

RECENT TRENDS AND DEVELOPMENTS IN OPERATIONS MANAGEMENT

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Abstract: Today operations management is used to characterize the management of the daily activities of all business units, which ultimately lead to the final product or service. The purpose of operations management is to streamline the production process and general operations within the business to maximize profit and ensure business growth. After going through three industrial revolutions, manufacturing technology and management are currently facing the fourth leap (and some researchers say we are in the fifth industrial revolution), industrial revolutions being driven by rapid change, achieved through innovation.

The purpose of this article is to highlight the trends in operations management based on the analysis of this concept evolution. In this sense, we mention the contribution of each revolution in the development of operations management. We note that today's main feature is the use of new technologies to provide prosperity beyond job creation while respecting the planet's production limits. Recent trends in production/operations management relate to global competition and its impact on companies, especially manufacturing companies. Following the research carried out, we highlight and characterize some trends in operations management. A special place belongs to the study of the influence of artificial intelligence on the development of operations management. We argue that artificial intelligence can significantly influence the management of production operations, but also in the service sector by providing significant advantages and improvements. The key question that appears in this order of ideas concerns finding the optimum between decisions made by humans and those determined by machines.

Keywords: production management, operations management, artificial intelligence, industrial revolution, digitization, agility.

JEL Classification: M10, M11

Introduction

Operations management refers to the management of all business activities that facilitate the transformation of inputs into outputs. Initially, the term operations management applied only to production departments. Over the years the system has evolved and now the term is used to characterize the management of the daily business activities of all units that ultimately lead to the final product or service. Production management governs the value-added transformation process within a service delivery system. The task is to process information into decisions, so as to organize and guide the production process towards the achievement of established performance targets (Dyckhoff, 2006). Operations management can be considered a multidisciplinary field that focuses on the effective management of an organization's processes for the production and distribution of specific products and services. It applies both qualitative and quantitative concepts and techniques to increase process efficiency and effectiveness, reduce costs, ensure high-quality results, and improve organizational flexibility to ever-changing demands.

The purpose of operations management is to streamline the production process and general operations within the business. One of the main roles of operations management is to maximize profits and ensure business growth

The stated purpose of this research is to highlight recent trends in operations management based on the analysis of the evolution of this concept.

The impact of industrial revolutions on operations management.

After going through three industrial revolutions (mechanization, electrification and automation) production technology and management are currently facing, as some say (Bauernhansl et al., 2014), the fourth leap, industrial revolutions being driven by rapid changes, achieved through innovation.

The first industrial revolution (Industry 1.0) began in the 18th century with the use of steam power and the mechanization of production. Even though the power of steam was already known, its use for industrial purposes was the greatest breakthrough for increasing labor productivity.

The second industrial revolution (Industry 2.0) began in the 19th century with the discovery of electricity, thus resulting in the first internal combustion engines. Then, towards the beginning of the 20th century, the first cars and the first airplanes appeared. The telephone and the telegraph appeared.

The third industrial revolution (Industry 3.0) began in the 70s of the 20th century. The culminating point is the appearance of a new energy source, the nuclear one. Electronic products appeared, the telecommunications industry and the computer industry experienced rapid development. A new era was born – that of the automation of production processes and the emergence of industrial robots.

The 4th industrial revolution (Industry 4.0) is characterized by the application of information and communication technologies in industry. It is based on the developments of the third industrial revolution. Production systems that already have computerized technologies are extended through a network connection. The networking of all systems leads to "cyber-physical manufacturing systems" and thus to smart factories, where manufacturing systems, components and people communicate over a network and production is almost autonomous ([https:// www.desouttertools.com/your-industry/news/503/industrial-revolution-from-industry-1-0-to-industry-4-0](https://www.desouttertools.com/your-industry/news/503/industrial-revolution-from-industry-1-0-to-industry-4-0)). The result is machines that can predict breakdowns and trigger maintenance processes autonomously or self-organized logistics that react to unexpected changes in production. The digitization of the production environment allows the use of more flexible methods to receive the right information by the right person at the right time. This changes the emphasis in the activity of the operations manager, who does not waste time in searching and collecting the necessary information, but solves the problems that arise. In Industry 4.0. technological innovations, including smart factories, the Internet of Things (IoT), artificial intelligence, 3D printing, bitcoin and gene editing, continue to spread across industries and economies (Marr, 2018; Cotelnic, Dorogaia, 2023).

If some authors talk about the fact that today's society has specific characteristics of the fourth industrial revolution, others consider that we have already entered the fifth (Industry 5.0), which includes the notion of harmonious human-machine collaborations, with an emphasis specifically on the well-being of several stakeholders (society, companies, employees, customers). Thus, it paves the way for a revolution in thinking and capitalizing on human-machine collaborations for the better welfare of society, through the effective use of technology (Noble et al., 2022). Also, the authors

note, it is not clear exactly where or when the term "fifth industrial revolution" originated, but articles and websites (e.g., Aryu Networks 2020; Gauri and Van Eerden, 2019) have noted its emergence. Manufacturing research also recognizes the term fifth industrial revolution (Xu et al. 2021), and the Journal of Manufacturing Systems, International Journal of Production Research, and IEEE Transactions on Industrial Informatics encourage research in this regard.

Noble S.M., Mende M., ș.a. (Noble și colab. 2022) realizând cercetări privind a cincea revoluție industrială evidențiază diferențele între a patra și a cincea revoluție industrială, astfel argumentând, într-un fel, intrarea omenirii în cea de a cincea revoluție. (Tabelul 1)

Noble S.M., Mende M., and others. (Noble et al. 2022) conducting research on the fifth industrial revolution highlights the differences between the fourth and fifth industrial revolutions, thus arguing, in a way, for humanity's entry into the fifth revolution. (Table 1)

Table 1. Key differences between the fourth and fifth industrial revolutions

		The fourth industrial revolution	The fifth industrial revolution
Human-technological focus	Maximization strategy	Maximizing the number and scope of technologies and their interconnection	Maximizing the strengths of both technology and people by understanding where each excels
	Competition vs Collaboration	Humans compete with machines for jobs	Humans and machines, metaphorically speaking, dance together; Humans collaborate with machines
Focus on well-being	Focus on the environment	No focus on the environment; Prioritizing technological progress (eg smart factories); Profit tracking	The well-being of all humanity and the planet; Focusing on sustainable and renewable resources; Tracking the profit with a specific purpose
	Pushing the limits of technology	Technology have to be trusted	Human usage of the technology

Source: Noble and colab., 2022, page 201

The Research and Innovation Community Platform (<https://research-and-innovation.ec.europa.eu/>) also tells us about Industry 5.0. It is mentioned that in order to remain the prosperity engine, the industry must lead the digital and ecological transition. Such an approach reinforces the role and contribution of industry within society and places the welfare of the employee at the heart of the production process and uses new technologies to deliver prosperity beyond job creation while respecting the planet's production limits. This platform also mentions that the current approach of "Industry 4.0" is completed, in such a way that research and innovation is put at the service of the transition to a sustainable European industry, centered on people and resistance.

Trends in Operations Management

How do these changes, industrial revolutions, influence operations management and what are the recent trends in the field? These are the questions that were put before this research. As Gunasekaran and Ngai (2012) mention, “operations management in both manufacturing and service organizations has evolved tremendously over the years”. The aforementioned authors further highlight four trends that have emerged and will continue to affect the field of operations management:

- The market has gone global, forcing business operations to keep up.
- Environmental awareness.
- The application of information technologies in operations management has changed the landscape of operations management.
- Manufacturing increasingly resembles the service industry, which indicates the significant level of services, including project management.

These trends are not mutually exclusive, but intertwine to varying degrees..

Synthesizing several bibliographic sources, we agree that recent trends in production/operations management refer to global competition and its impact on manufacturing firms. At the same time, we consider some of the recent trends much broader. We will stop at some of these to characterize them (Figure 1):

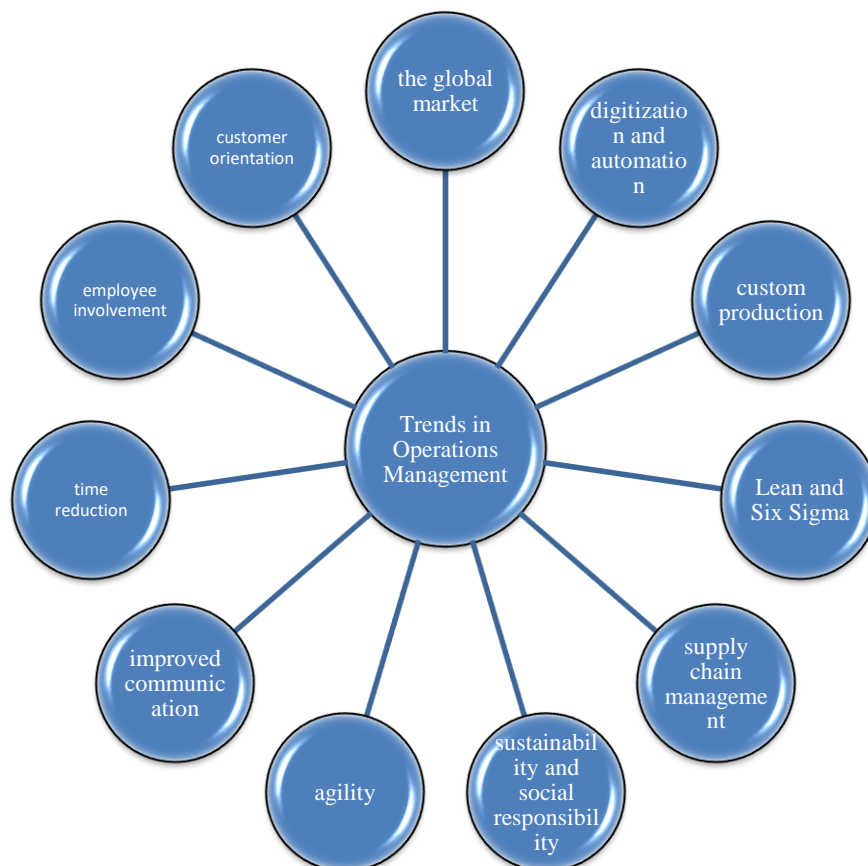


Figure 1. Some trends in operations management

Source: elaborated by the author

1. *Global market:* The globalization of business has forced many manufacturing firms to have operations in many countries where they have some economic advantage. This has led to a rapid increase in the competition level between manufacturing companies around the world.

2. *Digitization and automation.* It is an obvious trend, technology is advancing rapidly, and this makes digitalization to penetrate all fields. The automation of manual processes is also the order of the day, being more pronounced for industrial activities. The effect of these processes is visible: reducing unskilled labor, increasing the efficiency and competitiveness of enterprises, which, in turn, allow companies to reduce expenses and waste. The use of digital technologies and process automation have also become increasingly common in operations and production management. For example, industrial robots and computer-aided manufacturing systems can improve the efficiency and quality of the production process, and we are witnessing the gradual merging of the virtual world and the physical world. In this regard, the natural question arises: to what extent can and will operations management tasks be replaced by artificial intelligence (AI) technology? The key question that appears in this order of ideas concerns finding the optimum between decisions made by humans and those determined by machines. Who will set the performance targets? Who will be responsible for errors? And, most importantly, how much decision-making will actually remain a purely human task?

Artificial intelligence can significantly influence the operations management in both manufacturing and service sectors by providing significant advantages and improvements. We consider it necessary to mention the following positive implications of artificial intelligence:

1. *Process optimization:* Artificial intelligence can analyze and process large amounts of information to identify certain trends and more appropriate patterns. In this way, inefficient processes in the production process can be more easily identified and help to formulate suggestions for improvements.

2. *Predictability and planning:* In this direction AI would be of great use, by helping in production planning and inventory management, based on predictive analytics. Based on historical data analysis and factors influencing production processes, AI can plan demand and storage needs, ensuring efficient supply chain management.

3. *Quality improvement:* By monitoring sensors and analyzing data, AI can identify deviations and intervene before errors become major problems. This can lead to reduced defects and associated costs.

4. *Automation and robotics:* Integrating artificial intelligence with robots will help automate repetitive tasks and manual work, leading to both increased efficiency and reduced human error and work accidents.

5. *Autonomous manufacturing:* AI can be used to create and implement fully autonomous manufacturing systems without the need for human intervention in most operations. This can lead to increased efficiency and production speed.

6. *Equipment monitoring and diagnostics:* AI can be used for real-time monitoring of equipment operation within the manufacturing process. This can help quickly identify problems and diagnose breakdowns, allowing them to be rectified before they affect the entire production process.

3. Another recent trend in operations management refers to *Custom Manufacturing:* The growing demand for customized products requires companies to adapt their manufacturing operations to meet

individual customer needs. Techniques such as additive manufacturing (3D printing) enable the manufacture of customized products on a larger and more efficient scale.

4. Adoption of *Lean and Six Sigma* practices by business units. These are two management methodologies aimed at reducing waste and improving the quality of production processes. Many companies adopt these principles to increase efficiency and reduce costs. Instead of targeting mass sales of goods that generate economies of scale, the new trend focuses on manufacturing goods on order confirmation, which results in drastically reduced production costs and zero waste. It helps the organization to promote its operations to be faster, more reliable and of better quality.

5. *Supply chain management*: has become a critical component of operations and production. Companies focus on optimizing the flow of materials and information throughout the supply chain to reduce costs and improve delivery time (Galanton, 2021).

6. *Sustainability and social responsibility*: If in the past the basic purpose of business focused on making profit, today's business has started to focus on environmental sustainability. This new development in operations management discourages the acquisition and use of resources at the lowest possible cost, ignoring environmental damage. In the context of increasing environmental and social responsibility concerns, many companies are adapting their operations and production processes to be more sustainable and responsible. Today's operations managers are increasingly concerned with pollution control and waste disposal, have begun to initiate the design of products and processes that are sustainable, that consider minimal resource use, recycling possibility, provide biodegradable and environmentally friendly components, the use of less toxic chemicals. Thus, green production can be seen as a recent development in operations management

7. *Agility*. (<https://www.tutorialspoint.com/recent-trends-and-developments-in-operations-management>) Agile approach requires the enterprise to be able to adapt and drive change in a productive and cost-effective way without compromises quality. Agile manufacturing as a key component of operational flexibility (Taylor and colab., 2009) can include the use of reconfigurable manufacturing systems that are designed to rapidly change structure and components to respond to sudden market changes. Agility helps the organization to quickly adapt to internal and external market changes, and helps to respond in a quick and flexible way to customer demands. In a world of accelerated change agility is a vital characteristic of any organization and is an inevitable feature of operations management.

8. *Improving the communication system*. It may seem strange that we t improved communication have been highlighted as an operations management trend. But it is considered that proper and timely communication within the organization is crucial for the efficient functioning of each business unit. It is important to have a continuous flow of information, without any interruption or rupture, to withstand the smooth functioning of the whole system, and easy access and availability of enterprise data we can consider another area of development. Data availability is vital for an organization to make timely decisions, forecast and plan for the future. Unavailability of data leads to reduced efficiency.

9. *Time Reduction*: Reducing manufacturing cycle time and speed to market for a new product gives a company a competitive advantage over other company. When companies can provide products at the same price and quality, faster delivery (short lead time) provides a company competitive advantage over the other.

10. *Employee involvement.* Employees are the real resources that turn inputs into outputs in business. The recent trend is to assign responsibility for decision-making and problem-solving to lower levels in the organization. Namely, they face certain specific situations. They may be more aware of the advantages and disadvantages of the activities of the department or business unit concerned. Operations management began to focus on this area by involving employees and obtaining input for decision making. The right decisions are no longer the monopoly of top management. Examples of worker involvement are quality circles and the use of work teams or quality improvement teams.

11. *Customer orientation.* Any business cycle starts with the customer and ends with the customer. Being customer-oriented is the motto of every business, but focusing on trends and changing patterns of customer behaviors and preferences remains an ongoing trend in operations management. In addition to maintaining relationships with potential customers, it is equally important to find and anticipate customer preferences. Organizations that do not focus on this customer-oriented approach often risk losing market share. Continuous monitoring of customer preferences and changes through feedback can help the operations team come up with products and services that match customer expectations.

Conclusions

Referring to the above, thus taking an overview of the expected evolutions of operations management presented in this paper, the conclusion is that they have an important impact on the various stakeholders of the business, which will further change the character the work done:

- *Machines and other equipment* have undergone and will undergo major changes: Highly automated computer numerical control (CNC) machines coupled with industrial robots, sometimes working together with workers on specific tasks. This is how their future is seen. (Birla et al., 2020)
- *Workers:* their number will be reduced, they will be deployed for work that requires more knowledge, short-term and unplanned tasks, monitoring automatic equipment, etc..
- *Manufacturing process:* additive manufacturing technologies / 3D printing is considered to be the main process of the future. Additive manufacturing allows the creation of objects with precise geometric shapes that are built layer by layer, unlike traditional manufacturing, which often requires processing or other techniques to remove excess materials.
- *Organization:* Decentralized decision-making based on local information by workers with the support of Artificial Intelligence.
- *Product:* mass production and custom batch production manufacturing.

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