



## SCIENCE MANAGEMENT CHALLENGES FACING IN THE INDUSTRIAL REVOLUTION ERA 4.0

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**Abstract:** Science Management is now a challenge in facing the industrial era 4.0 where organizations and the industrial world are currently experiencing a more adaptive approach in viewing organizational theories in the field of management. The purpose of this research is to find out how big the impact of technological developments is on the development of science, especially management. This research was conducted with a qualitative descriptive approach by looking at the theories of management science with a case approach of the industrial era 4.0. This study uses secondary data contained in books, white papers, journals, articles which is the basis for a literature review. The results show that the role of organizational members, especially stakeholders, is required to study and understand all management theories produced by various streams and concepts or approaches that are most suitable for dealing with simple and complex problems and, this approach describes the current conditions. conditions and management positions in the future.

**Keywords:** Industrial Era 4.0; Management

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### INTRODUCTION

The presence of the industrial revolution 4.0 indeed presents new business lines, new jobs, new professions that were unthinkable before. But at the same time, there are also lines of business that are under threat, professions, and jobs that are being replaced by artificial intelligence machines and robots. The digital revolution and the era of technological disruption are other terms for industry 4.0. Production process automation is a must for all, which aims to increase productivity and reduce high operational costs.

As is well known, the industrial revolution 4.0 was marked by the development of the Internet of Things followed by new technologies in data science, artificial intelligence, robotics, cloud, 3D printing, and nanotechnology. This change is indeed drastic compared to the previous industrial revolution era. In the 1.0 industrial revolution, the growth of steam and water-based mechanization and energy became a marker. Human and animal power was replaced by the appearance of machines. The steam engine of the 18th century was one of the highest achievements. This 1.0 revolution can raise an extraordinary economy. During the two centuries after the industrial revolution, the income per capita of the countries in the world increased sixfold. The Industrial Revolution 2.0 changes were marked by the development of electrical energy and the motor. Mass manufacturing and production take place. Telephones, cars, and airplanes are examples of the highest achievement. Change quite quickly occurred in the Industrial Revolution 3.0. which is marked by the growth of industries based on electronics, information technology, and automation. The Industrial Revolution 4.0 not only has tremendous potential in overhauling the industry but also changes various aspects of human life both in the order of life and in the scientific sphere. There have been arguments for Industry 4.0 supporting better decision-making, information, and data sharing process to facilitate sustainable purchasing (Ghadimi, P., Wang, C., Lim, M. K., & Heavey, 2019).

Along with the rapid pace of the industrial revolution being applied to various scientific fields, technology adoption begins with management science, in this case, management science is currently developing very rapidly and changing continuously.



The history of the development of management science can provide knowledge and understanding of the approach to, analyze and solve problems that occur and relate to the organization to the individual level. Managers or leaders in the company need to learn and understand and be able to analyze as a whole about the development of management science that has occurred and has produced management theories that arise from various schools of thought, so that company management and company managers can determine, select and use management science theory that is most suitable to deal with certain situations and certain cases or problems.

In connection with the presence of the industrial revolution era 4.0, management science has the basics in applying the technological era to the organizational scope. For this reason, it is necessary to identify the extent to which management science plays a role in the presence of industry 4.0.

The main objective of this research is: (1) Mapping the pattern of challenges in the industrial era 4.0; (2) How industrial and Education can improve the management of science.

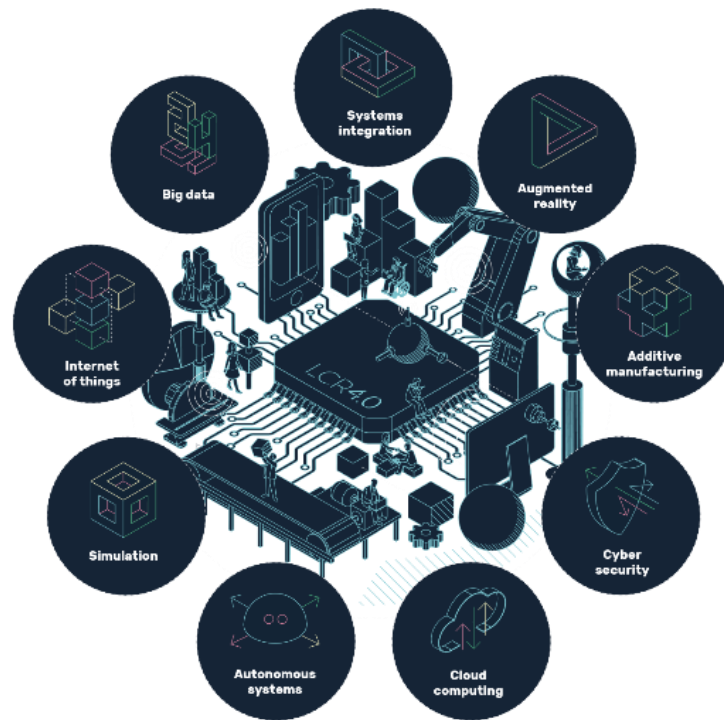
## **METHODS**

The data analysis method used in this study is qualitative. The analysis of secondary data that is qualitative is carried out in a way based on the theory contained in the framework, which can be applied to the focus of the problem. This article uses a qualitative method with a phenomenological approach. Phenomenological studies describe an experience or phenomenon (Creswell & Poth, 2017). Sources of data are done by searching for literature studies and using data collection methods from other source documents. The data collected consists of secondary data and is obtained through a literature study. The secondary data collection used in this research is a literature study which includes the collection of secondary data obtained from relevant articles and books. Data collection techniques by conducting a study of book reviews, literature, notes, and previous reports related to the problem being studied (Nazir, 2013).

## **RESULT AND DISCUSSION**

### **Facing the Industrial Revolution Era 4.0.**

Advances in technology allow automation in almost all fields. New technologies and approaches that combine the physical, digital, and biological worlds will fundamentally change the pattern of human life and interaction (Tjandrawina, 2016). Industry 4.0 is based on the boom of digitization, robotics and, automation, and is characterized by a fusion of information technology and production processes and in a smart way that is typical of autonomous machines. It is based largely on the Internet of things, which has brought about several changes to manufacturing and maintenance in the industry, from reduced production cycles to automation of machinery and equipment maintenance (Mohelska, H., & Sokolova, 2018). Industry 4.0 is an abstract and complex term made up of many components that are seen more closely in our society and today's digital trends. Here are some digital technologies that contribute as examples on the picture below:



**Figure 1. Digital Technologies 4.0**

Source: (Medium.com, 2018)

The figure above is: (1) Internet of Things (IoT) platforms; (2) Big data; (3) System integration; (4) Augmented reality; (5) Additive manufacturing; (6) Cybersecurity; (7) Cloud computing; (8) Autonomous system; (9) Simulation. Industry 4.0 goes even further than these goals by additionally addressing energy and resource efficiency, as well as increasing productivity and shortening innovation and cycle time to market (Kagermann, H., Wahlster, W., & Helbig, 2013).

The main focus of organizations and stakeholders involved in facing industry 4.0, namely Industry 4.0, can have a very large and broad impact, especially in the employment sector. Where robots and machines will eliminate many jobs in the world. Organizations or industries, in this case, should see this era not as a threat, but as an opportunity for the organization/industry which in the end will open up new opportunities and challenges for each organization to survive in competitive competition.

### **Development of Management Science Scientific Management Theory**

The beginning development of management science arose as a result of the industrial revolution in England in the 18th century which in particular led to the growing need for a systematic approach to management. Management science as science has several special characteristics as follows (Taylor, 1911 in Taneja, S., Pryor, M. G., & Toombs, 2011): (1) The existence of a human group, a group consisting of two or more people; (2) There is cooperation from the group; (3) The existence of process/business activities. Taylor argues that the success of these principles requires a "complete mental revolution" on the part of management and labor. This theory is better known as a classical theory in management science.



### **General Administrative Management Theory**

This theory focuses more on the aspects of administrative arrangements for all management activities. an attempt to develop a much broader theory about the administrative management function and is considered the forerunner of modern organizational theory. The basic functions of every manager have included planning, organizing, controlling, coordinating, and controlling Fayol (1949) in Edwards (2018) that all activities involved with industrial projects can be separated into six parts: (1) Techniques involving production; (2) Commercial which includes buying, selling, and exchanging; (3) Finance that enhances the search for, and optimal use of, the capital; (4) Security that protects property and people; (5) Accounting which includes statistical analysis; (6) Managerial which includes planning, organization, command, coordination, and control.

### **Behavioral Management Theory**

There is an assumption that Scientific Management Theory is for short-term interests and is incomplete. These researchers believe that the human aspects of the business organization have been neglected. That became the beginning of Behavioral Management Theory, namely an approach to management that is mainly related to human psychology, motivation, and leadership, which is distinguished from simple mechanical efficiency. Humans in an organization cannot always easily predict their behavior because they are often irrational. (Maslow, 1943 in Taormina, 2013) hypothesized that in all human beings there are the following five levels of need: (1) Psychological; hunger, thirst, protection, clothing; (2) Security; safety, protection against physical and emotional harm; (3) Social; affection, belonging, well-received, friendship; (4) Awards; self-esteem, autonomy, and perception, status, recognition, and attention; (5) Self-actualization; growth, reaching its potential, self-fulfillment.

### **Bureaucratic Management Theory**

Max Weber has proposed the concept of Bureaucracy which is considered the rationalization of society as unavoidable. Two conceptions of rationality are put forward by Weber, Formal rationality regards the means-end relationship and the accomplishment of practical and indisputable ends, through a precise calculation of the means adapted to the attainment of those ends, Real rationality concerns the increasing theoretical dominance of reality through increasingly precise and abstract concepts (Clegg, 1990 in Serpa, Sandro & Ferreira, 2019). Bureaucracy may be seen as being embedded in a process of formalization, that is, a way of redefining, reinterpreting reality, and reclassifying its elements, focused on increasing the capacity for control and direction, enabling the extension of the modern institutions' field of action (Serpa, Sandro & Ferreira, 2019)

Bureaucracy is an unavoidable notion, both in common language and even in organizational analysis, even if in the critical sense (Ang, 2016). Bureaucracy, in general, is associated with very negative features of organizations, such as delays in operation, the action centered on opaque standards, excessive requests for documentation, or even countless difficulties in meeting users or customers' requests (Godoi, A., Silva, L. F., & Cardoso, 2017).

### **Modern Management Theory**

This theoretical approach includes several approaches, namely: (1) process approach, that each identified management approach offers something to management theory and human resources and a quantitative approach is a tool rather than a management approach. (2) the systems approach, this approach views the organization



as an inseparable interacting unit. a system becomes two, namely the first is a closed system where the system is not influenced by the interaction of the external environment, then the second is an open system where it interacts with the external environment; (3) the contingency approach, is used to bridge the gap between theory and actual practice. Usually, between theory and practice, we must pay attention to the surrounding environment. Environmental conditions will require the application of different management concepts and techniques. This flow appears to be more of a quantitative stream, which is a combination of Operation Research and Management Science; (4) In strategic approach, Ansoff put forward a more rational approach in his words entitled "Corporate Strategy" according to him

In general, we recognize that management science theories exist in several different industrial conditions, as well as the following:

### **Science Management in the Industrial Age 4.0**

The challenge for researchers and practitioners in the field of management is that there is a shift in behavior and processes that quickly affect the direction of the organization, while several things pose challenges, namely in several ways as follows:

### **Analysis and Strategy**

In the industrial era 4.0, it is assumed that this will lead to an ecosystem with very low barriers to entry for new companies and nice suppliers, who will no longer be forced to develop entire systems to participate in the market. Instead, they may provide very specific components, applications, and services that serve as extras and in conjunction with larger solutions. This means that companies will see this era more as an era in competing in analyzing the market and the direction of the right strategy for the company to enter the right target market. the fact that transformation begins by redefining the scope of the business (in this case an orientation towards a solution-oriented, not a product-oriented business) and emphasizing the active involvement of corporate leadership determines the company's success (Schneider, 2018). Business models can be used to characterize individual companies in an industry as well as the competitive landscape and interactions within an industry (Spieth, P., Roeth, T., & Meissner, 2019).

### **Business Model**

Among the most frequently discussed topics in the context of Industry 4.0 are business models. Since the term Industry 4.0 was introduced and is closely linked to the discussion of potential disruptions, practitioners, as well as academics, have emphasized the importance of new business models for Industry 4.0. technology is only an enabler for Industry 4.0 and will evolve evolutionarily, whereas a truly revolutionary outcome of a new business model, which will determine the depth of revolution and the pace of change. If it is related to the existing management science theory, business models have not become the focus of the researchers' analysis, however, if it is seen from several companies that can survive today, namely companies that can create innovative business models. Currently, most companies only aim to increase the efficiency of the value creation process and only slightly adapt their existing business models, three out of eleven companies join a tight heterogeneous company network where they focus on their core competencies. Only two companies developed completely new business models, which were implemented in parallel with the existing model. (Schneider, 2018). A business model can be defined as the value logic of an organization in terms of how it creates and captures customer value and can be concisely represented by an interrelated set of elements that address the customer, value proposition, organizational architecture, and economics dimensions (Fielt, 2013).



## Human Resources

Relating to classical management science which emphasizes human resources as an asset for the company. Industry 4.0 is supported by technology and developments in production; however, HRs remain the cornerstone of it all (Liboni, L.B., Cezarino, L.O., Jabbour, C.J.C., Oliveira, B.G., & Stefanelli, 2019). Overall, it is important to note that Industry 4.0 not only poses various challenges regarding employee qualifications but also provides the possibility of new technologies that enable more efficient and safer training and learning processes. For example, mixed reality technologies, which each replace real-world visualization with virtual (learning) content, increase learning retention, increase problem-solving abilities and enable simulations with instant feedback in a safe training environment (Huang et al. 2010 in Blümel, 2013). Company leaders and HRD teams are required to better understand developments in the current situation and conditions. Using the latest technology is a must if you want to achieve success in the industrial era 4.0. The number of HR processes that can be done digitally, for example, assessment centers, virtual assessments, and others, has created a new HR model that everyone is required to be ready to face. Building human resources that can compete and be competitive requires a serious effort for the organization to form a strong organizational culture. Building an organizational culture based on good teamwork will lead to maximum results and goals (Permana, 2020).

## CONCLUSION

A manager is required to study and understand all management theories produced by various streams and the most suitable concepts or approaches to dealing with simple and complex problems and these approaches that describe the position and role of management at present and in the future. The industrial era 4.0 is an era of challenges for companies, especially managers, namely in digitizing the business processes that will be faced. Management theories in the future may be more on a more contributive approach to a result rather than a business process, why is that because the digitalization of business processes has been able to cut several stages in the management approach. Currently, what is more, important is the manager's ability to make a decision (decision making) with existing methods to make the right decisions for the sustainability of the company, and to encourage a significant shift starts some individuals or groups began to seriously look at the competitive situation of the company, market position, technology trends, and financial performance.

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