



# Developments in Modern Operations Management

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**Abstract:** This paper aims to explore the recent trends in modern operations management aiming at a better understanding of the current developments in this area. Discussing the general picture of operations management, this paper aims to highlight the most important and popular trends at the moment. With the help of identifying most important trends, paper try to find out how they are drastically affecting the way operations management is conceived. Limitations of this may include the superficial discussions of several trends and omissions of other important trends due to lack of scope. Operations management appears to be gaining position as a respected academic discipline. Therefore, this is a good time to update the evolution in this field. To achieve this goal, the major publications/citations in this field and their evolving research utility over the decades is also identified in this survey paper.

**Key words – Operations Management (O.M.), Management of Technology (MOT).**

## I. INTRODUCTION

Although the overviews on detailed historical developments in each cognition domain are useful, this survey will be discussing developments in modern operations management. Operations management (often called as production management) may be defined in different ways depending upon one's attitude or point of view. Since this discipline is a field of management then it focuses on carefully managing the processes to produce and distribute products faster, better, and cheaper than competitors. Operations Management practically concerns all operations within the organization and objectives of its activities focuses on efficiency and effectiveness of processes.

Modern history of production and operations management was initiated in 1950s by an extensive development of operation research tools of waiting line theories, decision theories, mathematical programming, scheduling techniques and other theories. However, the material covered in higher education was quite fragmented without umbrella what we call production and operations management (POM). Subsequently, the first publications 'Analysis of Production Management' by Bowman and Fetter (1957) and 'Modern Production Management' by Elwood Buffa (1961) represented an important transition from industrial engineering to operations management. Operations management finally appears to be gaining position as a respected academic discipline. Thus, this may be a good time to update the evolution of the field.

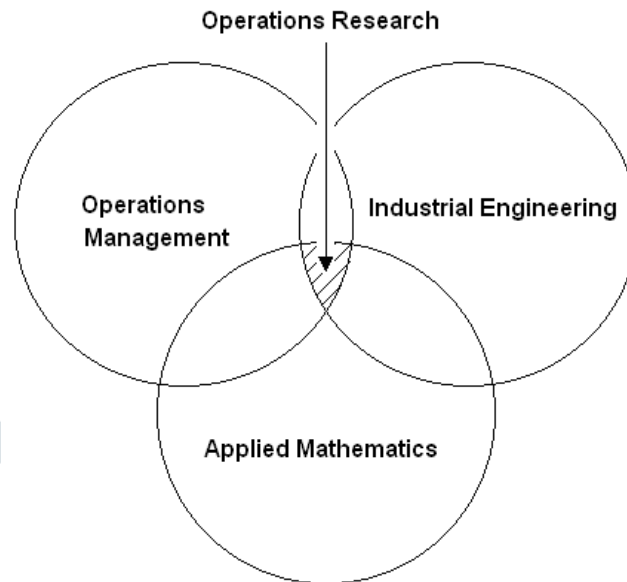
The aim of this paper is to present the advancements in the area of operations management, especially of advanced topics in manufacturing environments. To achieve this goal, the major publications/citations in this field and their evolving research utility over the decades is also identified in this paper. A large body of literature has attracted a number of researches to present different reports on the state of art of at different points of time. Several researches have reviewed literature and categorized different methods. But the intention in this paper is to identify the salient features of the literature and the future directions in the fields of modern operations management.

## II. OPERATIONS MANAGEMENT IN COMTEMPORARY ERA

The process of building operation management theory and definition of its scope or area has been treated by a number of authors. As it has been mentioned above, a modern era of O.M. is closely connected with a history of industrial engineering (IE). The development of IE discipline has been greatly influenced by the impact of operation research (Turner et al 1993). Operations research (OR) was originally aimed at solving difficult war-related problems through the use of mathematics and other scientific branches. The diffusion of new mathematical models, statistics and algorithms to aid in decision-making had a dramatic impact on industrial engineering development. Major industrial companies established operation research groups to help solve their problems. In the 60's, expectations from OR were extremely high, and as was commented by Luss and Rosenwein (1997), "over the years it often appeared that the mathematics of OR became the goal rather the means to support solving real problems". It caused that OR groups in companies were transferred to traditional organization units within companies. As a reaction on this disappointment Corbert and Van Wassenhove (1993) classified OR specialists into three classes: theoreticians, management consultants, who focus on using available methods to solve practical problems, and the "in-between" specialists called operations engineers, who adapt and enhance methods and approaches in order to solve practical problems.

The term "operations engineers" was formulated due to lack of better term and accordingly the group could be also called as operations managers and the field conducting applied research that helps to solve practical problems could be named as production and operation management. In farther development stages of OR, the term POM was consolidated and presented as

concepts, methods and approaches related directly to productive systems and enhanced their management. Based on such derivation of mentioned disciplines it is obvious that IE, OR and POM have commonalities and similarities in their definitions. However, it is also important to specify main differences among them. OM is field of management; OR is branch of applied mathematics (AM) and IE is engineering discipline (Chase and Aquilano, 1989). In addition, according to Anderson (2002), OM and OR differ substantially, since “OM is managerially and activity oriented while OR is mainly technique and mathematically oriented involving modeling a situation or a problem and finding an optimal solution for it”.



**Figure 1: Relations between Applied Mathematics and O.R., O.M., I.E.**

As can be seen from the Figure 1, Operations Management (OM) and Operations Research (OR) pursue in two complementary ways that create a win-win scenario. Fuller and Martinec (2005) who analyzed parallels between OM and OR, have mentioned that both disciplines can be considered as ‘innovations’ of the 20th century.

### III. DEVELOPMENT FEATURES OF OPERATIONS MANAGEMENT

When we want to discuss important features of OM, then the reasonable action is to define and explain how the term can be understood from the viewpoint of the paper theme. For this purpose following definition can be adopted. “Operations management is concerned with the ways of achieving the most effective and efficient use of an organization’s resources to produce goods and services needed by customers”. It goes without saying that there are many other definitions more or less similar to the above definition. Although Chase and Aquilano (1989) precisely documented the historical development of the OM starting with its real roots given by Taylor (1911), operations management is as old as industry itself (Bicheno and Elliot, 1997) and was articulated in the context of industrial production only after the 1600s (Baber, 1996; Landes, 1998).

**Table 1: Historical summary of the history of modern OM**

Decade	Concept or Tool	Originator or Developer
1950s	Extensive development of OR tools of simulation, Queuing theory, Decision theory, Project scheduling techniques of PERT and CPM	D. G. Kendall Erich L. Lehmann
1960s	Mathematical programming in industrial applications, Extensions of linear programming	Tjalling Koopmans George B. Dantzig
1970s	Software packages for: Shop scheduling problems, Layout design, Layout planning, Qualitative and quantitative Forecasting methods, Material requirement planning (MRP I)	Joseph Orlicky Oliver Wight George W. Plossl
1980s	Just In Time, Just In Case, Total Quality Control, Continuous improvement-Zero defect, Factory automation, Flexible Manufacturing System, Computer Integrated Manufacturing, CAD/CAM/CAE, Manufacturing resource planning (MRP II), ERP	Taiichi Ohno Edwards Deming A. V. Faigenbau Joseph M. Juran Mikell P. Groover
1990s	Principles of process innovations, Business Process Reengineering (BPR), Concurrent /Simultaneous engineering Logistics and Supply Chain Management, World Class Manufacturing, Optimized Production Technology (OPT), Theory of Constraints (TOC), Haystack syndrome, Goal	T. H. Davenport M. M. Hammer R. J. Schonberger E. M. Goldratt E. M. Goldratt
2000s	Management of technology change, Disruptive Innovations and Organizational Change Operations strategy, Toyota Production System,	C. M. Christensen Wick Skinner Slack Nigel

2010s	Product life cycle management, Mass customization, Core competency, Inclusive growth, Bottom of Pyramid, Business Process Reengineering, Continuous improvement, Lean Production System,	Martin Christopher C. K. Pralhad James A. Champy
2020s	Waste elimination, Sustainability, Environmentally sensitive production, Green manufacturing	W. Stevenson T. Johnson

Because Chase and Aquilano (2004) in their book map the history of the field of operations management between circa 1910-1990, Table 1 gives the updated view of the historical development of operations management from beginning of its modern era. The aim of this overview is to trace key concepts and tools by decades starting from 1950 to 2020. It is aware that the shown specification of the latest developments in operations management may not be fully encompassed by all decisive development directions, since operations management is fair-sized diversified.

#### IV. OPPORTUNITIES AND CHALLENGES OF MODERN OPERATIONS MANAGEMENT

During the latest decennium operation managers had to react to unforeseen situations more frequently than they needed to before. In this context they have been facing new challenges of market globalization, information and communication technology advances as well as opportunities for organizational improvements and efficiencies. One of the important challenges for the development of a modern operations management was emergence of so called Global Growth Companies (GGCs). According to Jones (2005), during the mid-nineteenth century, thousands of European companies were formed exclusively to operate internationally with no prior domestic business. Those companies became momentous actors of economic globalization in international business. The emergence and influence of a new breed of high growth global companies with a special attention to China and India was discussed by Kiggundu and Ji (2008). Attention to China and India as representatives of emerging economies explains a fact that these two countries were the best represented at the Dalian meeting in 2007 organized by the Centre for Global Growth Companies, and because they seem to be leading the drive for globalization by way of corporate. By them, “firms in emerging economies and developing countries tend to have weaker systems of corporate governance than those in developed economies. Yet, in order to grow, compete and become respected global citizens, global growth companies will have to develop corporate governance systems that are effective, transparent, accountable and responsive. In this connection, findings from differences between emerging economies and developed economies provide excellent opportunities for the study of corporate governance among global growth companies. The aim to specify general decisive and substantial challenges that managers was facing during last ten years comprises not very appreciative task, as it depends on different aspects.

**Table 2: Selective challenges a modern operations management**

Challenges	Description
Global Competition	Global market is increasingly complex and constantly changing. Products are traded internationally and components are sourced internationally. It requires a greater degree of international and cross-cultural communications, collaborations, and cooperation than at any time before. All companies have to think in global terms as regional companies are rapidly becoming a thing of past. (Stters and Nardon 2006).
Developments in strategic management approaches	Hambrick and Fredericson (2001) in their paper have talk about their uncertainty of whether that most organizations do actually have a strategy. According to them a meaningful strategy might consist of five elements, providing answers to following questions: Where will we be active? How will we get there? How will we win in the market-place? What will be our speed and sequence of moves? How will we obtain our returns? In reality, most strategic plans emphasize one or two of the elements.
Supply Chain Standardization and Integration	During the last decade has been proved the slogan that, much competition occurs between supply chains, not just between individual firms. This is due to the fact that company can't act as isolated entity, but as a part of supply chain integrated system.
Complex external environments	It is of crucial importance to understand how external environment impact on organization. Therefore, companies are quite interested in knowing about macro environment situation representing the information on trends for demography, market geography, technologies energy demand growth, labor productivity growth, etc. The environment in a global economy and its interactions with organizations is not only a complex phenomenon, but it is constantly changing in nature. Accordingly, any aspects of the environment can't be study as deterministic entities. By Kazmi (2008), “the organization and the environment are, in reality, more unpredictable, uncertain and non-linear”. Therefore, for their study the complexity theory including chaos theory and their applications are applicable.
Lean philosophy	There are many issues under lean philosophy. Toyota has identified seven categories of waste. These seven wastes are: overproduction, waiting time, transportation, inventory, motion, over processing and defectives. Japanese developed 5 S's which are: Seiri (sort), Seiton (simplify), Seiso (sweep), Seiketsu (standardize) and Shitsuke (sustain). Continuous improvements (Kaizen) are a part of lean philosophy. Involvement of all is a part of this.
CAD/CAM and shrinking product cycle	Computer aided design and manufacturing immensely helped in new product development and redesigning of processes. With fast expansion of technology, product life cycles have become short. The companies are forced to introduce rapid

	developments with encouraging innovations.
Green manufacturing and Ecological Sustainability	Ecologically sustainable processes are increasingly developed with minimum use and biodegradable, recycled, environment friendly are used.

This makes an interesting study as to how they are evolved in the face of changing businesses and give a very clear idea about what to expect in the near future with respect to operations management. In an attempt to satisfy this task, Table 2 depicts some topical challenges that are related to the latest concepts and tools shown in Table 1. In the continued text, some main features of accented concepts and tools assigned for the latest decade (shown in Table 1) with the aim to prove their topicality will be illustrated.

#### 4.1 Management of Technology Change

According to A. Thomas and B. Grabot (2006), two main factors have dramatically changed the industrial context in the manufacturing area: specialization and technological changes which have recently occurred in the information technology area. Attention to that fact along with a large diffusion of innovations in industries during the twentieth century most likely evoked emergence of the new managerial discipline of management of technology (MoT). The term itself was first introduced at the European Management Forum held in Davos in 1981. There are several definitions of MoT, which differ in understanding the very object of technology management in the sense of what needs to be managed. Drejer (2002), in this context comments that “the discipline of MoT is characterized by a vast number of contributions emerging in a divergent manner rather than a convergent one”. A succinct definition of MoT has been formulated, for example, by Bueno et al (1997). According to them it is “the combination of competences allowing technological capabilities aiding the achievement of business objectives to be promoted and controlled. Although definitions of MoT are specific to a concrete target platform, the main object of interest in this paper is its relevant context to business activities. One of the important roles of MoT is to promote innovation. It is especially topical for organizations that face a serious problem when technological changes are necessary in response to market signals. Usually, internal conditions for implementing advanced technology for routine production are not always adequate to achieve this aim. Draft (2010), in this context, see a problem with organization of work. He argues that this problem can be solved only through an innovative oriented organization, which is typically associated with change and is considered the best for adapting to a changing environment. Therefore, programmes for the development of employees' creativity became the important element of a cohesive corporate strategy.

#### 4.2 Disruptive Innovations and Organizational Change

Presently, distinctions between disruptive technologies versus sustaining technology are frequently discussed. According to Christensen (2002) and Bower (1995) findings, disruptive changes in technology had a significant impact on industries and a lot of leading companies failed when they were confronted with them. Paradoxically, these failed firms were well-managed companies that invested aggressively in new technologies; that carefully studied market requirements and opportunities; and that sharpened their competitive edges. Christensen (2002) proposed five principles of disruptive technologies in order to find a way how to understand and harness this phenomena. In his fourths principle it is focused on organization's capabilities and disabilities, where he states that “to succeed consistently, good managers have to be skilled not only just in choosing , training, and motivating the right people for the right job, but in choosing, building and preparing the right organization for the job as well”. So, it is axiomatic that phenomena of disruptive innovations and management of technology change are mutually reinforcing

#### 4.3 Operations Strategy

Admittedly, operations or manufacturing strategy is considered as an inherent part of long term corporate strategy. Chase et al (2004 ) offers by his sketch of a short history of operation strategy a broader insight into current operations strategy research and determines its role in contributing operations management functions to a firm's ability to achieve its competitive advantage in that marketplace. Since a firm's strategies are often changing and developing, it implies making sensible decisions that affect the business performances directly. In that context Swink and Way (1995) see the position of manufacturing strategy as “the decisions and plans affecting resources and policies directly related to the sourcing, production and delivery of tangible products”. Slack's and Lewis's view of operations strategy is that it is not only single decision, but according to them it is a total pattern of the decisions that include the extend and ability of its capacity; delivery of products and services; its approach to developing process technology, etc. The importance of operations strategy follow from the fact that the long-term success of manufacturing firms depends on their ability to vary their operations quickly enough to fill changing requirements of customers. Key factor which makes the operations function faster is called the manufacturing vision. For this sake, principally all world class manufacturers have explicitly formulated a strategic manufacturing vision for manufacturing. It practically means that all decisions related to system design, planning, control and supervision made by shop floor managers are consistent with a corporate vision. On the other hand, world class manufacturing ambition is not the only one at issue that matters. Therefore, it is not always optimal to adopt the most offensive manufacturing concepts that are inherent for world class manufacturers. Accordingly, an investment to improve marketing activities, product design or manufacturing operations can be like effective.

## V. CONCLUSION

It is evident from the concepts discussed above, that the latest developments in Operations Management may not be fully encompassed by all processes, since operations management is much diversified. But latest developments are tracked in the paper.

## REFERENCES

- [1] B. J. Carroll. 2009. Lean principles, tools & practices, 2<sup>nd</sup>edition, Auerbach publications.
- [2] Baber, Z. 1996. The Science of Empire, State University of New York Press, Albany, New York.
- [3] Bicheno, J. and Elliott, B. B.1997.Operations Management. An Active Learning Approach, Blackwell publishing, Oxford.UK

- [4] Bowman, E.H. and Feter, R. B. 1957. Analysis for Production Management, R. D. Irwin, Inc., Homewood, Illinois.
- [5] Bower, J. L., and Christensen, C. M. 1995. "Disruptive Technologies: Catching the Wave", Harvard Business Review, Vol. 73 (1) pp. 43-53.
- [6] Buffa, E.S. 1961. Modern Production Management. Wiley, New York.
- [7] Chase R. B. Aquilano, N. J. 1989. Production and Operation Management, A Life Cycle Approach, 5<sup>th</sup> Edition, Richard D. Irwin, Inc. Homewood.
- [8] Chase, R. B., N. J. Aquilano, F. R. Jacobs. 2004. Operations Management for Competitive Advantage, 10th ed. McGraw-Hill, Boston, Massachusetts.
- [9] Christensen, C. M. 2002. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business, Harper Business Essential, New York.
- [10] Corbett, C.J., Van Wassehove L. N. 1993. "The natural drift: What happened to operations research?" Operations Research, Vol. 41 (4), pp. 625-640.
- [11] Drejer, A, 2002. "Towards a model for contingency of Management of Technology", Technovation, Vol. 22(6). pp. 363-370.
- [12] E. Bueno, P. Morcillo, J.M. Rodriguez Anton. 1997. "Management of technology: Proposal for a diagnosis model", The Journal of High Technology Management Research, Vol. 8 pp.63 – 87.
- [13] Fuller, J.A. and Martinec, C.L. 2005. "Operations Research and Operations Management: From Selective Optimization to System Optimization", Journal of Business & Economics Research, Vol. 3 (7). pp. 11-15.
- [14] Hambrick, D. C., Frederickson, J. W. 2001. "Are you sure you have a strategy?" Academy of Management Executive, Vol. 15, Issue 4, pp. 21-29.
- [15] Jones, G. 2005. Multinationals and Global Capitalism: From the Nineteenth to the Twenty-First Century. Oxford University Press, New York.
- [16] Kazmi, A. 2008. Strategic Management and Business Policy, Tata. McGraw Hill Publishing Company Ltd, New Delhi.
- [17] Kiggundu, M.N. and S. Ji 2008. "Global growth companies in emerging economies: new champions, new challenges", Journal of Business and Behavioral Sciences, Vol. 19(1), pp.70-90.
- [18] Landes, D. 1998. The Wealth and Poverty of Nations: Why Some Are So Rich and Others So Poor, W.W. Norton, NY.
- [19] Luss H., Rosenwein M.B. 1997. "Operations Research Applications: Opportunities and Accomplishments", European Journal of Operational Research, Vol. 97 (2), pp.220-244.
- [20] M. Swink and M.H Way, 1995. "Manufacturing strategy: Propositions, current research, renewed directions", International Journal of Operations and Production Management, Vol. 15 (7), pp. 4-26.
- [21] R. Beaty .1996. "Mass customization", Manufacturing engineer, Vol.75 (5), pp. 217-240.
- [22] R.M. Steers, L. Nardon. 2006. Managing in the global economy, M. E. Sharpe, Inc. Armonk, NY.
- [23] Richard L. Draft .2010. Organization theory and design. 10th ed. South-Western Cengage Learning, Mason, Ohio.
- [24] Slack, N and Lewis M. 2002. Operations Strategy, Financial-Times Prentice Hall, London, UK.
- [25] Taylor, F. W. 1911. The Principles of Scientific Management. New York and London: Harper & Brothers.
- [26] Thomas A., Grabot B. 2006. "Key technologies and strategies for creating sustainable manufacturing organizations", IPROMS 2006 - Virtual International Conference on Intelligent Production Machines and Systems, Manufacturing Engineering Centre (MEC) Cardiff University Queen's Buildings, Wales, UK.
- [27] Turner, W.C., Mize, J.H., Case, K.E., Nazemetz, J.W. 1993. Introduction to industrial and. systems engineering, Englewood Cliffs, NJ: Prentice Hall.
- [28] W. Stevenson .2005. Operations Management, 8<sup>th</sup> edition, McGraw-Hill, Boston.