International Journal of Scientific Research and Management (IJSRM)
||Volume||10||Issue||04||Pages||EM-2022-3312-3321||2022||
Website: www.ijsrm.in ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v10i4.em9

The Effect of Industry 4.0 Maturity on Company Performance in Manufacturing Companies

[1] Ilker KARADEMIR, [2] Murside OZGELDI,

[1] PhD Student, Graduate Education Institute, Maltepe University, Istanbul, Turkey,
[2]Ass. Prof. Dr., Graduate Education Institute, Maltepe University, Istanbul, Turkey,

Abstract
The business world is changing rapidly, business models, products, services, customer expectations and the market are affected by this change. Undoubtedly, the manufacturing industry is also affected by this rapid change in technology and industry. It is clear that companies need to adapt to the environment where this technology and digitalization are developing so rapidly. If the companies how better adapt to the Fourth Industrial Revolution (Industry 4.0), they will be permanent in this environment of uncertainty and they will gain a performance advantage over their competitors. In this study, the effect of Industry 4.0 maturity level of companies in the production sector in Turkey on firm performance was examined.

Keywords: Industry 4.0, Firm Performance, Manufacturing Companies

1. Introduction

The digital revolution has begun. In the face of constantly evolving new technologies and the potential they provide, it is very difficult for leaders to predict how the digital future will affect their companies or the industries they are in, but it is not impossible. Companies that are open to transformation and capable, agile, and eager for digitalization will overcome this challenge more easily than their competitors.

Many of the Industry 4.0 technologies will have far-reaching implications and are still open to shaping. The environmental impact of many technologies will depend on which stakeholders are involved in the design of these technologies, how the materials are obtained, and what voluntary agreements are reached about the ways waste is protected, recycled and disposed of. Companies should establish processes of reflection on these nonlinear broader impacts and strive to understand how the organizational process and incentives value certain opportunities over others. This can provide perspectives that help companies empower and enrich their staff, customers and local communities. Achieving this requires stepping back and looking from afar to see potential conflicts and negative consequences, and being realistic about the potential for new technologies to impact the company, consumers and society at large (Schwab, 2019, s. 310-313).

2. Theoretical Background & Literature Review

Industry 4.0 maturity of companies; To what extent they adapt to industry 4.0 components, to increase company performance, to increase employee and customer satisfaction, to expand market share, to digitize the product portfolio, to use data and analysis to improve the work done, and to cooperate with all stakeholders such as customers, suppliers and workforce, managing integrated sales channels (in addition to physical sales areas, web site, online shopping site, social media platforms, blogs, etc.), dynamism of products/services and pricing systems and customization for customers, to what extent all processes from product development to production and sales are digitized The level of sophistication and digitality of production equipment, starting from the top management to the lowest employee, is examined in outlines such as Industry 4.0 participation, support and expertise. Some of these studies are as follows;

- Sustainable Industry 4.0 in Production and Operations Management: A Systematic Literature Review (Felsberger & Reiner, 2020 , s. 7982)
- The Impact of Industry 4.0 on Corporate Financial Performance: A Controlled Brokerage Model (Hong-Long, 2021, s. 6069)
- Industry 4.0 as a Moderator of the Impact of Lean Manufacturing Practices on Operational Performance Improvement (Tortorella, Giglio, & van Dun, 2019, s. 860-886)
- The Relationship Between Industry 4.0 and Supply Chain 4.0 and The Effects of Its Applications on the Performance of Companies: Latest Technology (Sassi, Ali, Hadini, Ifassiouen, & Rifai, 2021, s. 820-828)
- Corporate Survival in the Age of Industry 4.0: The Facilitator Role of Lean-Digital Manufacturing (Ghobakhloo & Fathi, 2020, s. 1-30)
- Industry 4.0 Maturity Model Proposal (Santos & Martinho, 2020, s. 1023-1043)
- Cyber-Physical Systems, Internet of Things and Big Data in Industry 4.0: Digital Manufacturing Technologies, Business Process Optimization and Sustainable Organizational Performance (Plumpton, 2019, s. 23-29)

2.1. Industry 4.0 (Fourth Industrial Revolution)

World history has been shaped by three radical revolutions. The Cognitive Revolution, which began 70,000 years ago, the Agricultural Revolution, which began 12 thousand years ago, and finally the Scientific Revolution, which began about 5 centuries ago (Harari, 2012, s. 17). The scientific revolution can be briefly discussed in four groups (Schwab K. , 2017, s. 16);

- Industry 1.0: It is the revolution that started with the use of railways and steam engines in 1760-1840 and pioneered mechanical production.
- Industry 2.0: It is the revolution that started in the late 1800s and early 1900s, with the mass production line and the integration of electrical energy into these mass production lines.
- Industry 3.0: It is the revolution that started in the 1960s when digital technologies replaced electrical and mechanical technologies in production.
- Industry 4.0: We can say the name of the era and revolution in which digitalization, which is developing more and more, becomes much more effective in our lives, artificial intelligence is involved, in short, almost every product and service can be digitized.

Industry 4.0; which came to the fore in Germany, is the name of one of these strategies. It is one of the main topics of the World Economic Forum. The Fourth Industrial Revolution was first used at the Hannover Fair in 2011. Bosch GmbH and H. Kagermann formed a working group and prepared the "The Fourth Industrial Revolution" submitted its proposal file to the German Government in 2012. The working group presented its report on Industry 4.0 at the Hannover Fair in 2013.

In the manufacturing sector, with the important industrial revolutions, countries and companies have had to adapt to these global changes and have developed some strategies in order to survive in the increasing competitive conditions.

Industry 4.0 can be defined as the digital-based transformation of production. Systems engineering-technologies, artificial intelligence, augmented reality - technology revolution applications and tools such as virtual reality, 3D printers, autonomous (autonomous) vehicles, cyber security, robots, sensors, bio-nano materials, digital social media, internet of things, production models Beyond its transforming power on marketing, sales approaches and logistics storage, it is necessary to think about its impact on social life and living codes.

The main difference of the fourth industrial revolution from other early revolutions is the intertwining of all these technologies and their mutual interaction in physical, digital and biological fields (Schwab K. , 2017, s. 17). In addition, the development and change of the revolution we are in is increasing exponentially compared to other revolutions, that is, this change is developing very quickly and it seems very difficult to adapt.

We need to think about what we need to do to shape the fourth industrial revolution. Living in a time of tremendous technological change brings a responsibility to take action. The more mature technologies and technical architecture, and the more stable usage and habits, the harder it is to bring systems into such a balance that they truly serve the largest possible segment of society, nations, and industries. The speed and scale of Industry 4.0 means that the world does not have the luxury of latency, in a future full of the possibilities of artificial intelligence, genetic engineering and autonomous vehicles, and in a virtual world where every part is as difficult as the real world to master, we can determine and define rules, standards, laws and business practices that will serve all people. It takes a lot of work to set it up (Schwab, 2019, s. 293-305).

Digital transformation is a radical change, it is inevitable for institutions to invest in education and learning in order to develop the digital skills of their human resources. Digital transformation is not a subject that can only be carried out under the responsibility of the IT departments of companies, it is an issue that companies should work and focus on as a whole. In adapting to digital transformation, the first task is considered to be leaders. In the literature review of the years 1990-2019, it is understood that there has been a paradigm shift in leadership. Therefore, it has emerged that research on the definition, characteristics and styles of digital leadership is necessary (Özmen, Eriş, & Özer, 2020, s. 63).

2.2. Firm Performance

To be successful, businesses must be fully aware of the factors that shape their environment. It is necessary to have shared norms, values and beliefs that are compatible with the environment and supported by the employees. The challenge to compete is to work in parallel with these factors while providing differentiated value or service to customers. If the culture of the business does not make it easier to adapt to its environment, it will either change the culture it has or will not survive (Schein & Schein, 1997).

For this reason, the work of every leader within institutions and companies should be defined in terms of the contribution he has to make to the economic results of his institution or company. Completing a job they are assigned with in terms of work and ability, their contribution and effort is sufficient for the employees. For employees who have to have a certain level of knowledge and judgment, self-direction and motivation, the main emphasis should be on contribution and results (Drucker, 1998, s. 256).

Firm performance; Sustainability of a company and being able to compete with its competitors can be evaluated under various sub-headings such as relatively high profitability, low costs, productivity, high customer and employee satisfaction, better financial indicators than competitors, product and service quality. In short, it can be defined as the outputs of the company. The people who make decisions about determining the vision, goals and strategies that will affect the performance results of the companies are the members of the organization that make up the top management of the companies, and it is expected that these companies will be the leaders who determine the strategies by deciding at what point and at what level they will be in the future. Studies show that organizational culture has an impact on the development of company goals, strategies, individual behavior, organizational performance, motivation and job satisfaction, innovation, decision making and organizational commitment of employees (Lok & Crawford , 2001, s. 594).

In order to achieve and maintain high performance in the ever-changing market environment, it will be beneficial for companies to turn Industry 4.0's crises into opportunities and adapt quickly to this digitalization.

In the "Leading Digital" book, four types of digital mastery levels are specified, taking into account Digital competence and Leadership competence. These; They are beginners, fashionistas, keepers and digital masters. digital masters; They are companies and managers who have a strong comprehensive digital vision, excellent governance, numerous digital initiatives that produce measurable business value, and have built a strong digital culture. A striking performance difference has been found in studies conducted in companies that manage this digitalization well. It has been seen that the two crucial elements of digital mastery (digital and leadership competencies) are identified with different types of performance, and companies that have gained a certain level of competence have surpassed their competitors in the sector in some performance criteria. It has been observed that these companies are 26% more profitable than their competitors in the sector and generate 9% more income from their physical assets (Westerman, Bonnet, & McAfee, 2015, s. 27-35).

2.3. Hypothesis

When the studies in the literature and the variables in question are examined, we expect that the Industry 4.0 Maturity level positively affects the Firm Performance. The hypotheses for this are stated in the next section. The main hypotheses of the research are given below;

Hypothesis 1: *There is a positive relationship "Industry 4.0 Maturity" and "Firm Performance".*
Hypothesis 1a: *There is a positive relationship "Business Models, Product & Service Portfolio" and "Firm Performance".*
Hypothesis 1b: *There is a positive relationship "Market & Customer Access" and "Firm Performance".*
Hypothesis 1c: *There is a positive relationship "Value Chains & Processes" and "Firm Performance".*
Hypothesis 1d: *There is a positive relationship "Organization & Culture" and "Firm Performance".*

3. Methodology

In this study, in which the quantitative research method was used; Relational screening method was used to test the relationship between the variables. Relational screening models are research models that aim to detect the existence and degree of change between two or more variables. In relational scanning, two types of arrangements can be made as correlation (r, R) and comparison (F, t, x^2). Here, the type of correlation is divided into three different types; Nondirectional change (unrelated), Same way change and Reverse change (Karasar, 2016, s. 114-116).

IBM SPSS Statistic v28 program was used in the analysis of the data obtained from the research. Descriptive statistical methods, exploratory factor analysis, reliability analysis, Pearson correlation analysis, and regression analysis were used in the analysis of the data.

A questionnaire was used as data collection tool and these data were obtained online. In order to measure Industry 4.0 Maturity and Firm Performance variables, which are discussed within the scope of the research, the relevant literature was examined and the scales that were used before, validity and reliability studies were determined, and a questionnaire was created from these scales. Briefly, the information about the scales used in the study is as follows:

- Industry 4.0 Scale: Studies are newly shaped today to measure Industry 4.0 maturity. The strongest of them; The 2016 Global Industry 4.0 Survey scale of PWC (Price Waterhouse Coopers) was used.

- Firm Performance Scale: In 2002, Ellinger et al. finalized the firm performance questions in their own study by making use of the work done by Watkins and Marsick in 1997. This scale was used in the study (Ellinger, Ellinger, & Keller, 2002, s. 26).

3.1. Research Model

It is predicted that companies can be one step ahead of their competitors, that those who manage these companies will be able to increase their company performance by raising their Industry 4.0 Maturity level,

by predicting the destructive changes in the current moment. To test this hypothesis, the following model was established (see Figure 1).

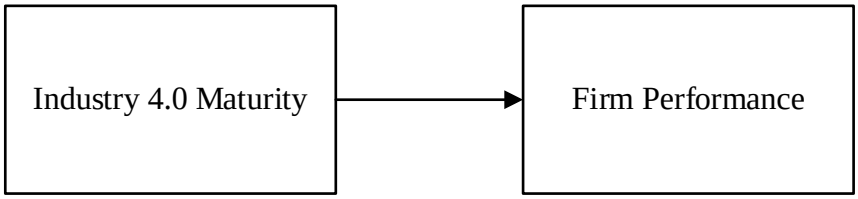

Figure 1: Research Model

4. Findings

4.1. Samples, Participants & Procedure

Research group; In 2020, it consists of a total of 103 company employees between the ages of 21-60, at the graduate, undergraduate, associate degree education levels of the production companies potentially affected by the Industry 4.0 revolution in Turkey. Demographic information is below (see Table 1).

Table 1: Demographics of the respondents

		Frequency	**Percent (%)**
Gender	Female	49	47.6
	Male	54	52.4
Age	21-30	34	33.0
	31-40	59	57.3
	41-50	9	8.7
	51-60	1	1.0
Company Age	1-10	3	2.9
	11-50	6	5.8
	51-200	12	11.7
	201-500	27	26.2
	501-1000	25	24.3
	1000+	30	29.1
Total Work Experience	0-1	5	4.9
	1-5	23	22.3
	6-10	25	24.3
	11-20	41	39.8
	21-30	9	8.7
Education Level	Master's degree	49	47.6
	Bachelor's degree	51	49.5
	Associate degree	3	2.9
Total		N=103	100

4.2. Statistical Analyses

The results of the reliability analysis of the research are below (see Table 2). Industry 4.0 maturity Crombach's Alpha is 0.941 and Firm Performance is 0.929.

Table 2: Reliability Analysis

	Cronbach's Alpha	Number of Expressions
Industry 4.0 Maturity	**0.941**	**21**
1.1.Business Models, Product & Service Portfolio	0.824	6
1.2.Market & Customer Access	0.888	6
1.3.Value Chains & Processes	0.861	5
1.4.Organization & Culture	0.860	4
Firm Performance	**0.929**	**16**

Kaiser-Meyer-Olkin and Average Variance Extracted (AVE) values are given in the table below (see Table 3).

Table 3: Kaiser-Meyer-Olkin & AVE

	KMO	AVE (%)	Bartlett's Test		
			Chi-square	df	Sig.
Industry 4.0 Maturity	0.897	67.809	1433.416	210	<0.001
Firm Performance	0.865	73.221	1107.983	120	<0.001

Descriptive analysis results are given below. Participants of the research; Industry 4.0 Maturity score average is 3.349, Firm Performance average score is 3.706 (see Table 4).

Table 4: Descriptive Analysis

	N	Minimum	Maximum	Mean	Std. Deviation
Industry 4.0 Maturity	**103**	**1.57**	**5.00**	**3.349**	**0.714**
1.1.Business Models, Product & Service Portfolio	103	1.50	5.00	3.510	0.748
1.2.Market & Customer Access	103	1.00	5.00	3.248	0.897
1.3.Value Chains & Processes	103	1.20	5.00	3.476	0.805
1.4.Organization & Culture	103	1.00	5.00	3.100	0.876
Firm Performance	**103**	**1.69**	**5.00**	**3.706**	**0.592**
Valid N (listwise)	103				

According to the results of the correlation analysis; There is a positive and significant relationship between Industry 4.0 Maturity and Firm Performance (r:0.507; p<0.01). On the other hand; Business Models, Product & Service Portfolio and Firm Performance (r:0.408; p<0.01), Market & Customer Access and Firm Performance (r:0.449; p<0.01), Value Chains & Processes and Firm Performance (r:0.452; p<0.01), there is a positive and significant relationship between Organization & Culture and Firm Performance (r:0.437; p<0.01). According to these results; As the participants' perceptions of Industry 4.0 increase, their perceptions of Firm Performance increase in the same direction (see Table 5).

Table 5: Corelation Analysis

	Mean	**Std. Deviation**	1.Industry 4.0 Maturity	1.1.Business Models, Product & Service Portfolio	1.2.Market & Customer Access	1.3.Value Chains & Processes	1.4.Organization & Culture
Industry 4.0 Maturity	**3.349**	**0.714**	---				
1.1.Business Models, Product & Service Portfolio	3.510	0.748	.828**	---			
1.2.Market & Customer Access	3.248	0.897	.854**	.530**	---		
1.3.Value Chains & Processes	3.476	0.805	.903**	.693**	.687**	---	
1.4.Organization & Culture	3.100	0.876	.867**	.650**	.647**	.769**	---
Firm Performance	**3.706**	**0.592**	**.507****	**.408****	**.449****	**.452****	**.437****
**. Correlation is sig. at the 0.01 level (1-tailed, Pearson).							

According to the results of the regression analysis; The degree to which Industry 4.0 Maturity explains Firm Performance is (R^2: 0.257 $p<0.01$) (see Table 6).

Table 6: Regression Analysis

Constant	**Dependent Variable**	**Constant**	**β**	**R^2**	**Sig.**	**S.H.**	**t**	**F**
Industry 4.0 Maturity	Firm Performance	2.196	0.507	0.257	<0.001	0.5129	9.429	34.966

The Digital Applications Used and Industry 4.0 Applications Used of the companies participating in the research are given below (see Table 7-8). As seen here, ERP - Enterprise Resource Planning 88.3%, MRP - Material Requirements Planning 86.4%, CRM - Customer Relationship Management 73.8%, BI - Business Intelligence 67.0% are used.
Moreover; Big Data & Analytics 54.4%, Cyber Security 49.5%, Cloud Computing 46.6%, Artificial Intelligence 38.8%, Deep Learning & Machine Learning 33.0%.

Table 7: Digital Applications Used

Digital Applications Used	**Frequency**	**Percent (%)**
ERP - Enterprise Resource Planning	91	88.3%
MRP - Material Requirements Planning	89	86.4%
CRM - Customer Relationship Management	76	73.8%
BI - Business Intelligence	69	67.0%
SCM - Supply Chain Management	66	64.1%
WMS - Warehouse Management System	61	59.2%
EDI - Electronic Data İnterchange	54	52.4%
MES - Manufacturing Execution System	52	50.5%
RPA- Robotic Process Automation	43	41.7%

PLM - Product Lifecycle Management	39	37.9%
BPM - Business Process Management	38	36.9%
EAM/CMMS - Enterprise Asset Management	29	28.2%
APM - Application Performance Management	13	12.6%
Other	6	5.8%

Table 8: Industry 4.0 Applications Used

Industry 4.0 Applications Used	**Frequency**	**Percent (%)**
Big Data & Analytics	56	54.4%
Cyber Security	51	49.5%
Cloud Computing	48	46.6%
Artificial Intelligence	40	38.8%
Deep Learning & Machine Learning	34	33.0%
Autonomous Robots, Cobots	29	28.2%
Internet of Things & Internet of Services (IoT-IoS)	23	22.3%
Additive Manufacturing (3D Printers)	18	17.5%
Virtual Reality - Augmented Reality (VR-AR)	17	16.5%
Smart Factory	12	11.7%
Cyber Physical Systems / Simulation	9	8.7%
Other	2	1.9%

5. Results and Discussion

The pace of change in today's world has increased exponentially. Innovation and technologies are disrupting the order and our lifestyle is changing day by day. As individuals, the digital services offered are also increasing and diversifying. Online shopping, sharing economy, network interaction, etc. While this is the case, it is certainly not possible to assume that the structure and rules of our business will remain the same, or at most will undergo a superficial change. Our old way of dealing with our customers is no longer valid, and this relationship is managed by customers who are increasingly aware of their preferences, strengths and rights. This rapid evolution can be frightening for most of us, and it is human nature to ignore it and argue that our business and expertise should stay away from this wave of change. The truth is that this situation falls outside of our sphere of influence. There is no doubt that keeping our eyes closed or burying our heads in the sand will lead us to failure and eventual destruction. We need to take action and do it as soon as possible and make it permanent. In this destructive and uncertain competitive environment, when these radical changes are experienced and even the changes are changing, the leadership of the leaders to inspire the organizations they lead has become a necessity rather than a good one.

Research results show that; In today's age, in Turkey's industrial companies, the Industry 4.0 maturity level is highly correlated with the firm performance of these companies. According to the research group; Industry 4.0 Maturity level explains the Firm Performance by 25.7%. With this research, data which were collected in 2020, Big Data & Analytics, Cyber Security, Cloud Computing, Artificial Intelligence, Deep Learning & Machine Learning, Autonomous Robots, Cobots, Internet of Things & Internet of Services, Additive Manufacturing (3D Printers), Virtual Reality - It has been observed that many Industry 4.0 applications such as Augmented Reality, Smart Factory, Cyber Physical Systems / Simulation are used intensively.

In addition to these, when looking at the software used; ERP - Enterprise Resource Planning, MRP - Material Requirements Planning, CRM - Customer Relationship Management, BI - Business Intelligence, SCM - Supply Chain Management, WMS - Warehouse Management System, EDI - Electronic Data Interchange, MES - Manufacturing Execution System, RPA- Robotic Many software such as Process Automation, PLM - Product Lifecycle Management, BPM - Business Process Management, EAM/CMMS - Enterprise Asset Management, APM - Application Performance Management are actively used.

6. Conclusions

Transformation and change is possible for any company, it will affect us in many ways, from our external relations, as well as the relationships of leaders with their teams and the way they motivate, to goal setting and performance measurement methods. It's more of a way of thinking than a matter of technology. Therefore, we cannot wait for our work to be finished by appointing someone to carry out the digitalization and transformation process or to develop our information technologies in line with the new standards. Each of us must be the chief digitalist and transformer of our respective fields of duty. As managers of organizations, areas or units, they must be the driving force of change. Companies must evolve in their strategy to embrace a range of concepts in radical innovation. On the other hand, the execution of processes requires us to act much more agile on the basis of developments in technology. The faster and more agile organizations are, the greater the profit.

To adapt to Industry 4.0, companies must adopt appropriate strategies and embed these strategies into their governance spectrum. Many companies are not well equipped to deal with cyber risks arising from the rapid development of artificial intelligence, IoT, Blockchain and other computational and digital technologies. The incidents we've heard about cybersecurity and data breaches, bitcoin thefts and IoT vulnerabilities show that as interconnected digital technologies become more common, so will the ways to exploit them. To protect assets, develop capabilities, and build trust between stakeholders and customers, companies need to come up with robust cyber risk strategies.

Developing and implementing technologies with opportunities in mind. Last but not least, companies need to restructure how they think about technological development. They should go beyond R&D and product development to try to imagine the future where these technologies play a role as a resource or product, and think critically about how their own corporate culture will affect others as these technologies are developed, purchased or deployed.

7. References

1. Drucker, P. (1998). *Sonuç İçin Yönetim, Çeviren: Bülent Toksöz.* İstanbul: İnkılâp Kitabevi.
2. Ellinger, A., Ellinger, A., & Keller, S. (2002). Logistics Managers Learning Environments and Firm Performance. *Journal of Business Logistics. Sayı 23. Konu 1, s.26.*
3. Felsberger, A., & Reiner, G. (2020). Sustainable Industry 4.0 in Production and Operations Management: A Systematic Literature Review. *Sustainability; Basel Vol. 12, Iss. 19,* 7982.
4. Ghobakhloo, M., & Fathi, M. (2020). Corporate Survival in Industry 4.0 Era: The Enabling Role of Lean-Digitized Manufacturing. *Journal of Manufacturing Technology Management; Bradford Vol. 31, Iss. 1,* 1-30.
5. Gözükara, E. (2014). Liderlik Tipleri, Yenilikçi Kültür, Örgütsel Yaratıcılık ve Firma Performansı Arasındaki İlişkiler. *Doktora Tezi*.
6. Harari, Y. N. (2012). *Sapiens: Hayvanlardan Tanrılara.* İstanbul: Kolektif Kitap.
7. Hong-Long, C. (2021). Impact of Industry 4.0 on Corporate Financial Performance: A Moderated Mediation Model. *Sustainability; Basel Vol. 13, Iss. 11,* 6069.
8. Karasar, N. (2016). *Bilimsel Araştirma Yöntemi.* Ankara: Nobel.
9. Lok, P., & Crawford , J. (2001). The Antecedents of Organizational Commitment and the Mediating Role of Job Satisfaction. *Journal of Managerial Psychology, Sayı16*, 594-613.
10. Özmen, Ö. N., Eriş, E. D., & Özer, P. S. (2020). Dijital Liderlik Çalışmalarına Bir Bakış. *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi C.25, S.1*, 57-69.
11. Plumpton, D. (2019). Cyber-Physical Systems, Internet of Things, and Big Data in Industry 4.0: Digital Manufacturing Technologies, Business Process Optimization, and Sustainable Organizational Performance. *Economics, Management and Financial Markets; Woodside Vol. 14, Iss. 3,* 23-29.
12. Santos, R. C., & Martinho, J. L. (2020). An Industry 4.0 Maturity Model Proposal. *Journal of Manufacturing Technology Management; Bradford Vol. 31, Iss. 5,* 1023-1043.
13. Sassi, A., Ali, M. B., Hadini, M., Ifassiouen, H., & Rifai, S. (2021). The Relation Between Industry 4.0 And Supply Chain 4.0 And The Impact Of Their Implementation On Companies' Performance:

State Of The Art . *International Journal of Innovation and Applied Studies, Rabat Vol. 31, Iss. 4*, 820-828.
14. Schein, E., & Schein, P. (1997). *Organizational Culture and Leadership.* The Jossey-Bass Business & Management Series: 45-55.
15. Schwab, K. (2017). *Dördüncü Sanayi Devrimi.* İstanbul: Optimist Yayım.
16. Schwab, K. (2019). *Dördüncü Sanayi Devrimini Şekillendirmek.* İstanbul: Optimist Yayım.
17. Tortorella, G. L., Giglio, R., & van Dun, D. H. (2019). Industry 4.0 Adoption as A Moderator of The Impact of Lean Production Practices on Operational Performance Improvement. *International Journal of Operations & Production Management; Bradford Vol. 39, Iss. 6/7/8*, 860-886.
18. Westerman, G., Bonnet, D., & McAfee, A. (2015). *Leading Digital - Dönüşüm için Teknolojiyi Kullanmak.* İstanbul: Türk Hava Yolları Yayınları.