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DIFFICULTIES IN DIGITALIZATION OF PROCESSES IN MANUFACTURING COMPANIES

DOI: 10.21008/j.0239-9415.2024.089.11

The aim of this article is to present what difficulties occur on the path of a company's transformation towards Industry 4.0¹ and how the companies surveyed have dealt with them, as well as to show what results they have achieved in the area of digitalization and digitization. The article presents the process of digitalization and automation in Polish manufacturing companies. It identifies effective solutions and examines their impact on organizational performance. The research was carried out in two large manufacturing companies operating in Greater Poland. Each of these companies was at a different stage of digitization, and there were visible differences in the effects of implementation.

The main problems were that the implemented systems were not used by managers and there was an apparent lack of a process approach in both organizations. There was a lack of awareness that digitalization was just a tool to achieve better manufacturing efficiency. Most importantly, in both companies the management recognized the mistakes made and realized how important digitalization is for the development of the company, and in both companies measures were taken to improve the digitalization process. ALFA hired an external company to help implement the changes with a strong commitment from the top management. BETA continued to develop the solutions already implemented and is looking for new ones to help improve the processes.

Keywords: Industry 4.0, problems of implementing digitalization in manufacturing, digitalization of processes

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¹ "The term industry 4.0 – refers to the ongoing fourth industrial revolution (industry 4.0 in German), comes from the German government's high technology strategy project and was first used at the Hannover Messe international fair in 2011. In turn, the beginning of the fourth industrial revolution is considered to be 2013, when the final report on the work of a working group operating in Germany, dealing with, among other things, preparation of recommendations in the field of smart industry" (Baza Wiedzy, Przemysł 4.0, 2022; Bedykowski, 2017). Fourth-generation industry means integrating all areas of industry using IT (Gotz, 2018).



1. INTRODUCTION

Currently, digitization is affecting all sectors of the economy. The associated developments are evidence of the ongoing transformation towards Industry 4.0, which includes the integration of value chains, the introduction of new business models, and the digitization of products and services (Baza Wiedzy, 2022). Digitization is therefore a very important and current issue. Organizations know that they have to keep up with the latest trends and technologies to succeed and gain a competitive advantage (Bracha, Szody, 2021). Digitalization opens up new opportunities for enterprises, but also brings uncertainty related to various types of threats resulting from the social effects of process automation and broadly understood security (Gajewski, Paprocki, Pieriegud, 2016).

Many manufacturing companies are striving to transform themselves into Industry 4.0. This is visible, e.g., in the fact that enterprises implement IT systems that are aimed at optimizing processes, e.g., through access to more real data – downloaded directly from machine controllers, and not recorded in reports by employees carrying out processes. This gives a much more accurate picture of the production reality, with direct access to indicators such as availability or efficiency of machines. In addition, each person responsible for the process can have access to the necessary data at any time and without having to visit the production hall. Collecting such data directly from machines is facilitated by systems such as: MES (Manufacturing Execution System), which are increasingly being used in manufacturing companies. In order to improve data flow, these systems are combined with ERP² systems – mainly with the SAP system – which is the most popular system of this class, especially in large manufacturing companies. In addition, companies also implement CMMS³ systems, the purpose of which is to support processes related to the maintenance of the machinery park. Predictive maintenance solutions are also becoming increasingly common in corporate fleet management, which is a popular strategy for the optimal use of machinery. The effectiveness of this approach depends on the level of knowledge of maintenance staff at the various stages of implementing its elements. The basis for making predictions includes measurements of parameters such as vibration, temperature, noise or even information about the lubrication system (Kosicka, 2016). The main purpose of this solution is to predict potential failures and perform maintenance activities just before they occur, thus avoiding unexpected failures and minimizing downtime. There is strong evidence

² ERP (ang. Enterprise Resource) – technology is software designed to manage enterprise resources by exchanging information between its various departments (GUS, 2020).

³ CMMS (Computerized Maintenance Management System) “is a system designed primarily for maintenance departments. By assumption, it is to guarantee access to all information on the current state of the machine park and enable easy access to reports on current faults and planned repairs of machines. It can also improve the management of a team of department employees” (Bania, Lubera, 2022).

that the use of AI-based solutions improves the maintenance process in companies (Ejdys, 2023).

Digitalization in the area of the company's infrastructure also plays a major role, especially in terms of reducing the consumption of utilities such as steam and energy. To reduce costs in this area, organizations are first streamlining the process of data collection and ongoing access to data, e.g., through information collected in the cloud, and then analyzing this data, e.g., through Power BI reports. Based on the data gathered, they are looking for solutions to better manage the company's entire infrastructure, implementing systems such as the Building Management System (BMS).

Moreover, companies can also see the implementation of other systems or applications that support other processes, such as ordering raw materials, HR processes or visualization of results. It is also common to observe various types of Cobots⁴, i.e., cooperating devices that assist employees in various tasks related to, e.g., work on the production line (Grendys, 2022), humanoid robots⁵, or other solutions that help eliminate manual activities and eliminate paper from processes.

2. DIGITIZATION – OPPORTUNITIES AND CONCERNS

It is worth starting with an explanation of the word digitization, which is defined in English as: "digitalization of written and printed data contained on magnetic or other carriers" (PWN, 2022). This definition indicates the transition from paper documentation to electronic data recording. An example would be to scan a paper version of a book. Digitalization, on the other hand, could not happen without digitization. It is a broader concept, defined as: "disseminating and popularizing digital technology and introducing electronic infrastructure on a large scale" (PWN, 2022). Therefore, it is related to the broadly understood processing of digital data. Digitalization is a series of activities aimed at increasing the availability of the Internet and its resources as well as implementing electronic mechanisms. An example of digitalization can be submitting an electronic application via the Internet, e.g., to the office. Another broader and more complex issue is digital transformation, which would not be possible without digitization. This transformation provides opportunities to build new business and operational models, to

⁴ According to the International Organisation for Standardisation, collaborative robotics involves automatically controlled robot systems sharing the same workspace with humans, as opposed to standard industrial robot systems, which are usually separated from humans to protect them from injury (Platforma Przemysłu, 2022).

⁵ Humanoid robots in highly developed countries, in combination with other media, play an important role in people's daily lives and change certain types of human relationships. Using a robot, we can obtain the information we need just by "talking" to it, or even by entering into a "dialogue" with it. The machine interacts with the user, imitating face-to-face personal communication' (Koczy, 2018).

create new access channels for customers and to build new markets” (Pietruszyński, 2018). Transformation consists of creating the structure, strategy or organization of the entire company using new technologies for this purpose.

Digitization can be associated with the entire supply chain, but there are certain aspects that need to be paid special attention to. First of all, the transformation process must be in line with the company's goals and should be consistent. This means that it should cover all existing processes in the organization, not only those related to the IT area, but also those related to production planning, production organization, machine park maintenance or transport. An important factor is also the connection of all entities, which is possible thanks to the flow of information up and down the supply chain. All recipients, but also suppliers, should be involved and informed about all activities. It is also important to constantly develop not only digital opportunities, but also employees' competences. Digitization in the supply chain is therefore aimed at improving the flow of materials, information and finance (Bracha, Szody, 2021).

The main characteristics of the development of the digital economy are currently: \neg Internet of Things (IoT), enabling data transmission via the Internet network without human intermediation, only between machines or devices connected to the global Internet network, and the Internet of Things Everything (IoE). There are also solutions enabling: \neg ubiquitous connectivity (called hyperconnectivity), \neg applications and services based on cloud computing, \neg solutions enabling analysis of big data sets (Big Data Analytics – BDA) and big data operating as a service (Big-Data-as-a-Service – BDaaS), \neg automation and robotization, \neg multi-channel and omni-channel) product and service distribution models (Gajewski, Paprocki, Pieriegud, 2016). There is also growing interest in digital twins, “which can deliver additional services by leveraging physical simulation and AI algorithms” (Ejdys, 2023; Malucha, 2018).

Despite the access to all these solutions and the benefits of transforming enterprises towards Industry 4.0, it turns out that over 40% of the companies surveyed do not implement new solutions. The reason for this situation is that leaders feel comfortable with traditional approaches and incurring further outlays. They want to precede the maximization of profits from previous investments. Companies also point to difficulties in finding data analysts (35% of respondents) and almost every third sees a problem in the organizational structures functioning in companies, which are an obstacle to the proper flow of data. Respondents also believe that it can be very difficult to overcome barriers related to the company's culture (Grendys, 2022). The surveyed companies also pointed out the high costs of I4.0 projects, return on investment that is difficult to calculate, and too much of the data needed to make the right decisions. When it comes to technical issues hindering implementation, respondents most often pointed to separate infrastructures of operational and information technology departments, too restrictive communication protocols, and too limited remote access. Some pointed out that, unlike traditional

solutions, cloud systems and data analytics applications do not fit in with business processes (Grendys, 2022).

The aim of this article is to show how the above solutions are implemented in manufacturing companies, the problems that occur, and how companies are coping with the difficulties arising from the digitalization and digitization of processes.

3. DIGITALIZATION IN THE SURVEYED COMPANIES

The research was carried out in two manufacturing companies operating in the Greater Poland region. Both organizations are large international companies (ALFA, BETA), operating in Poland for over 25 years, in the FMCG industry. The managers of both companies decided to digitize their factories a few years ago. In both organizations, the goals related to these projects were quite similar. First of all, the management sought to improve the indicators related to the efficiency of production lines (both companies used the OEE indicator to monitor the efficiency of the line operation). The plan was also to eliminate paper versions of reports and other documents from the production and supporting processes. Attention was also paid to activities aimed at protecting the environment and occupational safety.

However, the approach to the implementation of digitalization was different. At ALFA, a digitization map covering all areas of the organization was developed and a digitization plan was created on its basis. In the second organization, this approach was more tool-based, related to the implementation and development of production management support systems. An example of this can be a project related to the implementation of the MES system in order to improve the process of collecting data from production halls (one of the assumptions was: removing the paper version of orders and production reports and transferring them in electronic form). It was also ensured that that data was sent to the system directly from PLC⁶ controllers. Subsequently, the objective was to develop the system, with particular attention paid to integrating the MES system with the ERP system. Looking at the system implementation process itself, it is clear that it was very well thought out, with several processes (e.g. related to the consumption of materials) optimized, and manual data collection removed.

ALFA, on the other hand, devoted a lot of time to build the strategy. It is worth noting that it had already implemented several systems (apart from the ERP and MES systems, several additional applications, e.g., for reporting production problems, a separate media management system and one more for project management) which did not fulfill their functions and their integration was difficult, and in some cases even impossible (e.g. due to the lack of system updates). This was a big prob-

⁶ PLC – Programmable logic controllers (PLC) are small industrial computers with modular components designed to automate custom control processes (Portal Przemysłowy, 2020).

lem because the data was scattered around multiple systems, sometimes duplicated, and required the expertise of specialists to operate and maintain each system, which the company lacked.

What could be noticed in both companies was the obvious lack of knowledge of the implemented systems by the management, both at lower and higher level. It was associated with not understanding the data that came from the systems, and therefore with their interpretation and taking appropriate action.

In addition, decisions on the implementation of a given system in ALFA were made a bit impulsively, often after a meeting with the seller of a given system, which also affected the number of systems implemented in the company as well as the quality of their implementation. Not all functions in the systems were used and developed, especially in relation to the SAP system. In the BETA company, the implementation of the systems looked much better, the ERP system was treated as a base system and was very strongly developed, adapted to the needs and well-integrated with the MES system. This was due to the fact that in the BETA company, SAP system developers were employed full-time, which made it easier to contact them when problems arose or something had to be changed in the system. In ALFA, the SAP system was operated by an external company and all changes involved high costs.

It is also worth noting that the IT systems offered on the market are very expensive. Implementing them is often associated with additional costs in the case of customization, which is often necessary to properly organize processes. System suppliers often offer “shelf” solutions that in theory are supposed to fit all companies, which unfortunately is not possible. Often, additional people are needed to handle them, with different competencies than those previously employed by specialists. What is also surprising, despite so many systems, companies often use Excel files, where data on, for example, line performance or machine downtimes are downloaded. This may be due to the reluctance of specialists and managers to use the systems. However, these are additional activities that must be performed and additionally there are errors in the data, because something was imported incorrectly from the system or there was an error in the formulas. Many such files were also found in the surveyed companies.

What else could be noticed in the = organizations surveyed was the lack of a process approach. Companies did not have mapped processes, and there was often a lack of responsible people. This extended the digitization process because before implementing an IT solution, it was necessary to analyze processes and often plan corrections in the flow of materials and information. It is also worth paying attention to the approach to IT project management in companies. Unfortunately, the surveyed companies often lacked the testing phase, implementations in pilot areas in order to check whether the solution worked well in the production reality. There was also a lack of appropriate training on the functioning and use of the systems. Often the operation of IT systems is associated with new competencies and requires the user to understand the entire process, and unfortunately this

was lacking in the surveyed companies. Taking into account the labour market and the high staff turnover in both companies, it turned out that after some time, from the moment the system was implemented, the people responsible for the system left the organization.. Therefore, there was a lack of knowledge about how the system worked, and this contributed to inhibiting further development of the solutions already implemented.

It is also worth paying attention to the approach to the change organization management. Often, information about the implementation of new solutions, modifications in the system was sent by e-mail without meeting the users and explaining the change. As a result, employees had problems with understanding the changes and using new functionalities in the system.

A Cobot was also purchased by ALFA, which was supposed to cooperate with a human because the tasks performed there were monotonous and not ergonomic. Unfortunately, this investment did not turn out to be a great success either because the robot did not have the expected performance – it slowed down the line and often broke down. This was due to an incorrect purchase and handling of the device.

Table 1 describes all the problems noticed in the surveyed companies and the proposals to remove/neutralize them.

Table 1. Summary of the problems examined and proposals to neutralize them

Identified problem	Proposed solution
Large number of systems being implemented / lack of integration of systems	Storage of data from systems on cloud solutions, which facilitates access to data and allows for easier integration. Support of specialists in the area of integration, e.g., external companies.
Poor use of implemented systems in daily work and decision-making processes	Removal of Excel solutions in areas where digital solutions have been implemented. Management commitment and use of systems in day-to-day work.
Lack of a process approach in companies	Starting projects with process mapping involving the process owner and all people involved in the process.
Incorrectly implemented system (e.g. no tests)	Delegate the implementation of the system to a specialist with extensive experience.
Lack of proper change management in companies	Involving stakeholders in the implementation of the system.

Source: author's own elaboration.

4. CONCLUSIONS

As S. Kopera notes in the book *Digitalization of Business Processes*, “digitalization of organizational processes is not only about installing and launching new software”. As research shows, companies often forget about it, assuming that the



implemented system will work by itself. It must also be taken into account that production management support systems are quite extensive and in order to function well, people working in the company must understand not only their functionality, but also learn in detail the processes implemented in the company. The implementation of the system itself is a difficult task, but not the most difficult one. What should be the focus of attention is that the potential of the solutions in place should be properly exploited. It is important to understand the data coming from the system and to use it skillfully. It is also important to consider the necessity of updating the system and the accuracy of the data that is inputted into it. All this is also associated with properly selected employees who take care of the functioning and development of the systems and are able to manage changes and provide user training.

In the research presented in the article, the implementation processes were different. In one company the results were better, in the other slightly worse. However, most importantly, ALFA noticed the problems that appeared in the digitization process and the company's management decided to become more involved in the process, making digitization one of the company's main priorities. Several specialists from the market were also hired to support organizations in the transformation. BETA +, on the other hand, has taken the next step. It is currently working on algorithms that will allow it to process the collected data.

Summing up the research, despite the problems and mistakes made in the digitization process, both companies are aware that this is the future for the entire industry. In order to be competitive, you need to follow this direction. Therefore, in both companies, actions are taken to improve the already functioning solutions, and new solutions in the area of digitalization and digitization are sought, which would help to optimize processes and reduce production costs.

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PROBLEMY CYFRYZACJI PROCESÓW W PRZEDSIĘBIORSTWIE PRODUKCYJNYM

Streszczenie

Celem artykułu jest przedstawienie, jakie trudności pojawiają się na ścieżce transformacji przedsiębiorstwa w kierunku przemysłu 4.0 i jak sobie z nimi poradziły badane firmy, a także pokazanie, jakie rezultaty osiągnęły w obszarze cyfryzacji. W artykule zostanie przedstawiony proces cyfryzacji i automatyzacji w przedsiębiorstwach produkcyjnych w Polsce. Jakie rozwiązania są skuteczne i jak wpływają na funkcjonowanie organizacji? Badania przeprowadzono w dwóch dużych przedsiębiorstwach produkcyjnych z Wielkopolski. Każde z tych przedsiębiorstw znajduje się na innym etapie procesu cyfryzacji. Każde z nich ma też inne efekty cyfryzacji, ale wspólne są problemy, które przedsiębiorstwo spotyka na drodze transformacji do przemysłu 4.0. Problemy wynikały głównie z tego, że wdrożone systemy nie były wykorzystywane przez menedżerów oraz z faktu, że w obu organizacjach nie stosowano podejścia procesowego. Brakowało świadomości, że cyfryzacja to tylko narzędzie poprawy efektywności. Co jednak najważniejsze, w obu przedsiębiorstwach kierownictwo dostrzegło popełniane błędy i zdało sobie sprawę, jak ważna dla rozwoju firmy jest cyfryzacja. Dlatego w obu firmach podjęto działania mające na celu usprawnienie procesu cyfryzacji. Firma Alfa zatrudniła doradców do wsparcia wdrożenia zmian i wykazała duże zaangażowanie ze strony najwyższego kierownictwa, a firma Beta samodzielnie rozwija wdrożone rozwiązania i poszukuje nowych, które pomogą doskonaląc procesy.

Słowa kluczowe: przemysł 4.0, cyfryzacja procesów, problemy wdrażania cyfryzacji w produkcji