, Meredith [15] suggested that OM needs to incorporate IS tools into resource management, strategy, international, quality, project management, innovation, supply chain, technology management, and so on. It does not appear that this suggestion has been adopted, at least not explicitly. It may be a good idea to bring this discussion back since the suggestion may help teaching OM in a more integrated manner. Most studies on OM tend to cover the topic in general, without separating manufacturing and services. One interesting study on Service Operations Management (SOM) was reported by Machuca et.al. [14]. They examine the relative importance and nature of research on SOM, confirming the fact there is more research done on strategic issues than on tactical/operational issues. They state that models and simulations are still more common methods used, as compared to empirical research. However, they think that the trend seems to be shifting to the latter. Although these results suggest that more emphasis may be put on SOM topics and to empirical methods in teaching, further research needs to be conducted to be sure that this trend is still there.

The above short survey provides some clues for trends in OM education, but they are weak and insufficient. It is hoped that studies like the present one will increase in number of studies and generate more reliable information for updating educational strategies in OM.

III. METHODOLOGY

This paper is an exploratory study about how the educational issues are handled in OM and service systems in industrial engineering programs of six major Turkish universities. The study consists of two phases: data collection and analysis. Data collection is based on two sources: i) the knowledge areas included in the field of OM, and; ii) information found on the web sites of the corresponding IE programs.

In the first step of the data collection and analysis, the literature on the development of OM in terms of education and research is analyzed. Specifically, the current knowledge areas which are included in OM, from both goods and service production perspectives, are surveyed. The literature has revealed that most of the knowledge areas are common across the various sources; they are not viewed separately as goods and service production [16], [20]. As a result, the following 17 knowledge areas are identified:

- Capacity planning

- Inventory management and control
- Product design
- Aggregate planning
- Scheduling (machine & staff)
- Maintenance and reliability
- Quality engineering and management
- Distribution (Transportation)
- Process design
- Project management and control
- Facilities location
- Facilities layout
- Forecasting
- Purchasing
- Work systems analysis & design
- Strategy development in OM
- Marketing, demand management & sales

In the second step of data collection, the websites of the undergraduate IE programs of the six universities are analyzed in detail to determine the compulsory and elective courses that correspond to the above knowledge areas [26]-[31]. The undergraduate curricula and course descriptions are used as the source of data for determining the OM-related courses. In the second phase of the study, the data are reviewed, based on the predetermined OM knowledge areas. The performance of the selected IE programs are then reviewed and compared on the basis of course credit hours. Finally, the strengths and weaknesses of the programs are determined, leading to some recommendations for improvement.

IV. OPERATION MANAGEMENT EDUCATION IN THE INDUSTRIAL ENGINEERING PROGRAMS OF SIX MAJOR TURKISH UNIVERSITIES

In this section, the undergraduate IE programs of the six universities, namely Middle East Technical University (METU), Bilkent University, Bogazici University (BOUN), Istanbul Technical University (ITU), Sabanci University and Koc University, are reviewed in terms of their emphasis on OM education. All of the selected IE programs consist of eight semesters and their total credits range from 125 to 153 credit hours. The graph in Fig. 1 indicates that IE programs in ITU and Sabanci has the maximum and minimum total credits, respectively.

In this review, the compulsory OM-related courses and elective OM-related courses are analyzed separately. The compulsory OM-related courses represent the minimum OM-related topics covered in an IE program. On average, the percentage of compulsory OM-related courses in total credits is 7.06% for the selected IE programs. The graph in Fig. 2 indicates that IE program at METU offers the highest percentage of compulsory OM-related courses in the total credits, whereas the program at Sabanci University does not offer any compulsory OM-related courses. The case of Sabanci can be justified by the curricular flexibility of the IE program since it is consisted of zero compulsory courses, three core electives, five departmental electives and three unrestricted electives.

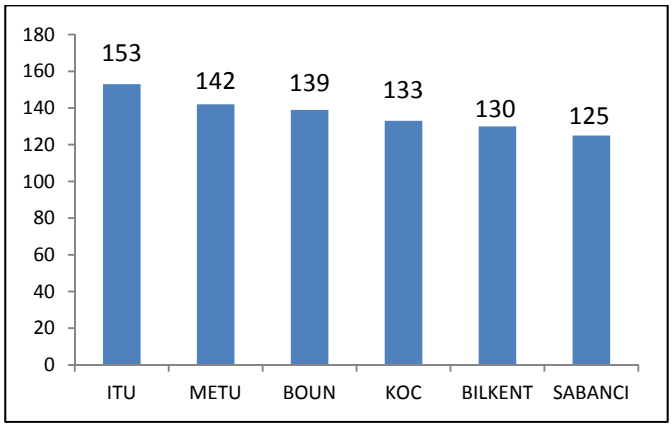

Fig. 1. Total credits required for undergraduate degree in six major IE programs in Turkey

The second part of the review is related to elective courses offered in the IE programs. Although some of the elective course options may not be opened due to insufficient demand, they still represent a conception of the extent to which students may excel at OM knowledge areas. Thus, for each IE program, the OM-related elective course options offered by the IE department and other departments are analyzed. Since the elective courses offered in six universities are all three credit hours, the count of the elective course options have been analyzed instead of the credit hours. The graph in Fig. 3 indicates that Bilkent and METU IE departments offer the highest number of OM-related elective course options. ITU and Sabanci IE departments both offer nine elective course options. KOC and BOUN IE departments are obviously the weakest of the six since both offer six OM-related elective course options.

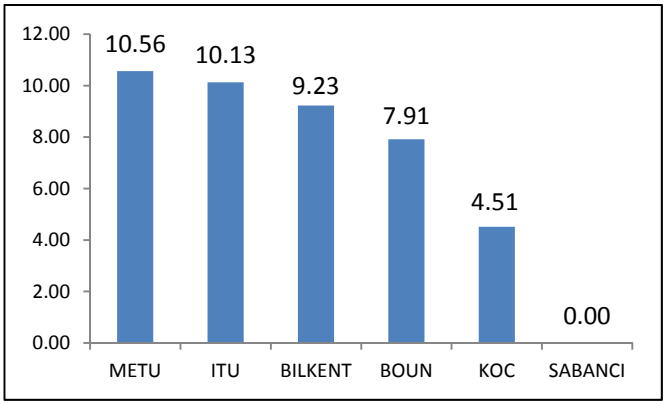

Fig. 2. Percentage of compulsory OM courses in total credits in the programs

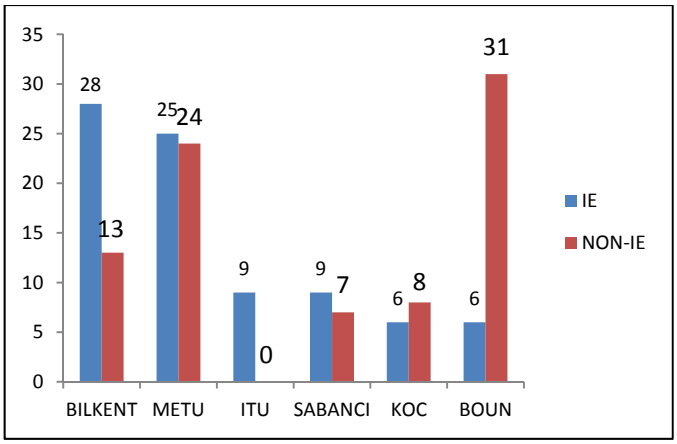

Fig. 3. Count of elective OM course options offered by IE and Non-IE departments

Based on the elective OM-related courses offered by other departments to IE students, BOUN IE program is stronger than the remaining five IE programs. METU ranks the second with 24 OM-related courses offered by other departments in the university. However, there is a big gap between these two IE programs and the remaining four as shown in Fig. 3. Especially, ITU has the worst performance since the program does not include any free, unrestricted or non-technical electives from other departments in the university.

The credits of compulsory OM-related courses represent the minimum level of education in OM knowledge areas. The maximum level of education in OM knowledge areas is computed as the total credits of OM-related courses that may be taken by a student if he/she takes all elective courses from OM-related options, in addition to the compulsory OM-related courses. In Fig. 4, the performance of the six programs in terms of maximum and minimum level of OM education is depicted. The average of minimum and maximum level of OM education is 9.92 and 33.42 credits for the reviewed IE programs. Fig. 4 indicates that the program at ITU offers the maximum level of education in OM knowledge areas. The ITU program also has the highest minimum level of OM education. Thus, the ITU program obviously has the best performance in OM education. The Bilkent program is the second best with respect to the maximum level of education; it is the third best program with respect to minimum level of OM-education.

The programs of KOC and Sabanci University are ranked third with respect to maximum level of OM education. However, the same programs are also ranked fifth and sixth with respect to minimum level of OM education, due to the lack of compulsory OM-related courses. Therefore, if the majority of students do not select OM-related elective courses, the overall performance of their students in OM knowledge areas may be considerably low. Increasing the number of OM-related compulsory courses will improve the average level of education in OM-related knowledge areas irrespective of students' choices.

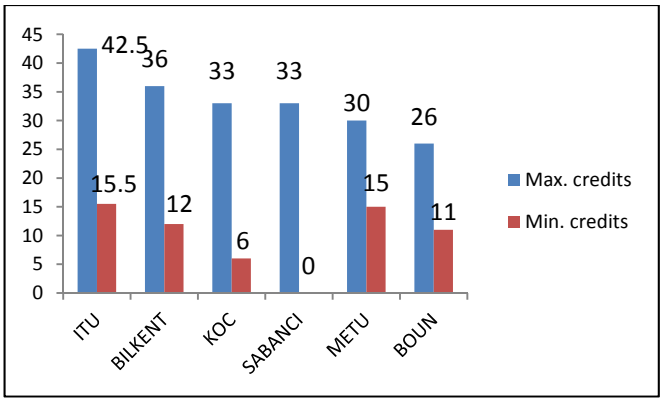

Fig. 4. Minimum and maximum level of education in OM knowledge areas

METU is ranked the fourth in terms of the maximum level of education in OM knowledge areas, and it is slightly lower than the average of the reviewed IE programs. However, the minimum level of OM education in METU IE program is approximately the same with ITU. Therefore, students in METU IE program are well-educated in OM knowledge areas due to the compulsory courses in the curriculum.

BOUN has the worst performance in terms of maximum level of OM education. However, with respect to the minimum level of OM-education, its performance is slightly worse compared to Bilkent. Since the minimum level of OM education is above the average of the reviewed programs', it can be concluded that the compulsory courses are not the main problematic area. Thus, the IE program at BOUN may be improved by increasing the number of complementary courses in the IE curriculum, or offering more OM-related course options as departmental electives.

The percentages of OM-related courses in the IE curricula are shown in Fig. 5. They indicate that the ranking of the IE programs with respect to the percentages of maximum level of OM education is the same as the ranking in Fig. 4, with only one exception: if a particular student at Sabanci selects all OM-related course options, the total OM-related courses will constitute 26.40% of his/her total credits. This is slightly more than the total credits seen at Koc University under the same conditions.

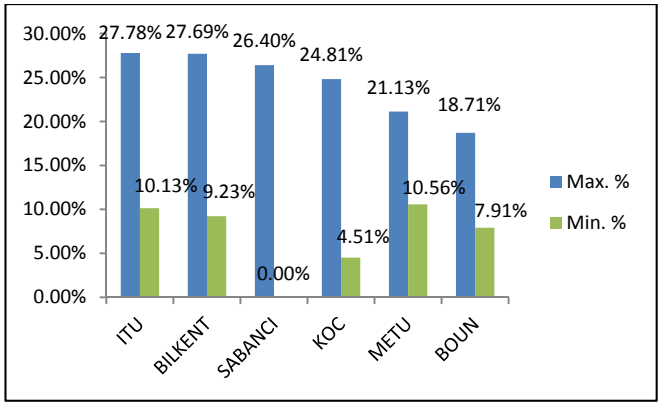

Fig. 5. Percentages of OM-related course credits in the curricula

The average of percentages of minimum and maximum level of OM education is 7.06% and 24.42% for the reviewed IE programs, respectively. Fig. 5 indicates that Sabanci has the lowest percentage of OM-related compulsory courses. Thus, the students of Sabanci IE program should be advised to take OM-related electives in order to close this gap. Similar case is also valid for the students of the Koc program.

The minimum level of OM education at BOUN IE program constitutes 7.91% of the total credits, which is slightly better than the average of the six programs. However, because of the limited number of OM-related options for specialization courses and departmental electives, the maximum level of OM education constitutes 18.71% of the total credits. This is the worst performance among the reviewed IE programs.

The ITU program has the highest percentage of maximum OM education level. It performs slightly better than Bilkent, considering the ranges of their OM-education levels. Although the METU program performs better than the remaining five programs with respect to the minimum level of OM education, its range of OM-education level is much lower compared to the programs at ITU and Bilkent. This reveals that the students of the METU program are well-educated in OM knowledge areas due to the high percentage of compulsory courses rather than their personal interests; the credits of OM-related elective courses in the curriculum may be at most15 (four technical electives and one free elective).

The contents of the compulsory and elective OM-related courses were also analyzed to determine the level of emphasis on traditional and modern topics. This analysis shows that majority of the courses are on the traditional topics of OM; and only a few courses are offered on modern or non-traditional topics. Among the six IE programs, KOC has the best performance with 3 courses in non-traditional or modern OM topics such as humanitarian logistics, CRM and e-commerce management. The two non-traditional OM courses offered in METU are on university management and industrial clusters. Similar to KOC, Bilkent also offers a course on humanitarian logistics and ITU offers a course on competition management. BOUN and Sabanci do not offer any course in non-traditional or modern OM topics.

V. SERVICE OPERATIONS MANAGEMENT EDUCATION IN THE REVIEWED INDUSTRIAL ENGINEERING PROGRAMS

The final analysis in this paper is related to the level of emphasis of OM in service systems in the programs. As mentioned before, the generic OM-related courses do not make a distinction between manufacturing and service systems. However, most of these courses, especially those offered by IE departments are generally taught in the context of manufacturing systems. The analysis of the reviewed IE curricula shows that none of the IE programs include compulsory courses focused specifically on SOM. Thus, the students' education in SOM-related topics is limited with the emphasis given in the generic OM-related courses, and their own preferences in elective courses. The maximum credits of SOM-specific courses are determined by looking at the SOM-related elective courses, and the percentages are shown in Fig. 6.

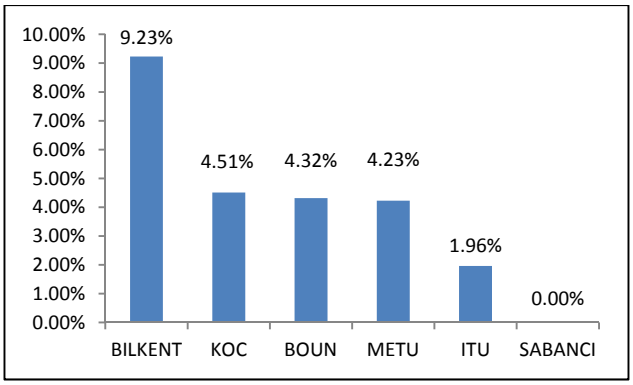

Fig. 6. Percentages of SOM-specific courses' credits in the curricula

Fig. 6 indicates that Bilkent IE students may take up to 9.23 per cent of the total credits in SOM-specific courses, which is obviously the best performance in this respect. There is a considerable gap between the Bilkent program and the remaining five programs. Koc, BOUN and METU programs follow Bilkent IE program with similar performance levels. The ITU program is ranked the fifth with 1.96 per cent, and Sabanci has the worst performance since SOM-specific compulsory courses or elective course options do not exist.

VI. SOME SUGGESTIONS FOR EFFECTIVE TEACHING OF THE SUBJECT

Some weaknesses and strengths of the six industrial engineering programs are discussed in the previous section. There are, however, some common elements that seem to be missing or weak in these programs: it is the coverage of "the contemporary issues". These issues can be classified as "approaching OM in a holistic manner", and "OM in the era of globalization".

As mentioned earlier, the recent approaches to OM tend to treat the subject matter in a supply chain framework. This is obviously quite a holistic treatment. Students see the big picture first, with the relevant subsystems and their interactions. They then study individual subsystems and their interactions in more detail. This helps them to relate consequences of certain decision taken at the system or subsystem levels for the overall system. The authors believe that this macro-to micro approach to teaching is more effective than micro-to-macro approach. However, this alone does not appear to be sufficient. The subject matter can be taught more effectively if curriculum is supported by a course or courses on "System Thinking" and "Applied Systems Approaches". Here, students should learn the fundamental concepts of systems thinking, and get exposed to a critical review of some system methodologies. They need to be

equipped with such tools in order to be able to deal with the complexities they will face in their professional lives. Experiences of the authors show that graduates feel uneasy with ill-defined problem or complex systems. Significant advances in systems thinking has been taking place in the last decade or so, producing a large variety of methodologies suitable for the analysis and design of complex systems. There are many books and publications available to be used as references in the context of OM. For instance, the two books by Jackson, titled as Systems Approaches to Management [6] and Systems Thinking: Creative Holism for Managers [7], give quite a comprehensive view of the areas mentioned to "beginners".

The interested reader may also want to look at some applications in order to appreciate the value of having a background on systems thinking and system methodologies. For instance, there are quite interesting applications of System Dynamics Methodology to a large variety of situations where "hard" and "soft" systems approaches are used together [13]. Another example can be found in the work reported by Small and Wainright [22]. They employed 'soft' OR theory to iteratively develop a new framework that encompasses problem structuring through to technology selection and adoption. In addition, Soft Systems Methodology (SSM) was used for problem exploration and structuring, learning theories and methods for problem diagnosis, and technology management for selecting between alternatives and implementing the solution. Also, the use of multi-methodological approach to complex systems is well demonstrated by Giacomo and Patrizi [4]. They discuss the characteristics of different management methodologies, and explain how the most appropriate methodologies can be chosen to develop accurate plans in a supply chain.

The other contemporary issues are related to globalization. As mentioned before, these topics are becoming very important in OM literature. For instance, two of the textbooks that cover these issues in a satisfactory manner are Management by Stephen P. Robbins [21] and Management Information Systems by Kenneth C. Laudon and Jane P. Laudon [11]. Topics such as Global Management, Global Environment, Managing Diversity in Work Force, Social Responsibility and Ethics, Green Management and Sustainability are treated at a reasonably good level in these books. It is believed that inclusion of these contemporary issues is essential not only in OM education, but in engineering and management education in general.

VII. CONCLUSION

Managing operations in both manufacturing and service organizations have evolved tremendously over the years with the change in market requirements. The market has become global, thereby compelling enterprise operations to keep up. The application of information technology/information systems (IT/IS) and outsourcing in managing operations have significantly altered the landscape of operations management (OM) strategies, techniques, and technologies. Consciousness towards environmental and safety also urges companies to examine their OM approach and manufacturing from various perspectives. Recently, energy cost and protection against terrorism have changed the portfolio of enterprise operations and therefore the approach to OM. In view of the evolution of market and operations, now is the time to revisit the OM principles, curriculum, and training at the institution of higher learning. Moreover, manufacturing has become more of a service activity, indicating significant service OM [5].

In this paper, an attempt is made to study the educational issues that are handled in OM and service systems in industrial engineering programs of six major Turkish universities. The study provides some weaknesses and strengths of the six industrial engineering programs as they are pointed out in section 4. Finally some common elements that seem to be missing or weak in these programs are discussed. The major missing element is identified as the lack of or weakness of courses in systems thinking and system methodologies. Some of these topics appear to be covered within some courses. There is even a compulsory course on Systems Thinking in the METU IE program, and an elective course on System Dynamics at BOUN. Yet, this coverage does not seem to be sufficient.

Furthermore, industrial experience should be part of the IE curriculum, and this may be in the form of a dissertation or major project in the areas of supply chain and ERP systems, among other OM issues such as global supply chain management, global marketing, operations and logistics, enterprise resource planning, virtual enterprise, risk management, production planning and control in global supply chain, operations research in global operations management, e-commerce, human resource management in global supply chains, outsourcing, culture and business management. In the future, by carefully identifying the gap between OM in education and practice, the need for a new direction in OM should be determined. Further research should be conducted in order to develop a framework for the "new OM". This framework should be proposing an appropriate objective and a suitable direction for developing a university curriculum, as well as for training and developing the skills of employees in practice.

REFERENCES

[1] Bellamy, M.A. and R.C. Basole, "Network Analysis of Supply Chain Systems: A Systematic Review and Future Research," Systems Engineering, DOI 10.1002/sys, 2012.

[2] Doming M.A. Lope, J.A. Albajeza and J. Santolaria, "The accreditation of industrial engineering in Spain: teaching and learning the skills of Manufacturing Engineering", The Manufacturing Engineering Society International Conference, MESIC 2013, Procedia Engineering vol. 63, pp. 786 – 795, 2013.

[3] Ergin, Merve H. and Babak D. Rouyendegh, "Increasing creativity with unusual designs," Procedia –Social and Behavioral Sciences, vol. 31, pp. 20 – 24, 2012.

[4] Giacomo, Laura Di and Giacomo Patrizi, "Methodological analysis of supply chains management applications," European Journal of Operational Research Production, vol. 207, pp. 249–257, 2010.

[5] Gunasekaran, A. and Nagai W.T. Eric, "The future of operations management: An outlook and analysis," Int. J. Production Economics, vol. 135, pp. 687–701, 2012.
[6] Jackson, M.C.; Systems Approaches to Management, Kluwer, 2000.
[7] Jackson, M.C.; Systems Thinking: Creative Holism for Managers, Wiley, 2003.
[8] Killingsworth, W.R.; "Design, Analysis and Optimization of Supply Chains: A System 013. Dynamics Approach," Business Expert Press, 2011.
[9] Krajewski, L.J., L.P. Ritzman and M.K. Malhorta, Operations Management, Pearson, 2
[10] Lau H.Y.K. and K.L. Mak, "The virtual company: a re-configurable open shell for problem-based learning in industrial engineering," Computers & Industrial Engineering, vol. 47, pp. 289–312, 2004.
[11] Laudon, Kenneth, C. and Jane P. Laudon, "Management Information Sciences: Managing the Digital Firm," Pearson, 2013.
[12] Li, Gang, Hongjiao Yang, Linyan Sun, Ping Ji, and Lei Feng, "The evolutionary complexity of complex adaptive supply networks: A simulation and case study," Int. J. Production Economics, vol. 124, pp. 310–330, 2010.
[13] Maani, K. E. and R.Y. Cavana, "Systems Thinking and System Dynamics: Managing Change and Complexity. Pearson-New Zealand, 2007.
[14] Machuca, Jose´ A.D., Marı´a del Mar Gonza´lez-Zamora, Victor G. Aguilar-Escobar, "Service Operations Management research," Journal of Operations Management, vol. 25, pp. 585–603, 2007.
[15] Meredith, Jack R.; "Editorial: Hopes for the future of operations management," Journal of Operations Management, vol. 19, pp. 397–402, 2001.
[16] Pannirselvam, Getrude P., Lisa A. Ferguson, Robert C. Ash and Sue P. Siferd, "Operations management research: an update for the 1990s," Journal of Operations Management, vol. 18, pp. 95-112, 1999.
[17] Pardy, W. and T. Andrews, "Integrated Management Systems: Leading Strategies and Solutions", Government Institutes Inc., U.S, 2010.
[18] Pilkington, A. and J. Meredith, "The evolution of the intellectual structure of operations management—1980–2006: A citation/co-citation analysis," Journal of Operations Management, vol. 27, pp. 185–202, 2009.
[19] Prasad, S. and S. Babbar, "International operations management research", Journal of Operations Management, vol. 18, pp. 209–247, 2000.
[20] Prasad, S., S. Babbar and A. Calis, "International operations management and operations management research: Comparative analysis," Omega, vol. 28, pp. 97–110, 2000.
[21] Robbins, Stephen P.; "Management", Pearson, 2014.
[22] Small, A. and D. Wainright, "SSM and technology management: Developing multi-methodology through practice," European Journal of Operational Research, vol. 233, pp. 660–673, 2014.
[23] Sunthonkanokpong, W.; "Future Global Visions of Engineering Education,"2ndInternational Science, Social-Science, Engineering and Energy Conference, Procedia Engineering, vol. 8, pp. 160–164, 2011.
[24] Yurtseven, M. Kudret and Walter W. Buchanan, "Socio-Technical System Design: A General Systems Theory Perspective," Proc. The International Conference on Engineering and Computer Education – ICECE'2013, Luanda, Angola, March 3 to 6, 2013.
[25] Wei, J.; "Engineering education for a post-industrial World," Technology in Society, vol. 27, pp. 123–132, 2005.
[26] Available: http://www.ie.metu.edu.tr
[27] Available: http://www.ie.bilkent.edu.tr/ieweb2012/en/homepage
[28] Available: http://www.ie.boun.edu.tr
[29] Available: http://www.end.itu.edu.tr
[30] Available: http://fens.sabanciuniv.edu/msie/eng
[31] Available: http://eng.ku.edu.tr/indr/home