Fiscaoeconomia

E-ISSN: 2564-7504
2024, Volume 8, Issue 2, 417-440
https://dergipark.org.tr/tr/pub/fsecon

Submitted/Geliş: 28.10.2023
Accepted/Kabul: 08.02.2024
Doi: 10.25295/fsecon.1382697

Research Article/Araştırma Makalesi

Scale Development Study to Determine the Effectiveness of Digital Transformation in Businesses: An Application in Turkish Defence Industry[1]

İşletmelerde Dijital Dönüşüm Etkinliğini Belirlemeye Yönelik Ölçek Geliştirme Çalışması: Türkiye Savunma Sanayinde Bir Uygulama

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Abstract

The global attractiveness of digital transformation technologies leads many nations to increase their investments in these technologies and to achieve a stronger economic position. While this process can be considered in the context of many sectors, it has emerged more clearly in recent years, especially in the defence industry. Not only in many developed countries but also in Turkey, especially with the developments in the last 15 years, the defence industry sector can find a place among the notable countries in the world. Therefore, the use of these technologies can be expressed as a dynamic structure whose potential increases daily thanks to the added value it creates and the ecosystem it has created. However, this process is not only the application field of the private sector but also creates value in the context of the theoretical framework and concepts revealed by scientific studies. This study, it is aimed to develop a scale to determine the 'digital transformation effectiveness' in defence industry enterprises. In this framework, the scale and questionnaire questions were sent to companies operating in the Turkish defence industry, and 65 companies responded. The data was subjected to validity and reliability analyses using SPSS 26 and AMOS 26 programs, followed by statistical testing through exploratory factor analysis and confirmatory factor analysis. The findings showed that the scale has sufficiently high internal consistency, has explanatory and confirmatory factor validity, and also has criterion validity based on sub-dimensions.

Jel Codes: *M15, M16, O30, O32, O33*
Keywords: *Digital Transformation, Defence Industry, Digital Transformation Effectiveness Scale*

[1] Bu makale Yunus Emre Sürmen'in "Dijital Dönüşümün Dış Ticaretteki Rolü: Türkiye Savunma Sanayi Örneği" başlıklı doktora tezinden türetilmiştir.

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Citation/Atıf: Sürmen, Y. E., İrak, G. & Öngen Bilir, B. (2024). Scale Development Study to Determine the Effectiveness of Digital Transformation in Businesses: An Application in Turkish Defence Industry. *Fiscaoeconomia, 8*(2), 417-440. Doi: 10.25295/fsecon.1382697

Sürmen, Y. E., İrak, G. & Öngen Bilir, B. (2024). Scale Development Study to Determine the Effectiveness of Digital Transformation in Businesses: An Application in Turkish Defence Industry. *Fiscaoeconomia, 8*(2), 417-440. Doi: 10.25295/fsecon.1382697

Öz

Dijital dönüşüm teknolojilerinin küresel düzeyde olan çekiciliği, birçok ulusun bu teknolojilere dönük olarak yatırımlarını arttırmasına ve ekonomik açıdan daha güçlü bir konuma ulaşma hedefini ortaya çıkarmaktadır. Bu süreç birçok sektör bağlamında ele alınabildiği gibi son yıllarda özellikle savunma sanayi alanında da daha belirgin bir şekilde gün yüzüne çıkmıştır. Sadece gelişmiş birçok dünya ülkesi değil, aynı zamanda Türkiye'de de özellikle son 15 yılda yaşanan gelişmelerle birlikte savunma sanayi sektörü dünyada hatırı sayılır ülkeler arasında kendine yer bulabilmektedir. Dolayısıyla bahsi geçen bu teknolojilerin kullanımı, yarattığı katma değer ve oluşturmuş olduğu ekosistem sayesinde potansiyeli günden güne artan dinamik bir yapı olarak ifade edilebilir. Ancak bu süreç sadece özel sektörün uygulama sahası olarak kalmamakta, aynı zamanda bilimsel çalışmaların ortaya çıkardığı teorik çerçeve ve kavramlar bağlamında da bir değer oluşturmaktadır. Bu çalışma ile savunma sanayinde yer alan işletmelerde 'dijital dönüşüm etkinliği'ni tespit etmeye yönelik bir ölçek geliştirilmesi amaçlanmıştır. Bu çerçevede, oluşturulan ölçek ve anket soruları Türkiye savunma sanayinde faaliyet gösteren firmalara gönderilmiş, 65 firmadan geri dönüş sağlanmıştır. Veriler, SPSS 26 ve AMOS 26 programları ile geçerlilik ve güvenilirlik analizlerine tabi tutulmuş, ardından açıklayıcı faktör analizi ve doğrulayıcı faktör analizi ile istatistiksel olarak sınanmıştır. Elde edilen bulgular ölçeğin yeterli ölçüde yüksek iç tutarlığa sahip olduğunu, açıklayıcı ve doğrulayıcı faktör geçerliliğinin bulunduğunu, aynı zamanda alt boyut temelinde kriter geçerliliğine de sahip olduğunu göstermiştir.

Jel Kodları: *M15, M16, O30, O32, O33*
Anahtar Kelimeler: *Dijital Dönüşüm, Savunma Sanayi, Dijital Dönüşüm Etkinliği Ölçeği*

1. Introduction

The increasing demand for technological innovations at the global level and the processes developing in terms of quality have enabled the concept of digitalization to become more prominent and the studies in this field to increase gradually. With this concept, the use of more modern and high-value-added technologies has been carried to a more advanced level compared to the past; thus, a more efficient, fast, and effective structure has been created. This situation has enabled businesses to seize the opportunity to gain cost advantages by integrating into digital processes that rapidly increase operational efficiency instead of using traditional production and service methods.

Investments in digital technologies increase the competitive factor not only at the national level but also in the international arena. Clearly, businesses that do not adapt to these technologies will lose their competitive advantage and their position in the sector will weaken. For this reason, enterprises prefer such approaches to obtain high-value-added product and service outputs and maintain their position in the sector.

As in the rest of the world, developments in digital transformation technologies are making significant progress in Turkey as well. In particular, the dissemination of the know-how and technological innovations provided by multinational enterprises to local firms has increased the diversity of products and services and their transformation into value-added products. Therefore, these factors, which have accelerated the technological developments in the defence industry and enabled the development of other sectors, have supported not only the interest in the private sector but also the increase in academic studies.

In the academic context, a large number of studies on digital transformation technologies can be observed in the literature. The majority of these studies are in the conceptual context, and the lower part of these studies are in the application context (Shaughnessy, 2018; Hess et al., 2020; Ciuriak & Ptashkina, 2018; Henriette et al., 2015; Reinartz et al., 2019; Małkowska et al., 2021; Do et al., 2022). However, since this field is perceived as new today, the development process is still ongoing and it is a dynamic structure, the number of scales created with a digital transformation perspective is almost negligible. Although studies are addressing digital transformation maturity, digital transformation performance and digital transformation effectiveness in the context of many sectors (Ifenthaler & Egloffstein, 2020; Masoud & Basahel, 2023; Tsou & Chen, 2023; Nwankpa & Roumani, 2016; Mergel et al., 2019; Singh et al., 2021) which will be mentioned in the literature section of this study, no study on scale development in the context of the defence industry has been identified. Therefore, it is important in terms of completing this gap in the literature and providing a new perspective for future studies. In this framework, a questionnaire form including the scale was applied to enterprises operating in the defence industry in Turkey.

Following is the organization of the research. The second section will summarise the definition, scope, development processes, and processes of digital transformation in Turkey. The third section will cover the literature review and the contribution of the research. In the fourth section, methodology and findings will be given and the study will be completed with the conclusion section.

2. Defence Industry and Digital Transformation

2.1. Definition, Scope and Historical Development Process of Defence Industry

The definition of the concept of defence industry is handled from different perspectives. While some circles consider the defence industry as an independent sector, others prefer to place it within the manufacturing industry. Another view suggests that the defence industry should be seen as the intersection point of all manufacturing sectors (Ülger, 1997: 1). While defence refers to the actions taken by a state to protect its national integrity and resist external attacks, defence industry can be defined as a sector that meets the military needs of the country in order to carry out these actions, creates production, design and continues R&D activities within the country's own borders (Wikipedia, 2023).

Countries take various measures to improve the quality of the defence industry and indirectly support other industry sectors. In addition to meeting military needs, these measures aim to increase export potential and contribute to the more effective implementation of strategic policies (Köseoğlu, 2010: 2).

Today, the defence industry is more important than other sectors and has some specific characteristics. These important features can be listed as follows: The customer base generally consists of governmental organizations and exporting companies, has high investment requirements, and focuses heavily on R&D activities. The product range prefers special production methods to adapt to changing demands and needs to be based on past technologies. Defence industry firms are diverse in terms of their qualifications and require expert personnel. Moreover, defence industry products are subject to strict controls and rules in global trade (Karakuş, 2006: 36-42).

Since the early 1970s, the foundations of the defence industry in Turkey have been laid in their most prominent form, and important institutions for the domestic defence industry emerged during this period. Until the 2000s, the Turkish defence industry continued its development and positioned itself at national and international levels. In this process, investments were made in R&D activities, knowledge transfer was ensured through foreign cooperation, incentives were given to the private sector, and strategies were determined to create a defence infrastructure capable of competing with global rivals (Ziylan, 2001: 31-34). However, after the 2000s, and especially with the strategic plan prepared between 2012 and 2016, a vision document was prepared with the goal of improving Turkey's defence capabilities, and in line with this goal, industrialization, technology development, and regulation of procurement processes were accepted as an important mission. Defence and security technologies were developed and capabilities were increased to reduce Turkey's foreign dependency and to strengthen the combat structure of the Turkish Armed Forces (Savunma Sanayi Başkanlığı, 2022).

The strategic plan prepared for the 2017-2021 period includes a series of objectives under four main headings:

1. Creating strategic human resources and effective corporate governance

2. Combining scientific knowledge and experience with technological innovations

3. Supporting capability acquisition with productivity management

4. Ensuring speed, quality, and cost-effectiveness in modernization projects

These objectives emphasize increasing cooperation between the companies in the sector and increasing the number of small and medium-sized enterprises to protect national interests. The design of these projects is based on the principle that prime contractor companies bear the main responsibility, while sub-responsibilities are carried out by subcontractors (Savunma Sanayi Başkanlığı, Stratejik Plan 2017-2021: 35-40).

2.2. Digital Transformation and Technological Innovations

Digital transformation is the process of creating new business models by combining traditional business models with digital technologies. This approach uses technology to gain a competitive advantage and increase efficiency (Liu & Chiu, 2021: 372; Schwertner, 2017: 388). One of the main goals is to radically change traditional business models by reshaping the existing capabilities, processes, and relationships of businesses (Lucas et al., 2013: 372). This process aims to provide more interactive services to digitalized customers (Schuchmann & Seufert, 2015: 32-33). The effective use of automation systems further strengthens digital transformation and therefore, adapting to digital transformation is now seen as necessary.

Digital transformation has developed and become a widely accepted concept with the fourth industrial revolution known as Industry 4.0 in the business world. This process aims to integrate various technologies into the business world and fundamentally change how businesses do business. The main components of digital transformation include technologies such as artificial intelligence, the Internet of Things, cloud computing, virtual reality, autonomous robots, cyber-physical systems, big data, simulation, 3D printing, and vertical and horizontal integration. These technologies help businesses to be more efficient, fast, and competitive (Schwab, 2016). As a result, digital transformation is a process that fundamentally changes the way businesses do business, integrates technologies, and can be seen as an inevitable necessity to gain a competitive advantage today.

2.3. Digital Transformation in Turkey and Developments in Defence Industry

Digital transformation technologies create many positive effects in a period when they are easily integrated into our daily lives and their usage is increasing. Individuals have gained the ability to access information instantly, and their level of awareness and consciousness of technology has increased. This situation has contributed to the welfare levels of societies. In the same way, businesses are balancing their processes to keep up with digital transformation and trying to increase their development by adapting to innovative technologies.

Turkey is experiencing a rapidly progressing digital transformation process, especially under the private sector's leadership and with public support. Digital transformation technologies are widely used in various sectors such as automotive, aviation, healthcare, tourism, education, finance, agriculture, gaming, and renewable energy, with innovative investments by multinational enterprises and local initiatives. These and similar developments enable the

production of high-value-added products, helping the country to raise its export income and contribute to reducing Turkey's current account deficit (Bakir, 2019: 133; Canbay and Mercan, 2017: 100-103; Sefer et, al. 2018: 207-208; Immib, 2023, Access Date: 03.01.2024; TİM, 2023, Access Date: 03.01.2024). Therefore, technological innovations and activities are spreading to more areas, directly contributing to the economy and positively affecting various sectors, enabling Turkey to play an important role both nationally and internationally.

Processes such as web design, e-commerce, and game software, which have an increasing importance worldwide, are also growing rapidly in Turkey. Especially the added value created by the gaming industry has attracted the attention of many countries and investments in this field have increased rapidly. Turkey has tried to be active in this sector by closely following these developments. In line with the target announced in 2018, various steps have been taken to achieve the target of "10 companies with a value of 1 billion dollars or more" by 2023. Peak Games was the first company to achieve this goal. However, in 2020, US-based Zynga acquired Peak Games for $1.8 billion, causing Peak Games to lose its title as Turkey's first "unicorn". In 2021, Getir, which received an investment of $300 million, became Turkey's second "unicorn" and its value is estimated to be approximately $11.8 billion. Insider startup also became Turkey's third "unicorn" in 2021 with a valuation of $1.2 billion. These companies have achieved high-added value by focusing on efficiency, speed, and cost optimization (NTV, 2023). In conclusion, Turkey is experiencing a period in which digital transformation is progressing rapidly in different sectors, and investments in this field contribute to the country's economic growth and international competitiveness. At the same time, entrepreneurs and companies in the country are achieving successful results by seizing the opportunities offered by digital transformation technologies.

In the history of Turkey's defence industry, the Mini-UAV (Unmanned Aerial Vehicle) project initiated in 2005 by Selcuk Bayraktar, the leader of Baykar, has been a key step for today's defence technologies. This project has contributed greatly to the development of UAVs and related technologies by encouraging cooperation between many companies (TRT Haber, 2023). At the same time, projects such as Anka, Bayraktar Akinci, Bayraktar TB2 have been the product of this know-how, and projects such as the Hurkus trainer aircraft and Hurkus C light attack and reconnaissance aircraft, Hurjet fighter jet, Gokbey utility helicopter, T129 ATAK attack and tactical reconnaissance helicopter, which were developed for training purposes, have also been developed with similar know-how. Therefore, the widespread development and use of digital technologies have paved the way for the digitalization of not only the defence industry but also many other fields (Türk Savunma Sanayi Ürünler Kataloğu, 2023).

3. An Overview of the Literature Review

The rise of digital transformation technologies has significantly changed how we innovate and create products and services (Nambisan et al., 2017). As a result, research in this field has taken a different approach compared to the past, with new methods and techniques being developed. Research on digital transformation technologies has explored various perspectives, not confined to a single field.

At the beginning of this study, most research on digital transformation technologies focused on concepts (Berman, 2012; Matt et al., 2015; Verhoef et al., 2021; Nadkarni and Prügl, 2021; Hilbert, 2022; Mergel et al., 2019; Singh et al., 2021; Ifenthaler and Egloffstein, 2020). However, beyond just concepts, some studies practically look at the effects of these transformation processes. These studies mainly revolve around how digital transformation performs (Masoud and Basahel, 2023; Tsou and Chen, 2023; Nwankpa and Roumani, 2016; Piccinini et al., 2015; Maiti and Kayal, 2017; Dapp, 2017).

The concept of technology is closely linked to innovation, referring to the development of new methods or technologies. Many studies have explored digital transformation within this framework, presenting various perspectives (Schwertner, 2017; Prem, 2015; Rachinger et al., 2018; Nambisan et al., 2017; Hinings et al., 2018). Some studies have also looked at how digital transformation is used in innovative processes (Sen et al., 2022; Cetindamar et al., 2021; Westerman et al., 2014; Lee et al., 2021; Bailenson et al., 2008). However, focusing solely on innovation would not give an accurate picture. In the context of digital transformation, factors like quality and flexibility are also considered alongside technology. These elements are considered as internal dynamics of digital transformation, shedding light on how effectively they are utilized. For example, 'quality' processes have been seen to contribute to the maturity of digital transformation processes and enhance their overall quality (Kim et al., 2012; Carvalho et al., 2020; Thekkoote, 2022). Quality is significant as it lays the foundation for the maturity of many innovative processes (Li et al., 2022; Ponsignon et al., 2019; Menshikova, 2019).

Efficiency studies in the context of digitalization, though mostly approached conceptually, include a few practical applications. These studies primarily explore how existing digital applications are used and their impact (Kuntsman and Arenkov, 2019; Zhong and Ren, 2023; Sandu and Voiku, 2019; Alesiuniene et al., 2021; Kimberly et al., 2022). The last aspect of internal dynamics is the notion of 'flexibility.' In many studies addressing this area, authors discuss the broad impact of digitization and its adaptability to various fields. These studies suggest that, through this dynamic structure, companies can more easily adapt to many processes and use digital operations more efficiently (Enrique et al., 2022; Chatterjee and Mariani, 2022; Sassanelli and Terzi, 2022; Tuktarova, 2022; Fachrunnisa et al., 2020; Matalamäki and Joensuu-Salo, 2022).

Despite the abundance of studies on digital transformation, there's a limited number of studies related to the defence industry sector. Among the studies addressing digital transformation in this context, Acerbi et al. (2022) conducted a case analysis to determine the roadmap of digital transformation processes in small and medium-sized enterprises, providing various insights. El Fertasi (2019) highlighted the significance of the digital ecosystem in bridging civil and military aspects, offering a conceptual perspective on its role in international security and defence. Fanni and Giancotti (2023) examined a case study on artificial intelligence in Italy's defence industry, applying qualitative methods to explore the impact of artificial intelligence on Italian defence dynamics. Studies that approach the defence industry through the lens of 'Industry 4.0' are more observable than those focusing solely on 'digital transformation.' Bibby and Dehe (2018) conducted a study evaluating the maturity levels of

Industry 4.0 in the defence industry sector, developing an empirical model to determine the maturity levels of companies in the sector. Segonds (2018) focused on the use of additive manufacturing technology, one of the Industry 4.0 technologies, for design in the aerospace and defence industry. In addition to these research efforts, there are studies on research and development (R&D) and the concept of innovation associated with the defence industry, indirectly related to digital transformation. However, as mentioned before, many of these studies approach the subject from a conceptual standpoint.

The aforementioned studies have mostly examined areas such as the service sector, education sector, finance sector, health sector, information technology sector, and automotive sector. Including these studies, the number of studies that jointly address digital transformation and the defence industry is limited. These limited studies were addressed in the context of Industry 4.0 in the literature and were rather examined conceptually (Lele, 2019; Bibby & Dehe, 2018; Segonds, 2018; Karakuş & Gönen, 2022). Therefore, with this study, which aims to fill the gap in both national and international literature, especially in the context of scale development, it will be possible to form a better basis for future studies.

4. The Distinctiveness of the Digital Transformation Effectiveness Scale

What sets this scale study apart from other studies is the evaluation of the scale in the context of 'effectiveness.' As mentioned in the literature section, the concepts of maturity and performance are often confused, despite carrying different meanings. To briefly explain these distinctions: The term "digital transformation maturity" in the literature defines what a company has achieved in terms of its transformation efforts and how it prepares to stay competitive in a digitized system. Additionally, this concept reflects a managerial interpretation of what a company has accomplished in terms of its products, services, processes, skills, culture, and change processes (Chanias & Hess, 2016). Therefore, digital maturity encompasses both technological and managerial dimensions, making it a comprehensive concept. Organizations can leverage a strong digital foundation for strategic business advantages when they have a good understanding of both aspects (Shahiduzzaman et al., 2017). As mentioned in studies in the literature, the 'maturity' concept is generally examined under a variety of research variables such as customer experience, operational excellence, business models, company size, leadership, strategy, technology, human resources, and organization (Simetinger and Basl, 2022; Ting et al., 2022; Wibowo and Taufik, 2017; Kljajić Borštnar & Pucihar, 2021; Schuh, 2020; Bouwman, 2019; Büyüközkan and Güler, 2020).

On the other hand, "digital transformation effectiveness" defines how effectively companies are using digital transformation technologies based on the assumption that they are currently using these technologies. Therefore, the fundamental distinction mentioned here expresses the steps towards transformation and adaptation during the maturity stage, while effectiveness indicates how efficiently existing digital technologies are utilized. Digital transformation effectiveness in this study encompasses transformative applications focusing on quality, high-quality technological elements, and components of a flexible structure that

extends to the digital base. On the other hand, digital transformation performance measures the overall success and competitive advantage that an organization achieves as a result of its digital transformation activities. Indeed, performance evaluation includes various long-term effects in many studies, such as customer satisfaction, increase in market share, revenue growth, and improvements in business processes (Zhai et al., 2022; Yu et al., 2022; Trieu & Pavelková, 2020; Martínez-Caro et al., 2020; Gastaldi and Corso, 2012; Harteis, 2017; Erhel and Jamet, 2013). Therefore, although concepts such as 'digital transformation maturity' and 'digital transformation performance' may seem to examine similar processes, 'digital transformation effectiveness' distinguishes itself from these concepts and serves as the fundamental distinction in this study.

5. Scale Development Study for Digital Transformation Effectiveness

5.1. Method

There are almost no studies in the industrial sector to measure the effectiveness of digital transformation processes. The research is a scale development study and aims to develop a measurement tool whose validity and reliability have been determined in order to determine the effectiveness of companies operating in the defence industry.

5.2. Study Group

The defence industry sector, which is one of the most important users of digital transformation, constitutes the study group of this study. The population of the research consists of 213 companies included in the product catalog list determined by the Presidency of Defence Industries (since 14 companies are under the same roof organization, the number of companies is based on 199). However, due to one of the primary limitations of this study, which involves the importance of information within the sector, a strict structure in information sharing is adhered to by sector representatives, and the company locations being situated in different cities, responses to the survey were only from 65 company representatives. This number is at a level that can be considered sufficient in terms of sample size. It is commonly recommended to conduct the study with a sample size at least 5 times the number of items in the scale (Tabachnick & Fidell, 2001), from this point of view, while it would be ideal to consider 70 firms in the context of the sample, the study was completed with 65 firms due to the limitations mentioned in this section. Exploratory Factor Analysis (EFA) was conducted to analyze the factor structure of the scale and Confirmatory Factor Analysis (CFA) was conducted to analyze the accuracy of the factor structure. Exploratory Factor Analysis was performed using SPSS 26 package program and Confirmatory Factor Analysis was performed using AMOS 26 program.

5.3. Scale Development Process

The following stages were followed in the development of the Attitude Towards Digital Transformation Scale (Tavşancıl, 2019).

1. Literature review and creation of the item pool: In the writing of the scale items, firstly, a literature review was conducted on "digital transformation usage", "digital transformation implementation", "digital transformation effectiveness", "digital transformation performance", "digital transformation quality", "digital transformation technology", "flexibility in digital transformation", "attitude towards digital transformation" in the defence industry, and the studies conducted in this field and the defence industry sector were examined. An item pool of 150 questions was created by utilizing the literature review. Before finalizing the scale, a large and comprehensive item pool with candidate items was created.

2. Obtaining Expert Opinion to Ensure Content Validity and Face Validity: A language expert was asked to evaluate the questionnaire in terms of spelling and expression. To ensure content validity, the opinions of four academicians who are experts in their fields were taken. For this purpose, the researcher created an "Expert Evaluation Form". The relevant form includes the expressions "suitable", "can be used with modification" and "not suitable" for the items in the item pool. As a result of the opinions of the experts, some of the items in the item pool were eliminated and some were rearranged. To determine the level of agreement of the individuals with the items in the scale, a Likert-type five-point rating scale as "strongly agree (5)", "agree (4)", "undecided (3)", "disagree (2)", "strongly disagree (1)" was used.

3. Creating the Draft Form: In the draft scale, items were written to measure positive and negative reactions. All 15 items in the draft scale form consist of positive sentences. These sentences were not given in a certain order. The number of questions was reduced to 14 as a result of validity and reliability.

4. Preliminary Application: A preliminary application was made with 15 companies in Bursa Chamber of Commerce and Industry which were not included in the research. According to the responses of the companies to the items in the pool, it was decided to reduce the number of questions to 14.

5.4. Data Collection and Analysis

The purpose of the study was explained to the participants and questionnaires were created online via Google Forms. These questionnaires were sent to the e-mail addresses of the respondents via Linkedin, by establishing one-to-one communication with the respondents at the defence industry fair. Preliminary information was given that the names of the companies would be kept confidential and that their responses would be used within the scope of scientific research.

Before analyzing the data, the collected survey forms were reviewed and it was seen that the questions were answered completely. 65 companies responded to the questionnaire and the validity and reliability of the scale were analysed. The construct validity of the scale was analyzed by Exploratory Factor Analysis (EFA) with the help of the SPSS 26 package program. In the first stage, the Kaiser-Meyer Olkin [KMO] coefficient and Barlett Sphericity Test were used to check the suitability of the data for factor analysis. Then, the varimax rotation technique was used for construct validity. The sub-dimensions obtained were named in

connection with the literature. Cronbach's alpha coefficient was calculated for the reliability of the sub-dimensions and the whole scale, and item-test correlations were calculated for item validity. Confirmatory Factor Analysis (CFA) was conducted with AMOS software to analyze the accuracy of the scale structure.

5.5. Findings

The research will be presented under the titles of findings related to explanatory factor analysis, findings related to confirmatory factor analysis and findings related to reliability.

Findings Related to Exploratory Factor Analysis of the Scale

Kaiser-Meyer-Olkin (KMO) coefficient and Barlett Sphericity test values were calculated in order to check whether the data were suitable for analysis and to reveal the adequacy of the sample. The analysis findings related to KMO coefficient and Bartlett Sphericity Test are shown in Table 1.

Table 1: KMO and Bartlett's Sphericity Test Findings

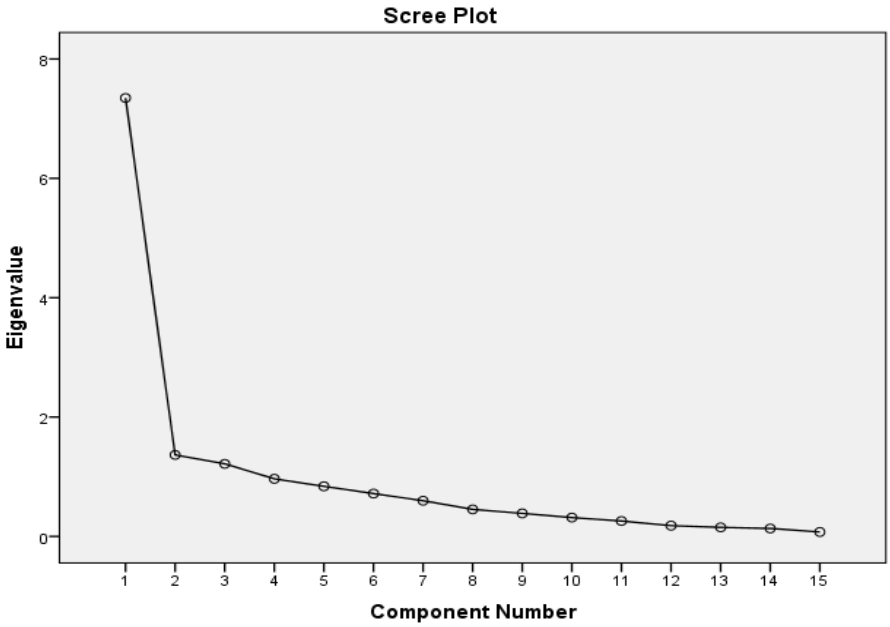
KMO Coefficient		0.809
Bartlett's Sphericity Test	Chi-Square	443.083
	df	105
	p	0.000

As a result of the analysis according to Table 1, it is seen that the data size is sufficient since KMO=0.80>0.50. Since the probability value of Bartlett's Test (Sig=0.000) is less than 0.05, it is concluded that there is a relationship between the variables and therefore it is suitable for factor analysis.

Explanatory factor analysis aims to determine fewer factors from a large number of interrelated variables. For this purpose, in this scale development study, related scale items were grouped and defined these groups as the sub-dimensions of the scale. The items that should be included in the scale or should be removed from the scale were determined by explanatory factor analysis. For this purpose, components with eigenvalues of 1 or higher are included in the analysis. As a result of EFA, it was determined that the items were grouped under three factors with eigenvalues greater than 1. In scale development studies, it is stated that the factor loading value can be reduced to a maximum of 0.30. In order to be stronger, 0.40 was determined as the factor loading value in our study (Bayram, 2017).

Items below 0.40 loading value were removed from the scale and EFA was performed again. As a result of these analyses, 1 item was removed from the 15-item draft scale. As a result of the EFA, it was seen that 14 items remained from 15 items and these items were grouped under 3 factors. Eigenvalues of the 3-factor structure are shown in Figure 1.

Figure 1: Eigenvalues of Factors



The eigenvalue, which gives information about the importance and weight of the factors, was found to be 7.347 for the first factor, 1.365 for the second factor, and 1.216 for the third factor.

According to the EFA results, the loading values of the first factor ranged between 0.615 and 0.798, the loading values of the second factor ranged between 0.845 and 0.526, and the loading values of the third factor ranged between 0.417 and 0.786. The factors in which the items were included were evaluated in the light of the literature by taking into account the opinions of three experts in the field the first factor was named "quality", the second factor was "technological" and the third factor was "flexibility". Table 2 shows the variance values explained by these factors and the items in the factor. The scales in the table have been developed to assess the effectiveness of the use of digital transformation technologies in the defence industry in terms of quality, technology, and flexibility.

Table 2: Cronbach's Alpha of facets in the Digital Transformation Effectiveness

Factor		Items	Factor Loadings	Cronbach's Alpha	CR	AVE	Explanatory Factor
Quality	**Quality 1**	As the technologies increase that we use, our product/service increases in terms of both quality and quantity.	0.630	0.867	0.84	0.53	%23.812
	Quality 2	Thanks to digital technologies, customers' confidence in our production/service processes has increased.	0.615				
	Quality 3	Thanks to our advanced digital infrastructure, it is easier to set goals for the	0.615				

		future both for production and service.					
	Quality 4	As technological elements have increased, employee health and safety has gained importance and come to the forefront.	0.701				
	Quality 5	Company policies have been developed in parallel with technological developments.	0.735				
	Quality 6	With the employment of qualified personnel, studies for digital transformation are gaining momentum and new generation technologies can be implemented.	0.798				
Technology	**Technology 1**	Thanks to digital transformation, we have more technological elements than our competitors.	0.635	0.863	0.80	0.52	%23.552
	Technology 2	Thanks to the importance we attach to digitalization, we can implement new methods and production/service techniques.	0.526				
	Technology 3	The software/algorithms used in our company are much more advanced compared to the companies in the sector.	0.838				
	Technology 4	We use digital transformation technologies (artificial intelligence, cloud computing, internet of things, big data, etc.) with the aim of being a pioneer in the sector.	0.845				
Flexibility	**Flexibility 1**	Thanks to the digital technologies that we used, we can be involved in different platforms and processes faster.	0.717	0.816	0.82	0.54	%18.822
	Flexibility 2	Digital technologies (cloud system, artificial intelligence, big data, Internet of things, additive manufacturing, etc.) accelerate and facilitate inter-departmental co-operation/data flow.	0.664				
	Flexibility 3	The production and service process is based on	0.786				

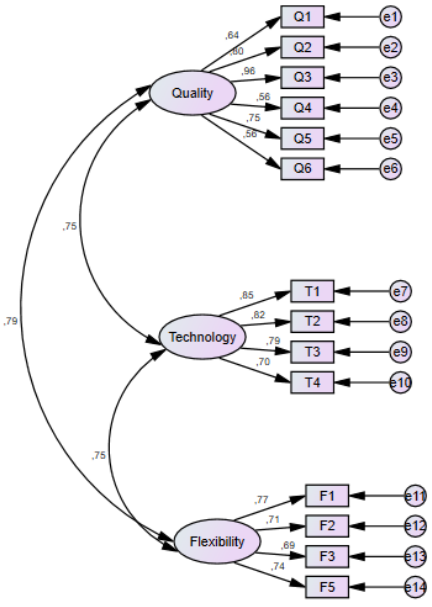
		a customer-oriented structure thanks to digital technologies.					
	Flexibility 5	There are personalised/unique processes due to operational requirements.	0.781				
				Cronbach Alpha for the Overall Scale 0.92			**Total Variance** %66.186

In Table 2, the factor loadings of EFA are listed from high to low for each factor. According to the factor loadings in the table, it is seen that the scale being developed is gathered in 14 items and 3 factors. The first factor consists of 6 items, the second factor consists of 4 items and the third factor consists of 4 items. By analyzing the items forming the factor, the first factor was named "quality", the second factor was "technological" and the third factor as "flexibility". It is seen that the first factor explains 23.812% of the variance, the second factor explains 23.552% the third factor explains 18.822%, and the factor consisting of all components explains 66.186% of the total variance. In analyses conducted in social sciences, an explained variance ratio between 40% and 60% is considered sufficient (Başol, 2020).

5.5.1. Findings Related to Confirmatory Factor Analysis of the Scale

Confirmatory factor analysis was performed to check the fit of the three-dimensional structure that emerged after the exploratory factor analysis and the scale model is presented in Figure 2.

Figure 2: Confirmatory Factor Analysis



When analyzing the correlation between Factor 1 (Quality), Factor 2 (Technological), and Factor 3 (Flexibility) in Figure 2, significant correlational relationships were observed. The correlations are as follows: 0.75 between Factor 1 and Factor 2, 0.75 between Factor 2 and Factor 3, and 0.79 between Factor 1 and Factor 3. The high and significant correlations indicate that the scale consists of three sub-dimensions.

The fit indices resulting from confirmatory factor analysis were analyzed. To evaluate this fit, chi-square (χ2), Root-Mean-Square Error of Approximation (RMSEA), Normed Fit Index (NFI), Comparative Fit Index (CFI) Goodness of Fit Index (GFI), GFI (Goodness of Fit Index), Adjusted Goodness of Fit Index (AGFI) and Incremental Fit Index (IFI) values were examined. Table 3 shows the Goodness of Fit Indexes for the Digital Scale.

Table 3: Goodness of Fit Indices of the Scale

Compliance Criteria	Good Fit	Acceptable Compliance Scale	Scale
RMSEA	0<RMSEA<0.05	0.05≤RMSEA≤0.10	0.03
NFI	0.95 ≤ NFI ≤1	0.90≤ NFI ≤ 0.95	0.904
CFI	0.97 ≤ CFI ≤1	0.95≤ CFI ≤ 0.97	0.908
GFI	0.95 ≤ GFI ≤1	0.90≤ GFI ≤ 0.95	0.915
AGFI	0.90 ≤ AGFI ≤1	0.85≤AGFI≤ 0.90	0.914
χ 2/df	0< χ 2/df<3		1.622

Looking at the fit indices in Table 3, it was seen that the χ2/df value obtained in this study was 1.622. A χ2/df value below 3 indicates a good fit and a value between 3 and 5 indicates an acceptable fit (Gürbüz, 2019); this result indicates that the CFA is statistically significant and has a good fit. GFI value varies between 0 and 1 and above 0.90 indicates a good fit, CFI value of 0.90 and above indicates good fit. AGFI value above 0.95 indicates a perfect fit. NFI varies between 0 and 1. Values between 0.90 and 0.94 are acceptable fit. RMSEA values below 0.05 indicate a good fit (Sumer, 2000). In addition, the IFI value, which is not included in the table and takes into account the sample size, indicates a good fit of 0.95 and above (Şimşek, 2007). In this study, the IFI value was found to be 0.958, which indicates a good fit.

According to the goodness of fit index for the model given in Table 3, RMSEA, GFI, and AGFI values are at a good fit level, while NFI, and CFI values are within acceptable limits. The evaluation of this goodness of fit coefficients, shows that the three-factor "quality", "technological" and "flexibility" dimensions obtained as a result of EFA were confirmed by CFA.

5.5.2. Findings Related to the Reliability of the Scale

Regarding the reliability of the attitude scale towards digital transformation, Cronbach Alpha internal consistency reliability coefficient was calculated. The reliability coefficients of the factors are shown in Table 4.

Table 4: Reliability Coefficients of the Scale

Factor	Factor Name	Items	Cronbach Alpha (α)
First Factor	Quality	Quality 1	0.867
		Quality 2	
		Quality 3	
		Quality 4	
		Quality 5	
		Quality 6	
Second Factor	Technology	Technology 1	0.863
		Technology 2	
		Technology 3	
		Technology 4	
Third Factor	Flexibility	Flexibility 1	0.816
		Flexibility 2	
		Flexibility 3	
		Flexibility 5	
	Cronbach Alpha for the Overall Scale		0.92

The Cronbach's Alpha coefficient calculated for all items in the scale was 0.92, 0.867 for the first factor "quality", 0.863 for the second factor "technological" and 0.816 for the third factor "flexibility". In cases where the Cronbach's Alpha value is above 0.70, the scale is considered reliable (Gürsakal, 2019). These numerical data show that the scale obtained is sufficiently reliable both in sub-dimensions and in general.

6. Conclusion

As a result of digital transformation technologies being an area of focus all over the world and the rapid progress of its development, it has been possible to obtain high-value-added products. Adaptation to these technologies is also progressing rapidly in Turkey. This process is progressing much faster than expected thanks to the importance given to digital transformation technologies and R&D studies by Turkey, which has achieved an important position on a global scale with the defence industry projects carried out in recent years (Worldbank, 2023; ESD, 2023; Reuters, 2023; ITA, 2023; Defencenews, 2023, Access Date: 04.01.2024).

The prioritization and development of innovative technologies by many companies, especially multinational companies, allows the application field of the private sector to progress much faster. However, these processes are based not only on the field of application but also on the conceptual and theoretical background that underpins these dynamics. Therefore, thanks to the scientific studies and scales developed in the background, new application areas can be revealed and more systematic processes can be coordinated. In this respect, it can be said that the added value created by scientific studies is an important element in the defence industry sector and digital transformation practices, as in many sectors.

This study aims to develop a valid and reliable Likert-type scale to determine the digital transformation effectiveness of the defence industry. As stated under the literature title, a study in which digital transformation and the defence industry are examined jointly has been

dealt with in the context of Industry 4.0 applications and has been examined in a limited way. At the same time, although there are scales in digital transformation performance, usage, and maturity, no scale for the 'effectiveness of digital transformation' has been identified. Therefore, it can be stated that the main motivation for this study is to create a study in which digital transformation technologies and the defence industry are jointly addressed, in addition to creating a scale that has not been identified and developed in the literature before and that can be used for future studies.

The main field of activity of the study is the defence industry and the enterprises affiliated with this industry. In this respect, the most important constraint of this study is that this industry is a strategic field and the enterprises are strict in sharing information. In addition to this constraint, the fact that the relevant data will be collected through a questionnaire and the company representatives consider the time to fill the questionnaire as a waste of time and do not fill the questionnaire can be characterized as another constraint. On the other hand, the fact that the locations of most of the firms to be surveyed are located in different cities and that it is difficult to visit the firms if necessary can be stated as another constraint.

Within the scope of this study, the literature on scale development was first reviewed, scale development stages were specified in items and scale development stages were carried out accordingly. In this context, the 'digital transformation effectiveness' scale was analyzed in the context of 3 sub-dimensions and 14 items. In the light of the data obtained, firstly, reliability, validity, and explanatory factor analysis were performed with the SPSS 26 program, then confirmatory factor analysis with the AMOS 26 program. The results showed that the scale has sufficiently high internal consistency with its sub-dimensions, has explanatory and confirmatory factor validity, and also has criterion validity based on sub-dimensions. Therefore, it is possible to say that this scale can be used for future studies in light of the results obtained.

The concept of digital transformation includes a wide range of processes. In this study, rather than the general context, 'digital transformation effectiveness' was addressed more specifically and the application was carried out on companies in the defence industry. As it is known, one of the issues that constitute the basis of scientificity is that there is no single truth and that the results obtained can be improved and revised. Therefore, it will be useful for future studies to apply the 'digital transformation effectiveness' scale applied in this study to different sectors with different scale dimensions and to examine the findings obtained by comparing them. Thus, it will be possible further to observe the international validity of the scale in question.

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Çıkar Beyanı: Yazarlar arasında çıkar çatışması yoktur.

Etik Beyanı: Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara uyulduğunu yazarlar beyan eder. Aksi bir durumun tespiti halinde Fiscaoeconomia Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir.

Yazar Katkısı: Yazarların bölümlere katılımları eşittir.

Conflict of Interest: The authors declare that they have no competing interests.

Ethical Approval: The authors declare that ethical rules are followed in all preparation processes of this study. In the case of a contrary situation, Fiscaoeconomia has no responsibility, and all responsibility belongs to the study's authors.

Author Contributions: Authors' participation in the chapters is equal.