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Assessing Industry 4.0 Transformation of SMEs: A Swot Analysis*

Okan ERNUR¹, Hilmi YÜKSEL²

Abstract

This Study is to examine Industry 4.0 transformation of SMEs, using SWOT analysis to conduct their awareness, activities and current situation within strengths, weaknesses, opportunities and threats in the journey of Industry 4.0 transformation. In this study, interview method was used to analyze the SMEs' Industry 4.0 transformation. Interviews were conducted with 5 SMEs where is engaged in The Aegean Area, Turkey more disadvantages to the industry than its advantages. They are aware of technological developments but They are still at the beginning of the transformation process. SMEs should analyze their state time by time and always follow the development of industry for being sustainable regarding the digital age. They should do their best for what can be controlled by themselves. This study pioneers SMEs to gain awareness about industry 4.0 and lead them to manage their situation.

Keywords: Swot Analysis, Industry 4.0, SMEs

Jel Codes: O14, M00, D20

KOBİ'lerde Endüstri 4.0 Dönüşüm Sürecinin Swot Analizi Metoduyla Değerlendirilmesi

Özet

Bu Çalışma, KOBİ'lerin Endüstri 4.0 dönüşüm yolculuğunda farkındalıklarını, faaliyetlerini ve mevcut durumlarını SWOT analizi kullanarak, fırsatlarını, tehditlerini, güçlü ve zayıf yönlerini tespit etmektedir. KOBİ'lerin Endüstri 4.0 dönüşüm sürecinin analiz edilmesinde yarı yapılandırılmış mülakat yöntemi kullanılarak 5 KOBİ üzerinde inceleme yapılmıştır. Türkiye'de, Ege Bölgesi'nde faaliyet gösteren KOBİ'lerin, dijital dönüşüm sürecinin farkında olmalarına rağmen henüz sürecin çok başında oldukları ve bu süreçte avantajlarından çok dezavantaja sahip olduğu tespit edilmiştir. KOBİ'ler, dijital çağda sürdürülebilir olmak için zaman zaman durumlarını analiz etmeli ve endüstrinin gelişimini daima takip etmelidir. Kontrolleri dahilinde olan yeni araç, gereç ve uygulamaları bünyelerine dahil etmelidirler. Son olarak, bu çalışma, KOBİ'lerin endüstri 4.0 hakkında farkındalık kazanmalarına ve durumlarını yönetmelerine öncülük etmektedir.

Anahtar Kelimeler: Swot Analizi, Endüstri 4.0, KOBİ

Jel Kodu: O14, M00, D20

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1. INTRODUCTION

Organizations would like to figure out about alterations of their environment at times and they examine their situation according to environmental alterations. SWOT Analyze can also be used for this aim. Firstly, Swot Analyze was mentioned in 'Business Policy' which has been published by Learned et al. in 1960s to be detected situation of organizations related to Strengths, Weaknesses, Opportunities and Threats. SWOT Analyze, is also called as Situation Analysis in Turkish Literature (Güngör and Arslan, 2004: 68) is an important analyze that is used by organizations to determine an efficient organizational strategy regarding strategic management and strategic planning (Gürel and Tat, 2017: 995).

SWOT Analyze not only helps managers or decision makers to analyze current situations and potentials but also helps in being awake to organization's environment (Naryanan and Natch, 1993: 197). SWOT Analyze which reveals strengths, weaknesses, opportunities and threats of organizations helps researchers, planners or managers to determine organization's targets and prioritize them. It also helps create a competitive and sustainable strategy for decision makers (Ommani, 2011: 9448). Organizations are used SWOT to gather information that is regarding profitability, product development, sales and marketing strategy. But Swot does not use only for business environment. It is also used by individuals to analyze personal situation (Gökoğlan and Kaval, 2020:19).

SMEs face with many difficulties in Industry 4.0 transformation related to their characteristics. SMEs have different characteristics than large companies so the

challenges and the importance of the challenges for Industry 4.0 transformation in SMEs will also be different. In order to achieve Industry 4.0 transformation in all companies, SMEs should also plan Industry 4.0 projects. So, analysis of strengths, weaknesses, opportunities and threats of Industry 4.0 transformation of SMEs is also very important.

2. LITERATURE REVIEW

2.1. Industry 4.0

The term 'Industry 4.0' was introduced in 2011 during the Hannover Fair in Germany. The Fourth Industrial Revolution will be marked by the full automation and digitization processes, and the use of electronics and information technologies in manufacturing and services (Roblek et al, 2016). Industry 4.0 refers the fourth industrial revolution initiated by the integration of the Internet of Things (IoT) and the Internet of Services (IoS) in the manufacturing process (Kagermann et.al, 2013). Frank and colleagues conceptualized Industry 4.0 as a new industrial maturity stage of product firms, based on the connectivity provided by the industrial Internet of things (Frank et.al, 2019). Piccarozzi and colleagues (2018) stated that "Industry 4.0 is based on the development of a completely automated and intelligent production, capable of communicating autonomously with the main corporate players". Lu described Industry 4.0 as "An integrated, adapted, optimized, service oriented, and interoperable manufacturing process which is correlated with algorithms, big data and high technologies" (Lu, 2017). One of the aims of Industry 4.0 is to combine the digital and physical worlds. Industry 4.0 is predominantly shaped by two main drivers; Cyber Physical Systems, and the Internet of Things and Internet of Services (Pereira and Romero, 2017).

A literature review by Horvath and Szabo (2019) reveals that the driving forces of Industry 4.0 are growing competition, increased innovation capacity and productivity, increasing customer expectations, the need to save energy and improve sustainability, financial and performance factors supporting management activities, and opportunity for business model innovation. Adopting Industry 4.0 is not just a matter of new technologies and/or tools and/or production methods, but implies changes in all management aspects, and involves all actors of the ecosystem in which the company operates (Piccarozzi et al., 2018).

2.2. Industry 4.0 In SMEs

Industry 4.0 may present many opportunities for increasing productivity, efficiency and flexibility, and for decreasing costs. Several studies argue that Industry 4.0 implementation will lead to better performance in terms of productivity, costs, quality, sustainability, responsiveness and leanness (Chauhan and Singh). Manufacturing will be more intelligent, more flexible, more adaptive, more autonomous, more unmanned, more sensor based with Industry 4.0 technologies (Öztemel and Gursev, 2020). However, companies are facing unique challenges in the era of the Fourth Industrial Revolution, also known as Industry 4.0 Horvarth and Szabo (2019) clarified that it is also unclear how far the various driving forces and inhibiting factors will affect small and medium-sized enterprises. The opportunities provided, and challenges faced by Industry 4.0 transformation affect the level of applications. Operational opportunities are considered as particular drivers for SMEs (Müller et. al 2018). Industry 4.0 will require considerable investments, and because of the lack of clarity over the gains, firms may be unwilling to initiate Industry 4.0 transformation (Horvarth and Szabo,2019)

Most firms believe that Industry 4.0 will bring many benefits, a much lower proportion of firms are investing in and developing plans for Industry 4.0 technologies. In developing countries, SMEs have significant problems with financial resources, management and labor skills which hinder SMEs to invest for Industry 4.0 technologies (Yüksel, 2020). SMEs have different characteristics from larger companies, and therefore a different the Industry 4.0 transformation roadmap. Industry 4.0 provides new paradigms for the industrial management of SMEs (Maresova, et.al,2018). In addition, for SME, the introduction of new technologies and practices always have risks and the real requirements and benefits for SMEs are still not fully known (Moeuf et.al,2018). Small and medium sized manufacturing companies are especially, uncertain about the financial effort required for the acquisition of such new technology and the overall impact on their business model (Schumacher, et.al: 2016). Many SMEs are not aware of the advantages and benefits of increased digitalization; therefore, simply removing these obstacles will not be sufficient (Zimmerman, 2016). Sevinç et al. (2018) also mentioned the challenges faced by SMEs in Industry 4.0 transformations in the terms of innovations, organization and cost dimensions.

2.3. Swot Analyze

Organizations would like to figure out the alterations of the environment of their organizations and to examine their situation according to these alterations. SWOT Analyze is one of the methods to analyze an organization's situation according to the environment of the organization.

Firstly, Swot Analyze was mentioned in 'Business Policy' which has been published by Learned in 1960 to be detected situation of organizations related to strengths, weaknesses, opportunities and threats. SWOT Analyze, is also called as Situation Analysis in Turkish Literature (Güngör and Arslan, 2004:

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SWOT Analyze which reveals strengths, weaknesses, opportunities and threats of organizations helps researchers, planners or managers to determine organization's targets and prioritize them. It also helps to create a competitive and sustainable strategy for decision makers (Ommani, 2011: 9448). SWOT analyze used to gather information to organizations that is regarding profitability, product development, sales and marketing strategy. SWOT analyze are not used only for business environment. It is also used by individuals to analyze personal situation (Gökoğlan and Kaval, 2020:19). In addition to all these aims, SWOT is a valuable analysis for army and governance strategy (Demirtaş, 2020). In short, SWOT can be used by everyone who wants to explore their personal situation. Swot may be thought as easy analyze by implementers due to It can be used by everyone but there are some critics point to take into consideration. These factors are listed below (Al-Rousan ve Qawasmeh, 2009: 85);

- Determination of most important factors and find why these factors are important out,
- Being proactive for important factors in the future and taking action for it.
- All forecast about SWOT should be listed based on issues,
- Another major factor is regarding implementor of SWOT. At the side of evaluation of their competitors, implementers have to be realistic and be honest themselves while they analyze their situation and be aware of that.

Firstly, Apart from critical factors which are listed, Implementers have to decide the main aim about SWOT before analyzing their conditions. By reason of having aims and targets before analyzing helps organizations to gather a focusing specific strategy and that is anotherther significant subject. Secondly, Implementers of SWOT have to check and research their markets, sectors and business to compare their competitors and list their strengths, weaknesses, potential opportunities and threats. Finally, With refence to output of SWOT organizations deduce about their state and They should determine their priority and develop new strategies to carry on their activities (Namugenyi, 2019: 1148).

2.3.1. Components of Swot Analyze

SWOT is an analyze technique which focuses on an organization's internal and external environment. While Swot focuses on an organization's internal and external environment, it tries to determine strengths, weaknesses, opportunities and threats of organizations. Strengths and weaknesses which are the parts of SWOT are related with the organizations internal. That means organizations could manage and control them. The other parts of SWOT are opportunities and threats. These parts are related with the organization's external and they can't be managed or controlled by organizations (Wheelen and Hunger 2012: 16-17). Internal and external environment factors of SWOT is showed by Figure 1.

With reference to Figure 1, the internal environment of SWOT, which is also named as a micro-environment that has strengths and weaknesses, analyzes workers, strategic location, production capacity, product and product services and financial situation of organizations. The other part of SWOT is about the external environment that is also called macro-environment. External environment is related out of organizations control like the competitive and technological environment. These environment brings some opportunities and threats for organizations and focus on the

political, economic and social environment (Dyson, 2002: 632).

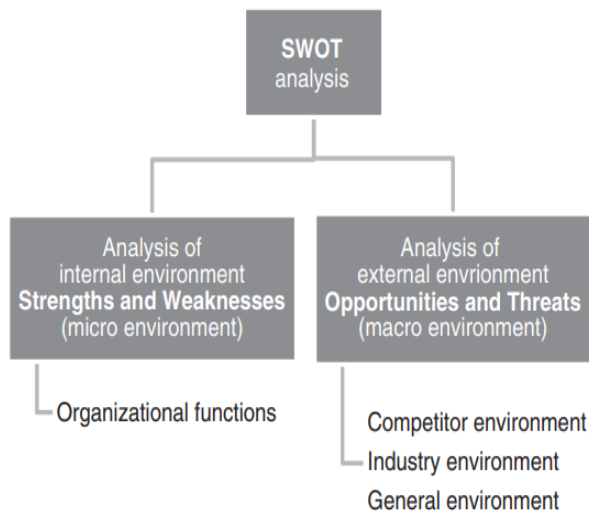


Figure 1: Swot Analyze

Source: Bonnici and Galea, 2015: 2

SWOT analysis, which gives organizations a holistic perspective with internal and external environmental analysis, comprise of strengths, weaknesses, opportunities and threats. In other words, Swot has four components. These components are showed by Figure 2.

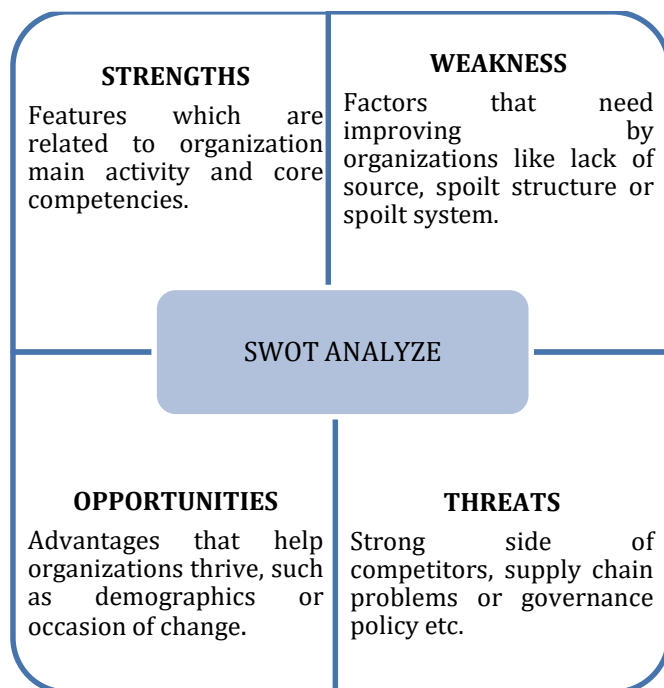


Figure 2: Components of Swot Analyze

Source: Mindtools, 2021.

In figure 2, Strengths in SWOT lead organizations to be front of their comeptitors using with their core competencies. Weakness in SWOT help organizations to be aware of their missing sides and improve them against to their competitor. If opportunities in SWOT gather organizations competitive advantage and forward them to be proavtive for exploring their occasions. At last, threats in SWOT contribute organizations to defend threats which come from their competitor in the market.

Organizations that use SWOT to analyze their strengths, weaknesses, opportunities and threats have four main questions to answer outputs of SWOT. The questions are (Hay and Castilla, 2006: 2);

- How do organizations manage their strengths?
- How do organizations interfere with their weaknesses?
- How do organizations benefit from their opportunities?
- How do organizations protect themselves from the threats?

As a result of those questions, Organizations could know their current situation and sustain their life with reference to outputs of SWOT and they use their strengths and opportunities to get competitive in their industry. They should also be aware of their weaknesses and threats to protect themselves.

Swot which help organizations to have an idea about their current situation and use their information to get over in their paths. Figure 3 shows a holistic perspective regarding SWOT's components relations with each other.

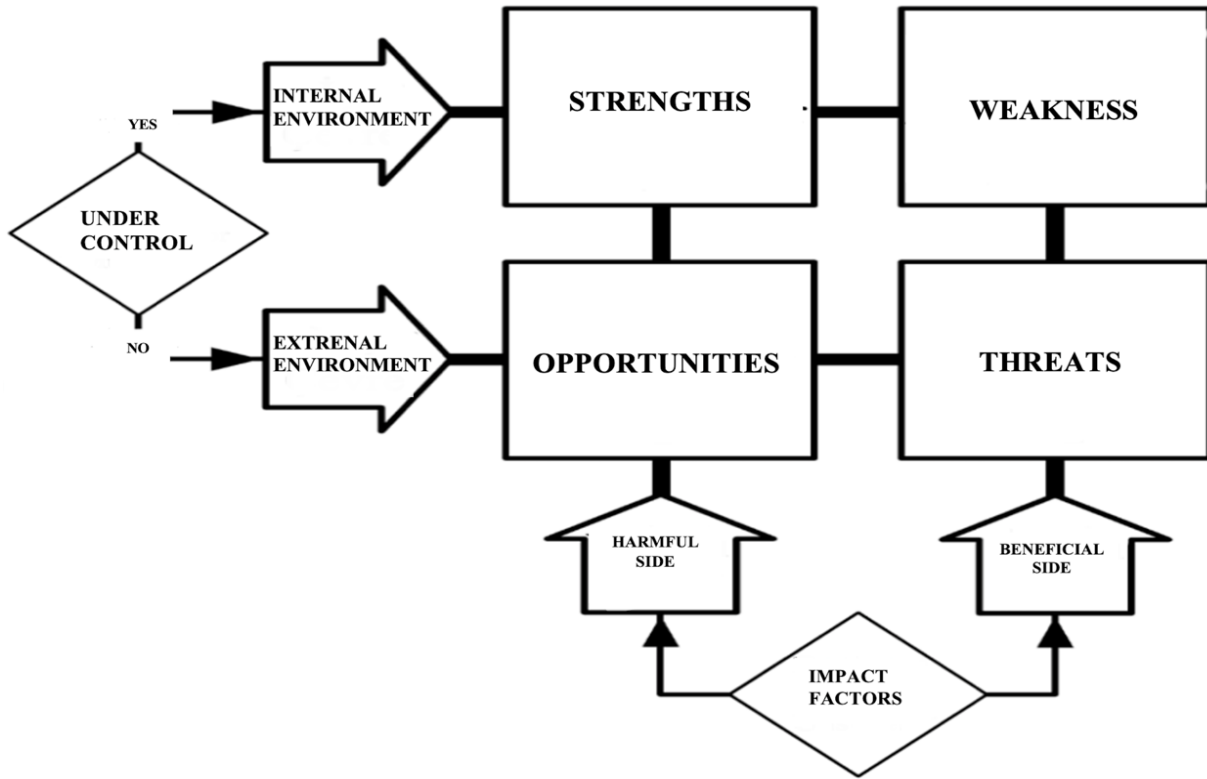


Figure 3: Components Relation of Swot

Source: Sarsby, 2016: 7

Based on figure 3, While Strengths and weaknesses that are related to the internal environment can be taken under control by organizations, Opportunities and threats which are related to the external environment can not be taken under control by organizations. Nevertheless, while Strengths and weaknesses mean dangerous for organizations, Opportunities and threats include beneficial factors for organizations. In additions all these informations, SWOT brings advantages and disadvantages for organizations (Gürel ve Tat, 2017:1003-1005);

Advantages of SWOT:

- SWOT enables an extensive perspective for decision makers and helps them to focus on the main point without being attached to details.

- SWOT is a kind of matrix analysis method so this matrix helps to connect components of SWOT to each other.
- SWOT reveals organizations current situations and leads them to compare with their competitors.
- Decisions makers benefit from outputs of SWOT to determine their organization's targets and follow steps which bring them to success.
- SWOT leads organizations employees to brainstorm and discuss their overviews.
- SWOT helps decision makers or manager to be interested of strategic event instead of daily plans.
- Finally, SWOT is one of the basic and easy techniques. So That makes SWOT everyone would apply it.

Disadvantages of SWOT:

- SWOT may not always show all reality due to implementers of it. The underlying reason is human. Humans have emotions which makes humans take sides while they make a decision or analyze something. For example, decision makers or managers take a side while they analyze their strengths. That may affect their decisions and cause mistakes.
- SWOT presents a large perspective for implementers. So it could not be a convenient analysis for 21 century. Because of Environment gets more complex and dynamic day by day. For that reason, SWOT could be more stable analyzed between the others.
- Lastly, SWOT is a highly cost analysis technique. In addition to cost, Applying of SWOT takes a long time to determine an organization's current situation. So it could cause missed opportunities and encounter risks for organizations.

2.4. Swot in Digital Transformation Age

In 21. Century, Technological developments affect nationals and organizations which need to have global economic activities. Across the technological pressure, organizations would invest technologic stuff like software, machine or gadgets etc. to compete in global markets that are related with their industries. However, organizations have to analyze their situations before they invest for technologies. That analysis is an important step for organizations because it helps to have plenty of ideas about organizations and it also forwards decision makers or managers regarding what they should do for their organizations in the future. In the context of that, organizations could determine their technological needs and analyze their internal and external environment so that they could reveal technological developments for their industry. In view of the fact that SWOT is a really reasonable analysis technique. Oreski (2012: 283) stated that Swot is an applicable analyze for everyone and it helps implementers to analyze their conditions and decide a strategy for their organizations.

Evolution of SWOT with the digital age's perspective, technological developments do not be controlled easily by organizations owing to technology is related to the external environment. Even if most of researchers think external environment could not be managed, Kurtilla et al. (1999: 42), SWOT admits of accomplished analyze with evaluate internal and external environment at the same time. So that gains a proactive perspective for organizations (David, 2011: 16).

New production methods, applications (robots, artificial intelligence etc. that occurred in the digital transformation age affects entirely organization's structure and activities like management style, services or production. All of these advances are forced organizations to change their current situations (Ernur and Tozkoparan, 2018: 2). So organizations which are forced by technologies to change their structure apply SWOT to determine and find out sources that are necessary to change. By this means organizations remove the uncertainty for their future.

In substance, organizations are also preferred SWOT to analyze themselves regarding technologic needs or deficiency in digital transformation age. Using SWOT helps organizations to compare their competitors and determine their strengths, weaknesses, opportunities and threats. So they may evaluate their financial power or structure and gather many advantages by using them. As a result of that, with reference to outputs of SWOT, organizations can know their situation and rotate their ways to be successful.

3. METHODOLOGY/METHOD

In order to analysis of strengths, weaknesses, opportunities and threats of Industry 4.0 transformation of SMEs, an interview method was used. Interviews were conducted with 5 SMEs and forward some specific questions to the manager or owner of the SME'S to detect their situation. Questions are listed below.

1. Do you have any actions across to technological developments? If it is yes. Please, explain it.
2. Do you have any core component which could not be imitated by your competitor?
3. Do you have any plan in the short, middle or long period for digital transformation? If you had, Could you share it?
4. Can you evaluate your adaptation process and agility of organization in Digital Transformation based on your competitors?
5. Do you think being a SME affects to reach financial opportunity?
6. Do you think your organization has enough facility space to assemble automation systems that is a requirement for digital transformation?
7. Does your organization has a good skill employees to use technologic stuff?
8. Do you think your organization has an integration problem between the management applications and production applications in the digital transformation process?
9. Do you have R&D, IT department? If you have. How much does it budget?
10. Do you work with universities to improve your organizations?
11. Have you ever attended any KOSGEB or TUBITAK projects? Have you ever experienced this?
12. Do you have ERP software? If you do not. Do you plan to get it?
13. Do you think economic uncertainty is a threat to your organization?
14. Does your organization have any support like financial or educational etc. from the government in the Digital Transformation Process?
15. Do you have any special management or leadership method in the Digital Transformation Process?
16. What do you think about sharing your data (stock, production or financial data etc.) with the other organizations?
17. Do you think your service providers adequately supports your organization?
18. When you consider your organization's financial condition Do you think about investing in Industry 4.0 technologies?
19. Do you believe that your organization have a transformational culture and have an agility structure?
20. Does your organization take precautions regarding cyber-attack, data safety etc.?
21. What kind of activities does your organization have regarding Industry 4.0?
22. Are there any threats for your organization when you compare your organization with your competitor?
23. Do you believe that there is a sufficient legal infrastructure regarding digital transformation?
24. Do you consider Industry 4.0 brings facilitations for your customer?
25. What kind of developments do you consider as threats for your organization in the Digital Transformation Age?
26. What kind of opportunities does Industry 4.0 bring for your organization?
27. What is your core competency that sets you apart from your competitors?

With reference to explanations, semi-structured interviews were conducted and 27 predetermined questions were forwarded to the participants of the research. The results of the interviews were evaluated by SWOT and revealed strengths, weaknesses, opportunities and threats of the SMEs in the extent of Industry 4.0 transformation. Importance of

this study is creating awareness regarding Industry 4.0 for SMEs' and It is one of the priority studies in the Aegean Region in Turkey.

4. FINDINGS

Within Industry 4.0 scope, interviewing was conducted with SMEs' to detect their perspective and situation. For detection of SMEs state, SWOT analysis was applied to determine the SMEs' factors of industry 4.0 into strengths, weaknesses, opportunities, and threats. From the analysis, it is observed that industry 4.0 offers SMEs' to compare their advantages and disadvantages. Table 2 shows the strengths and opportunities of SMEs in the Digital Transformation Age regarding industry 4.0 as well as its weaknesses and threats.

Table 2: SWOT of SMEs' in the Digital Transformation Age

| STRENGTHS | WEAKNESSES |
|--|--|
| Each SMEs' has their core competency. Easy to adapt to new conditions and cover the customer demands. More flexible organization structure. Possibility to design their own technologies | Lack of skilled employees regarding using technological devices like robots, softwares etc. Financial issues. Inadequate facility filed. Integration problem with supply chain partners. High investment cost for technological devices. Lack of the some department that is related technology like IT (Information Technologies). |
| OPPORTUNITIES | THREATS |
| Government support regarding technological investment stuff. Availability of education by universities. Availability of diversity Digital Transformation Projects like TUBITAK, Research and Developments. Less production cost according to conventional production. | Unstoppable technological developments day by day. Availability of data safety issues and digital risks. Insufficient legal substructure by government. Lack of technological device for some step of process. Uncertain economic conditions. |

As a result of SWOT which showed on the chart 2, SWOT for SMEs' reveals some of the major strengths. One of them is that each SMEs has their core competency So It makes SMEs'

competitive regarding Industry 4.0 in the Digital Transformation Age. The other strength is related organization structure. SMEs have a flexible organization structure. That helps SMEs to adapt to new conditions easily and they can cover the customer demands fast due to their size and act on the time. In the opportunities perspective of SWOT, SMEs' have some advantages like financial support from the government, national Digital Transformation Projects from institutions that are called TUBITAK, KOSGEB or availability of education facilities by universities.

In addition to these opportunities, SMEs' have less production cost than classical production thanks to their small structure. If they adapt their structure according to Industry 4.0 they can gather more income and they can manage that income to develop their organizations.

Right along with strengths and opportunities, SWOT also reveals weaknesses and threats that are called disadvantages. Lack of skilled employees regarding using technological devices, financial power, facility filed is weaknesses for SMEs' regarding Industry 4.0 in the Digital Transformation Age. SMEs' also encounter integration problems with their partners. For example, SMEs' may contain some technological devices or software which do not have their partners contrary to this, SMEs' may not contain software or technologic stuff that have their partners. So It affects SMEs' ability to integrate with their partners. In addition to this lack of the departments related to technology like IT (Information Technologies) is an important weaknesses for SMEs'. Lack of these department prevents to be aware of technological development and draws back SMEs' in Industry 4.0 transformation. SWOT also presents threats for SMEs' that are called in disadvantage. For instance, unstoppable technological developments day by day. While SMEs' try to invest in some technologies, technology may change fast. So SMEs' may not

apply for each development because of high costs. The other threats is digital risks. They may not be only for SMEs' but also corporate companies. Lack of highly technological machines for some step of process and uncertain economic conditions are also crucial threats for SMEs' regarding Industry 4.0. SMEs' usually produce customizing products and they may have more complex production steps. So, they may not find essential highly technological machines for their productions. Uncertain economic conditions is also a serious problem. Uncertain conditions affect SMEs' and prevents them from investing for the future.

5. CONCLUSION

Industry 4.0 offers more advantages for organizations than its disadvantages. For example, more efficient, increased productivity, more flexibility in production system, ease of customization or customer satisfaction etc (Bakhtari et al. 2020: 221). Even if It brings more advantages for organizations. Transformation process may not be easy for them, especially SMEs'. Because structural barriers of organization stand in front of the transformation process. One of significant handicap is that (OECD, 2021: 7). With that point, This study examine SMEs' regarding Industry 4.0 in The Digital Age.

As a result of study, We find out that SMEs have some strengths like having their core competency, easy to adapt to new conditions and cover the customer demands, more flexible organization structure and possibility to design your own technologies. In addition to the strengths of SMEs in The Digital Age, SMEs also have opportunities like government support regarding technological investment stuff, availability of education by universities, availability of diversity Digital Transformation Projects like TUBITAK, Research and Developments. So These opportunities help SMEs regarding being competitive. With reference to explanations, Strengths and opportunities of SMEs can be called as

advantages for them. The other results of study for SMEs is about weaknesses and threats. Weaknesses that are the output of SWOT are lack of skilled employees regarding using technological devices like robots, softwares, financial issues, inadequate facility filed etc. Threats are unstoppable technological developments day by day, availability of data safety issues and digital risks. Insufficient legal substructure by the government. These weaknesses and strengths can be dangerous when they are not controlled by SMEs. So it may be also called a disadvantage for SMEs.

From the analysis, it is observed that industry 4.0 offers SMEs'where is engaged in The Aegean Area, Turkey more disadvantages to the industry than its advantages. In other words, They are aware of technological developments but They are still at the beginning of the transformation process. With reference to the study results, SMEs' have more challenges. They may follow technological developments and incorporate technologies to their structure to cope with challenges. They should detect their transformation needs and create reasonably applicable systems based on their facility to adapt themselves the digital age. Beside what organizations can develop for themselves. There are some challenges that can not be controlled by organizations, even if they wish to improve and invent somethings to compete versus their competitors. With refence to resuslt of Erdil and Ertekin's study (2017: 23), These challenges are related to governance like bureaucracy, policy documents that take time to have support from the government, custom regulations which disable the trade of high tech devices etc. In sum, SMEs should analyze their state time by time and always follow the development of industry for being sustainable regarding the digital age. They should do their best for what can be controlled by themselves.

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