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DIGITAL TRANSFORMATION PROCESSES OF MANUFACTURING ENTERPRISES IN ORGANIZED INDUSTRIAL ZONES: THE EFFECT OF DIGITAL TRANSFORMATION ON COMPETITIVENESS IN INTERNATIONAL TRADE

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Abstract:
Today, enterprises producing in every sector are looking for ways to increase efficiency and quality in their manufacturing processes. In the globalizing world economy, competition conditions are increasing day by day, and the cost of each product produced is monitored and kept under control. Most of the manufacturing enterprises operate in Organized Industrial Zones (OIZ). OIZ, in order to ensure the structuring of the industry in suitable areas, to direct urbanization, to prevent unplanned industrialization and environmental problems, to use the resources rationally, to place the industrial types within the scope of a certain plan, to establish certain laws in the necessary administrative, social and technical infrastructure areas within the zoning plans of the previously determined land plots. It refers to the production regions of goods and services that are operated in accordance with the provisions of the law. It is observed that manufacturing enterprises operating in OIZ regions face difficulties in digital transformation processes. These challenging processes can cause many manufacturing businesses not to switch to digital transformation. However, with the right planning and management of the manufacturing enterprises in the OIZ, the digital transformation processes will be much easier, faster and less costly. Manufacturing enterprises that complete their digital transformation processes gain advantages over their competitors in international trade in terms of performance and productivity gains. In this study, the digital transformation processes of the manufacturing enterprises in the OIZs will be examined, and the difficulties experienced, the application methods and the advantages provided after digital transformation will be discussed. It is aimed to contribute to the digital transformation processes of manufacturing enterprises located in other OIZs by examining the application methods of digital transformation in an exemplary manufacturing enterprise in detail. The advantages of manufacturing companies that have successfully completed digital transformation and their impact on competitiveness in international trade will be examined.

Keywords:
Industry 4.0, Digital Transformation in Industry, Organized Industrial Zones, Production Systems

1. Introduction

The first of these is the design and commissioning of all processes together with industrial automation systems and production management systems (MES), starting from the design of a newly established manufacturing company. In this case, there is no need for an additional digital transformation solution, as all processes in the manufacturing company are designed in a digital environment and commissioned accordingly. This situation provides a great advantage to the enterprise, all production processes can be monitored in the digital environment from the moment the production starts in the enterprise. The biggest disadvantages of this solution are the high initial investment cost, longer implementation and commissioning processes, and the need for technically qualified personnel. Because of these, it is seen that the number of businesses that choose this solution is not very high. The second application we encounter is the enterprises that were established many years ago, manufacturing and at the same time wanting to implement Industry 4.0 and Digital transformation applications on their own production lines. In this study, the basic concepts and a sample application related to the application processes of both industrial automation and control systems and the Industry4.0 concept will be discussed. On the one hand, the difficulties experienced by the manufacturing enterprises in the digital transformation processes will be examined, on the other hand, the advantages of digital smart factories will be evaluated on a casting manufacturing company located in Elazig OSB. At the same time. The advantages of manufacturing companies that have completed their digital transformation processes compared to their competitors in international trade will be evaluated, and the advantages to be provided both in terms of performance and efficiency gains and production costs will be discussed. Since Industry 4.0, which is described as the age of digital industry, cannot be successful only as an academic or commercial enterprise, the triangle of academia-business-politics should be drawn solidly. With this article, it is aimed to raise awareness to many people in environments such as growth, employment, investment, business world, academia and government institutions & organizations and help the adaptation of this new level to be achieved in a successful and easy process.

2. Digital Transformation in Industry

Digitalization is moving towards a completely different process with the rapid development of information technologies in recent years, especially with the introduction of smart phones into our lives. Not a day goes by that a new application that we use in our daily life does not enter our lives. Especially during the Covid-19 pandemic, we can see how digital applications make our lives easier. The importance of digitalization and Industry 4.0 was once again clearly understood during the Covid-19 outbreak. It has been seen that it is very important for the sustainability of production in such epidemic disease conditions that the operations are carried out using minimum people at different stages of production (Kayar, 2020). Nowadays, when digitalization has entered our lives so intensely, the digitalization of production or digital transformation in production is encountered with industrial applications with the same intensity. Digitalization and Industry 4.0 are met with interest in almost every sector. When Industry 4.0 was mentioned for the first time at the Hannover fair held in Germany in 2011, no one thought that the process would develop so quickly. We see that the rapidly developing digital transformation applications all over the world are now used in production lines. It is seen that IoT, big data, autonomous robots, simulation, system integration, cyber security and augmented reality (AR) applications, which are considered as the main components of Industry 4.0, are preferred for different purposes in different processes in different processes. Especially in production lines where continuous production is made, digital transformation applications play an important role (Kayar et al., 2019). The changes in social and economic systems that emerged with the rapid development of new technologies led to a global revolution known as the 4th Industrial Revolution. Industry 4.0 is characterized by the rapid development of the internet of things (IoT), artificial intelligence and machine learning; It radically changes human lifestyles and significantly contributes to the development of new production methods (Ben Arfi et al., 2021). Nine different technologies, known as Industry 4.0 components, are already used in different ways on production lines. However, with Industry 4.0, manufacturing, isolated and optimized cells come together as a fully integrated, automated and optimized production flow, leading to greater productivity and changing traditional production relations between suppliers, manufacturers and customers and people (Öztürk et al., 2019). IoT, big data, autonomous robots, simulation, system integration, cyber security and augmented reality (AR)applications, which are the main components of Industry 4.0, have been used extensively in production lines in recent years (Kayar et al., 2019). Industrial automation systems and digitalization are the most important elements for businesses that aim to increase efficiency in engineering and operations, reduce operating costs and improve product quality. When it comes to digitalization and smart manufacturing, manufacturing businesses around the world often have to address key 2. Organized Industrial Zones and Manufacturing Sector

Organized industrial zones allocate private sector investments to certain regions in order to balance regional development. In addition, by meeting the land needs of developing industries, they support industrial production according to a certain program, thus forming an external economy. In addition, organized industrial zones contribute to national development goals by promoting the underdeveloped regions in which they invest in order to ensure regional equality (Dursun et al., 2019). The development process and results in industrial areas in southern China differ from those in other land use areas due to the very different land and regulatory regimes. The stimulus of the 1980s producer economy was supported by simple zoning arrangements in many industrial zones that received little demand from developers in exchange for rapid investment. Such an approach was adopted first in the Shenzhen Special Economic Zone (SEZ) and later in Bao'an and Longgang districts, Dongguan, Huizhou, and other Guangdong export-oriented manufacturing cities (Zacharias and Ma, 2015). In the current global trend of industrial development, generating economic benefits is no longer the sole purpose of industrial development. Increasing importance is given to the concept of harmonious and continuous development of the economy, environment and society and has begun to advocate the use of "eco-efficiency" to measure the relationship between economic value and environmental impact. An Eco-Industrial Park has a sustainable relationship between the economic, environmental and social aspects of planning the exchange of material and energy resources of the industrial system, minimizing resource consumption and reducing waste emissions (Pai et al., 2018). Resource integration allows industries to promote cyclical operations that lead to the creation of sustainable systems. Industrial parks integrate multiple processes in this way to achieve greater cumulative economic and environmental benefits that exceed those achieved by the independent operation of these processes. Over time, technological advances, market fluctuations and regulatory changes can cause the processes and resources that make up a network to change (Abraham et al., 2022). Businesses operating in OIZs can provide cost advantage, efficient use of country resources and prevention of technology waste, by providing many investments they make individually, such as license, hardware, internet, education, employment, energy and air conditioning system, by an organization and teams to be provided by the OIZ managements.

Gebze Organized Industrial Zone (GOSB) management, which has successfully carried out these studies, has been providing technology services to manufacturing enterprises for many years. GOSB management, which is a good example for Turkey and the world, meets the technological infrastructure needs of manufacturing enterprises with its telecommunication, data center and security operation center services.

3. Application Example

The project work for the Industry4.0 digital transformation of production and maintenance processes in an iron casting factory located in Elazig OIZ has been examined. After this digital transformation application, the efficiency of the enterprise, performance increases, improvement of production and maintenance processes and the competitive advantages of the enterprise in the international market as a result of digital transformation were examined in detail.

3.1. The Project Summary

In the digital transformation project, necessary studies were carried out to identify, collect, archive, monitor and report the data generated during the production and maintenance processes. The studies carried out during the transformation process carried out within the framework of Industry 4.0, which provides up-to-date technology and industrial standards, are shown in (Table 1)

Table 1. Studies in Iron Casting Plant

No	Application areas and operations
1	Supply and field installation of data collection digital infrastructure equipment
2	Installation and commissioning of KIOSK and Andon stations
3	Commissioning the MES application
4	Polymer line digital transformation
5	Core line digital transformation
6	CIME Casting line digital transformation
7	Robot grinding line digital transformation

8	Digital transformation of molding and sand preparation
9	Digital transformation of laboratory unit
10	Commissioning of forms and reports
11	Commissioning of the periodic, breakdown and preventive maintenance module

3.2. System Architecture and Methodology

A project study was carried out to transform the existing production and maintenance data in casting processes into meaningful values. In this study, all necessary digital activities were implemented as a transformation strategy. The data architecture from the machines is shown in (Figure 1).

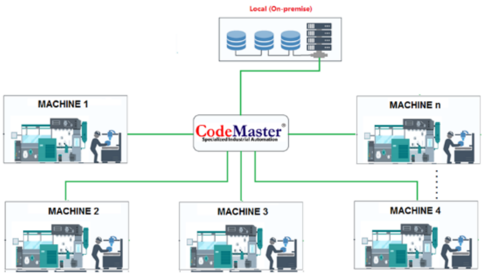

Figure 1: Data Collection Architecture From Machines

4. Methodology of the Research

A digital transformation project is being carried out in an iron casting company operating in Elazig OIZ. The name of the project is "Smart Casting Line". OEE (Overall Equipment Effectiveness) calculation method is used to improve the processes of production lines. It is a measurement technique that shows how an operator can take advantage of a machine, meter or equipment. The following parameters will be taken into account when calculating OEE:

A) Performance rate = (standard cycle time x production rate) / (Planned production time – unplanned downtime)

B) Equipment availability rate = (Planned production time – unplanned downtime) / Planned production time

C) Quality rate = correct product rate / total production rate

OEE = Performance x Availability x Quality

The following calculations were made according to the B shift production data dated 23.05.2022 at the Elazig plant. Example of OEE actual shift report is shown in (Figure 2).

Performance Calculation = A

Actual Capacity= Working Time (s) / Target Production Cycle (s) Capacity = 317 units (60min x 275min /52sec)

Performance % = Actual production (Printed) / maximum production(capacity) x 100%

Performance % = 311 / 317 x %100 = % 98,11

Availability Calculation = B

Availability% = Working Time / Shift Time (Planned) x 100% Availability % = 275min / 480min x100% = 57.62%

Quality Calculation = C

Quality % = (Net Spilled / Printed mold) x (1 – Injured number/Net Spilled)

Quality % = (282/311) x (1-0/282) = 90.68%

OEE= A X B X C = 98.11 X 57.62 X 90.68 = 51.26%

Vardiya Raporu					
Model	Basilan	Dökülen	Bozuk Kalip	Free Line	Tonaj
M1151 KAPA		10	0	1	0.60
M1121 KAPA		34	0	1	3.23
M 1129 KAP		34	3	8	3.43
M1129 KAPA		62	1	4	6.20
FONDE 3B C		142	21	24	8.52
Toplam	311	282	25	38	21.98

Vardiya Bilgileri						
Vardiya Süresi	Durus Süresi	Çalisma Süresi	Kullanabilirlik	Performans	Kalite	OEE
480 dk	204 dk	275 dk	57.62 %	98.11 %	90.68 %	51.26 %

Figure 2: Example of OEE Actual Shift Report

5. Conclusion

The biggest impact of digital transformation is traceability of production processes. After the digital transformation application, the malfunctions occurring in the enterprise can be monitored instantly and the technical personnel can intervene in a very short time. Thus, we see that the downtimes in the manufacturing processes in the iron casting plant have decreased and the productivity has increased. As of December 2021, as a result of the improvement made in the production line as the achievement of the digital transformation MES application, 52 sec. The target cycle speed is 48 sec. It has been updated to approximately 10% performance increase. Accordingly, the shift production capacity, which was approximately 554, increased to 600. As can be seen from these data, digital transformation applications not only enable the monitoring of production processes, but also increase the efficiency of manufacturing enterprises and create value for the enterprise.
Our manufacturing businesses will become competitive in international trade with the advantages of digital transformation, both in technology and in production costs. A traceable and curable production process will always provide advantages in terms of sustainability. In order to be aware of the features of the Digital Transformation project, such as scalability, interoperability, dissemination and ease of operation, accessibility and operational management, and ease of installation and learning of selected technologies, frequent digital transformation awareness trainings should be organized and a perception of transformation should be created as an organization.

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