

Organizational Performance and Digitalization in Industry 4.0

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Abstract

The aims of the paper are to present the relationship between the concepts of organizational performance and digitalization in Industry 4.0, and to illustrate the case of a globally operating German car and motorcycle manufacturer, the Bayerische Motoren Werke Aktiengesellschaft. In recent years, organizations have increasingly launched, developed and delivered products and services, and interacted with their stakeholders in a digital manner. Social media, mobile and cloud computing, big data and the Internet of Things are among the new drivers of the actual business world and together with other digitally based technologies have a huge impact on today's organizational performance. Digitalization represents a key feature of the fourth industrial revolution or the so-called "Industry 4.0", a new phase in the development of industry all over the world. In Industry 4.0, products, logistics and services are technically and organizationally merged with one another by using cyber-physical systems in such a way that an increased and self-controlling production flow is created. In order to reach the aims of the paper the authors used a quantitative research method and a case study. The findings of the research showed that digitalization improves the performance of today's organizations and, in the case of the German company, leads to providing safer products for customers and achieving better results. The paper contributes to the development of the scientific literature by emphasizing the key role played by digitalization in obtaining a higher corporate performance.

Keywords: organizational performance, digitalization, Industry 4.0, company, BMW.

JEL classification: M10.

1. Introduction

Since the birth of modern organizations, concerns over their performance have stimulated the emergence and development of numerous researches and studies related to organizational performance. Therefore, the need for a systematic study of organizational performance both in the private and public sector has led to the expansion of a burgeoning literature that addresses key issues of this topic as organizations have always competed with one another. Especially the last decades witnessed the publication of several bestsellers (Peters and Waterman, 1982; Peters and Austin, 1985; Collins and Porras, 1994; Collins, 2001; Porter and Tanner, 2004) aiming at identifying the features of high performance organizations.

For a long period of time, organizational performance was regarded in a quantitative manner through the output terms. Later, it began to be assessed also qualitatively by reference to benchmarking and standards of performance (Armstrong and Baron, 2005).

In recent years, organizations have increasingly launched, developed and delivered products and services, and interacted with their stakeholders more and more on a digital way. Social media, mobile and cloud computing, big data and the Internet of Things are among the new

drivers of the actual business world and together with other digitally based technologies have a huge impact on today's organizational performance. Digitalization represents a key feature of the fourth industrial revolution or the so-called "Industry 4.0", a new phase in the development of industry all over the world. In Industry 4.0, products, logistics and services are technically and organizationally merged with one another by using cyber-physical systems in such a way that an increased and self-controlling production flow is created (KPMG, 2016). Companies that have successfully implemented Industry 4.0 became digital organizations, obtained increased annual revenues and reduced their costs (PricewaterhouseCoopers, 2016). The aims of the paper are to present the relationship between the concepts of organizational performance and digitalization in Industry 4.0, and to illustrate the case of a globally operating German car and motorcycle manufacturer, the Bayerische Motoren Werke Aktiengesellschaft (BMW AG). In order to reach these aims the authors used a quantitative research method and a case study.

2. Literature review

The main concepts of the paper, namely organizational performance, digitalization and Industry 4.0, are to be found in many articles and books worldwide. Thus, the term organizational performance can be defined in various ways as follows:

- "Organizational performance encompasses three specific areas of firm outcomes: (a) financial performance (profits, return on assets, return on investment, etc.); (b) product market performance (sales, market share, etc.); and (c) shareholder return (total shareholder return, economic value added, etc.)" (Richard et al., 2009, p. 722).
- Organizational performance represents "an analysis of a company's performance as compared to goals and objectives. Within corporate organizations, there are three primary outcomes analyzed: financial performance, market performance and shareholder value performance (in some cases, production capacity performance may be analyzed)" (Business Dictionary, 2018, p. 1).

Organizational performance and digitalization are already working close together. New methods of work, business models and organizational structures have been created in order to obtain higher performances as follows (Federal Ministry for Economic Affairs and Energy, 2015):

- Moving away from the organizational chart: instead of established line responsibility, the employees organize themselves into independent teams that work exclusively on particular projects. Instead of specific established functions, everyone works to attain the same goal (e.g., to create something new).
- Moving away from the old job: employees need time and opportunity to develop something new. By focusing their attention exclusively on the new project, they are investing time and energy into it without any frictions.
- Moving away from established regulations: sprint projects work exploratory, prototype-driven and after customer feedback. This is easier if employee have a higher degree of freedom than in the classic organizational chart.
- Moving away from the old office: working with short feedback cycles needs direct interaction. Colleagues exchange ideas informally in a project office or on a common floor, and develop faster a sense towards the project.
- Moving away from departmental thinking: teams are multi-functional and act across departments. The close cooperation of various people (e.g., product managers, knowledge professionals, software engineers, designers) in a team creates a comprehensive understanding of a product and/or service and triggers a change of perspective among the people involved in the project.

- Digitalization: people are working together in teams all over the world at the same time by using modern telecommunication devices and shared technology platforms.

Industry 4.0 describes the merging of production and information technology. It offers the opportunity to take the flexibility, energy and resource efficiency of production processes to the next level through intelligent control and networking. Electronics and sensors play a key role in these processes as they lead to cyber-physical systems that communicate with each other, optimize production and interact safely and reliably with human beings. The required hardware is based on complex microelectronic systems for the acquisition, processing and exchange of data as well as plant control. Such "More than Moore" systems combine sensor and actuator components, radio frequency and communication components, power supplies, power electronics and microelectromechanical systems (MEMS) as well as components from optoelectronics. Important applications are the tracking of production goods, the preventive maintenance of production facilities and relevant infrastructures through continuous monitoring and the statistical evaluation of process data. For such applications, various sensors and measuring methods must be used and combined. These increase the complexity of microelectronic systems, which at the same time have to fulfill high demands related to performance, reliability, robustness and energy efficiency.

This digital transformation is based on a fast and broad adaptation of technologies in the context of Industry 4.0. Each of them, and even more so in interaction with each other, has great potential to fundamentally influence the way people do business and work. The technological foundations of the digital transformation of the working and business world can be differentiated into the following fields of technology (Figure 1):

- Technologies related to the collection, processing and analysis of digital data, such as big data approaches.
- Technologies for networking systems (e.g. cloud computing) and for virtualization, such as augmented and virtual reality (AR / VR).
- Technologies for the automation of value chains and products, such as approaches of robotics (Gilchrist, 2016).

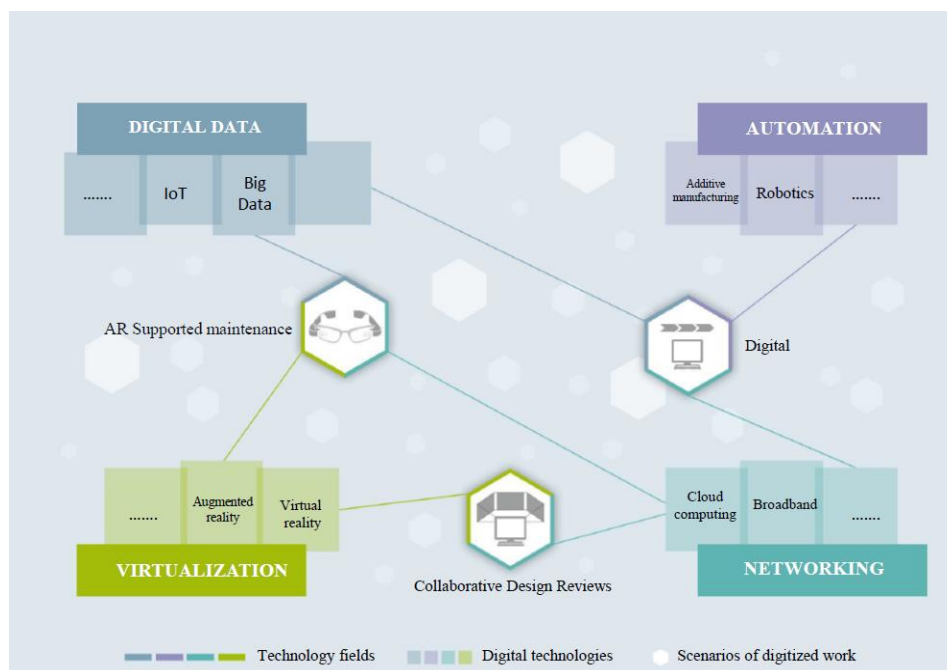


Figure 1. Digital technologies- the basis of the working world of today and tomorrow

Source: own adaptation after Institut für Angewandte Arbeitswissenschaft, 2016

Digitalization and networking are among the drivers of a comprehensive, dynamic and complex change: everything is going to be linked together, the evolution curve is going to be much higher and technology will co-work with people in a matter of impacting the performance and business processes in the daily activities of the company.

3. Research methodology

In order to achieve the two above mentioned research objectives the authors used a quantitative research method combined with a case study. In this respect, the authors searched for various sources of data in order to define the key concepts of the paper and to show their relationship by exemplifying the case of BMW AG. The information was gathered from secondary sources of data (e.g., annual reports, books and articles from the domains of management and information technology) through a desk research on the basis of a literature review. The literature review was conducted mainly in German libraries where electronic databases (e.g., SAGE) were found and consulted.

4. Digitalization, a driver of organizational performance at BMW AG

BMW AG is the parent company of the BMW Group, a globally operating German car and motorcycle manufacturer based in Munchen. The product range includes the automobile and motorcycle brand BMW, the car brands Mini and Rolls-Royce as well as the BMW sub-brands BMW M and BMW i. With its anniversary of 100 years of existence and the beginning of the digital age, BMW decided in 2016 to improve its organizational performance. In this respect, the company concentrated its efforts on three main issues (BMW Group, 2018a): strategy, process and resources (Figure 2).



Figure 2. A model for designing digitized working environments at BMW

Source: own adaptation after BMW Group, 2018a

The domain STRATEGY is designed in the following fields of action:

- *Corporate strategy* has to take into account the way the effects of digitization on corporate strategy are shaped. This applies to products and business models, but also

to the organization of value creation structures and service creation processes.

- *IT strategy* examines to what extent scenarios of digitized work influence this strategy. The topic of data security plays a central role. If value-adding processes and core competences are digitized, the protection of these data is crucial to business success.
- *Corporate culture* can be the biggest barrier to implementing digitized work environments. The willingness to change as well as the common togetherness is a critical success factor.

In the section PROCESS the following elements play an important role:

- *Digital organization*- by introducing scenarios of digitized work, the adjustments to the structure and, in particular, to the process organization of companies, are accompanied by profound changes that have come about. These need to be identified and appropriate recommendations for action derive.
- *Technical infrastructure*- an important prerequisite for the implementation of digital working environments is the provision of the necessary infrastructure. The focus is put on internal resources, such as the knowledge management systems.
- *Human-system interface*- the interaction between human beings and systems is designed. This applies to both motor and cognitive assistance systems. The focus is put on the effective completion of work tasks. Accordingly, it is necessary to design interaction possibilities and to define the division of tasks between people and systems.

Finally, the following three fields of action can be identified in the section RESOURCES:

- *Work organization and methods*- the digitization of work requires or enables new working methods and forms of organization. On the one hand, the work can be made even more flexible. An increasing delimitation of time and place can be observed. On the other hand, for example, new creativity methods in product design are possible - based on technologies such as the virtual reality.
- *Working tools*- digitized work tools are considered in terms of human-technology interaction. It has to be examined how technologies should be designed meaningful in the sense of the user in order to guarantee a technology acceptance among the employees. From this perspective, of course, already existing technologies must be considered.
- *Qualification*- scenarios of digitized work lead to a fundamental and continuous change in the activities and qualification profiles of the actors involved. It is important to involve the employees in this change and to accompany them. In doing so, chances and possibilities for a human-oriented organization of the working world have to be created, and, therefore, the human factor in the digital work plays a decisive role.

By implementing the above model and taking as a foundation the Watson AI technology, BMW AG has started a project aimed at helping vehicles communicate with each other and providing the driver a better understanding of traffic conditions, and, finally, to improving the organizational performance and supplying much safer products for the customers. The results after the first years were the following:

- Networked vehicles are now able to analyze real-time information to give vehicle users and fleet operators new insights. Thus, their experience is optimized.
- Information comes from vehicles and in-vehicle data, so that the driver can be better

understood and protected – digitalization of the business/customer communication.

- Engineers are connected to the vehicle over its entire lifecycle, and can improve and extend their functionality, avoiding quality issues and callbacks.

The main objective of the German company is that the car has to become familiar with driver's habits and provide suggestions on how to adopt a safer driving style, optimizing vehicle-to-vehicle communication or monitoring the status of the vehicle in order to diagnose and fix automatically any issue by implementing modern technologies like machine learning or internet of things improving the performance in the company (IBM, 2018). As a consequence, the net profit of BMW Group has continuously risen from 5,817 mil€ in 2014 to 6,396 in 2015, 6,910 in 2016, and 8,706 mil€ in 2017 (BMW Group, 2018b).

5. Conclusions

Being highly connected with the global megatrend of digitalization, Industry 4.0 has created the favorable environment for the digital transformation of the manufacturing industry. The findings of the research showed that digitalization improves the performance of today's organizations and, in the case of the German company, leads to providing safer products for customers and achieving better results. The paper contributes to the development of the scientific literature by emphasizing the key role played by digitalization in obtaining a higher corporate performance.

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