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2023, 12 (4), 2296-2322 | Research Article

Evaluation of Digital Skills Development Policies with the Examples of Netherlands, Sweden, and Germany

Didem KOCA [1]

Abstract

Despite no consensus on its definition in the literature, digitalization - essentially coined thanks to the widespread integration of digital technologies into everyday life - is likely to bring diverse impacts to each country. The inevitability of digital technologies in contemporary daily life forces almost every country to design different strategies to encourage its citizens to adopt digital skills. In this sense, the present study aims to draw attention to the increasing demand for digital skills with digital transformation processes in selected countries and scrutinize these countries' digitalization-specific policies and strategies. Accordingly, this case study focuses on three digitally competent European countries - the Netherlands, Sweden, and Germany - regarding their digital transformation processes and practices, strategies, and fundamental policies for improving their citizens' digital skills. In this regard, we can assert that each country bears different digital strengths. While Sweden has an advanced digital economy and has rapidly started to transition to an efficient knowledge economy, Germany has a relatively high supply of digital skills to satisfy the increased demand by an innovation-oriented industry. The Netherlands, on the other hand, shines out by ranking first in Europe as about 80% of its population aged 16 to 74 years adopt digital skills. This study synthesized several strategies and objectives by using exemplary examples from different countries in the realm of digital skills development. In general, this research suggests that the achievement of digitalization success is contingent upon establishing social acceptance of digital transformation and embracing human-centric approaches throughout the process.

Keywords: Digital Transformation, Digital Skills, Workforce, Education

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Dijital Becerileri Geliştirme Politikalarının Hollanda, İsveç ve Almanya Örnekleriyle Değerlendirilmesi

Didem KOCA [1]

Öz

Literatürde mütabık kalınan herhangi bir genel tanım bulunmamasına karşın esas itibarıyla dijital teknolojilerin günlük yaşama entegre edilmesi ile başlayan dijitalleşme süreci her ülkeyi farklı şekillerde etkilemektedir. Dijital beceri gerekliliğinin her birey için kaçınılmaz olduğu bilinci, neredeyse her ülkeyi farklı stratejiler geliştirmeye zorlamaktadır. Bu çalışmanın amacı, seçilen ülke örnekleri kapsamında; dijital dönüşüm süreçleri ile eş zamanlı olarak dijital becerilere olan artan talebe dikkat çekmek, söz konusu ülkelerin uyguladıkları politikaları ve stratejileri detaylı bir biçimde analiz etmektir. Araştırmada dijital becerilerin topluma kazandırılmasında öne çıkan Hollanda, İsveç ve Almanya ülkeleri incelenmiştir. Nitel çözümleme yaklaşımlarından biri olan örnek olay durum çalışması yöntemi kapsamında söz konusu ülkelerin, dijital dönüşüm süreçleri, bireylerin dijital becerilerinin geliştirilmesine yönelik uygulamaları, stratejileri ve temel politikaları bakımından analiz edilmiştir. Dijital dönüşüm kapsamında iyi uygulama örnekleri kategorisinde yer alan her bir ülke sahip olduğu farklı özelliklerle dikkat çekmektedir. İsveç, 'gelişmiş dijital ekonomi' statüsüne sahiptir. Ülke hızla etkin bir bilgi ekonomisine geçiş yapmaya başlamıştır. Almanya, dijital inovasyona yönelik bir endüstri ekseni tarafından üretilen yüksek talebi karşılamak için nispeten yüksek bir dijital beceri arzına sahiptir. 2021 yılında Hollanda ise 16 ila 74 yaş arası nüfusunun yaklaşık yüzde 80'inin dijital becerilere sahip olması nedeniyle Avrupa'da ilk sırada yer alması ile öne çıkmıştır. Bu çalışma, dijital becerilerin geliştirilmesinde iyi ülke uygulamalarının yardımıyla bazı temel strateji ve hedefleri bir araya getirmiştir. Genel olarak bu araştırma, dijitalleşme başarısının, dijital dönüşümün sosyal kabulünün sağlanmasına ve süreç boyunca insan odaklı yaklaşımların benimsenmesine bağlı olduğunu öne sürüyor.

Anahtar Kelimeler: Dijital Dönüşüm, Dijital Beceri, İşgücü, Eğitim

Koca, D. (2023). Dijital Becerileri Geliştirme Politikalarının Hollanda, İsveç ve Almanya Örnekleriyle Değerlendirilmesi . İnsan ve Toplum Bilimleri Araştırmaları Dergisi , 12 (4) , 2296-2322 . https://doi.org/10.15869/itobiad.1335724

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Introduction

Digitalization is often described as the act and process of integrating digital technologies into daily life (Hagberg et al., 2016, p.696). Yet, the term digital transformation was coined only two decades ago in the study by Patel and McCarthy (2000) titled "Digital Transformation: The Essentials of e-Business Leadership." Later, Stolterman and Fors (2004, p.689) defined digital transformation as "changes that digital technologies entail or affect all aspects of human life." Then, the debates continued where the "human factor" would be located in the technology revolution. While some authors raised sharp predictions that there would be no need for humans in the new world order (Sachs and Kotlikoff, 2012; Brynjolfsson and McAfee, 2014), some signaled that the need for human resources would never fade in the process except for slight changes (Manyika, 2017; Wisskirchen, 2017; Harari, 2018; Wolter et al., 2015; Bonekamp and Sure, 2015). In other words, replacing manual dexterity with machines led to the transformation of the employees from "workers" to "operators." Nevertheless, the story was not that simple, and "workers" had to acquire new skill sets to survive in the labor market. In this regard, the concept of "digital skills" has begun to rise within skills attributed to the demands of the 21st century.

This research was designed as an explanatory case study (Davey, 2009). Creswell (2016, p.241) describes a case study as "a qualitative inquiry in which the researcher focuses on one or more cases bounded over time through in-depth data collection involving multiple sources of information (observations, interviews, audio-visuals, documents, and reports)." According to Gerring (2007), a case study is the in-depth study of a single case to expound on more similar cases. Further, we adopted the document analysis technique to collect and analyze the data. Ultimately, we descriptively analyzed the aspects of digital transformation in the Netherlands, Germany, and Sweden regarding their practices, strategies, and fundamental policies for improving their citizens' digital skills.

Focusing on only the mentioned countries may be shown as the only limitation of this study. Relying on our findings, we can assert that each country bears different digital strengths. While Sweden has an advanced digital economy and has rapidly started to transition to an efficient knowledge economy, Germany has a relatively high supply of digital skills to satisfy the increased demand by a digital innovation-oriented industry. On the other hand, the Netherlands shines out by ranking first in Europe as about 80% of its population aged 16 to 74 years adopt digital skills. Since the present study aims to draw attention to the increasing demand for digital skills with digital transformation and analyze digital-friendly policies and strategies of the said countries, we may claim that each strategy, roadmap, and policy for keeping up with digital transformation may differ by development level, demographic structure, and culture. Overall, the fundamental understanding of digital skills policies would be a remarkable milestone for every country in the digital transformation era.

This study descriptively explores the use of digital skills in selected countries with the help of multidimensional datasets. In addition, in the study policies and strategies for digital skills acquisition in the Netherlands, Sweden and Germany are discussed. In this context, the study "Which digital skills development policies are implemented in the Netherlands, Sweden and Germany?" focused on the question. Various studies have proved the digital skill levels of these countries.

Digital technologies play an essential role in the revival of the world economy in today's information society. This study brought together some key strategies and objectives with the help of good country practices in developing digital skills. Therefore, this study can serve as a guide in determining the ways to be followed in skill development.

In the first part of this study, literature research on digital skills is included. In the following section, digital skill dimensions in the Netherlands, Sweden and Germany are examined comparatively. Finally, strategies and policies related to the digital skill acquisition in question are included.

Literature Review

The concept of skill refers to the ability to perform tasks by settling problems with the help of relevant knowledge and proper qualifications. In the 21st century, the changing paradigm of information and technology has unlocked significant transformations in many domains of life. To put it another way, differentiating social life dynamics and information and technology-oriented developments have caused the differentiation of the skills and competencies one needs to acquire. Even though persisting skill sets were differentiated in the past to embody the spirit of the era, 21st-century skills seem more complex than those demanded in the past centuries. In this regard, national and international organizations have proposed different skill set categories for the 21st century (Koca, 2020, p.106). For example, the report titled "The Future of Education and Skills: Education 2030" by OECD (2019) calls the skills students should acquire in the 2030s "transformative competencies" within three groups: creating new value, reconciling tensions and dilemmas, and taking responsibility. Acquiring these skills is then thought to help students adapt to changing social and digital domains of life.

The idea of integrating education and technology may be considered an indispensable tenet of skill acquisition. Indeed, a study by the International Society for Technology in Education (ISTE) in 2016 set forth necessary skills in the use of educational technologies within six standards for students: empowered learning, digital citizenship, knowledge constructing, innovation, computational thinking, communication, and collaboration. These standards, designed by about 250 scholars from many countries, primarily aim to contribute to the skill-based classroom and curriculum contents.

The necessity of adopting digital technologies may be evident in working life the most. McKinsey (2018)'s study titled "Skills Shift Automation and The Future of The Workforce" claimed that automation would accelerate changes in workforce skills in the coming 15 years. While the demand for digital skills was 9% in 2002, the study expected it to rise to 16% by the end of 2030. Moreover, almost half of the companies included in the mentioned research were found to be ready to lead in shaping the future workforce and emphasize the necessity of collaborating with stakeholders in education. According to the European Commission, the demand for workers with digital expertise is increasing by about 4% per year (Berger and Frey, 2015), implying that rapidly transforming technology may lead many digital skills to be obsolete in a short time (e.g., coding skills are thought to become obsolete within a few years). Similarly, a European Center for the Development of Vocational Training (CEDEFOP,2012) study proposed that skills in information and communication technologies (ICT) are vulnerable to rapid obsolescence.

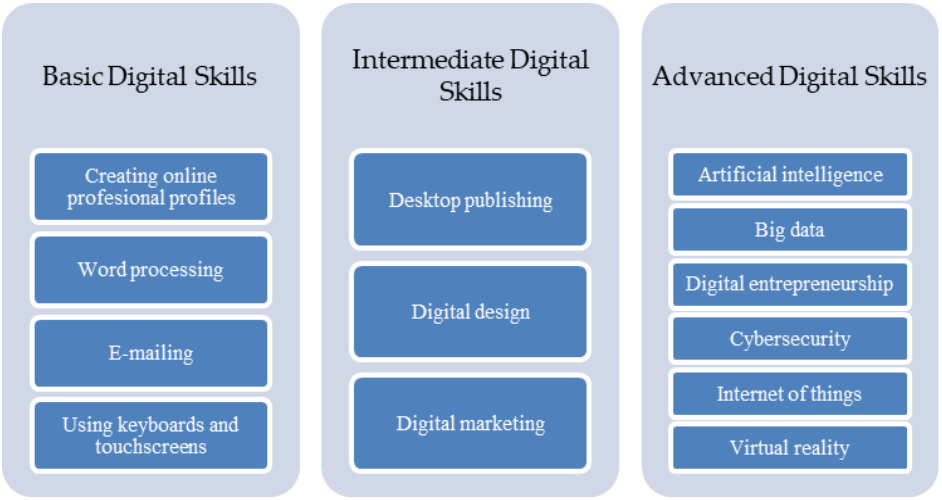
In addition, 16% of workers in Finland, Germany, Hungary, and the Netherlands were reported to no longer use their skills in the last two years (CEDEFOP, 2012). Therefore, employees may need to continuously acquire new skills to remain competitive, which makes it inevitable to embrace change, to embrace lifelong learning. As trends, such as globalization and advances in artificial intelligence, force changes in the demands of the labor market and skills, people need to place more emphasis on their ability to "learn to learn." OECD Skills Outlook (2017) indicated that employees' cognitive skills and readiness to learn matter in state-wise development and economic growth.

Kane et al. (2020) traced the demands for digital skills in industries as a consequence of the digitalization of professions. Accordingly, almost 80% of online job postings in 2018 demanded digital skills and knowledge. Yet, a significant difference might be highlighted considering the levels of vacancies. While 94% of postings for high-skill jobs required a robust competency in digital skills, it dropped to just 62% for low-skill jobs.

Accenture (2017) classified digital skills demanded in workplaces by occupations. Accordingly, he categorized the occupations as operators, technicians, engineers, and IT engineers. Therefore, the findings may then imply that the use of Industry 4.0 technologies would affect all employees in the production industry. Indeed, digital skills are demanded not only in engineering but also in intermediate operational and technical jobs. Thus, it can be asserted that employees always need to seek new skills involving flexibility, lifelong learning, and curiosity. On the other hand, despite the increasing demand for ICT specialists, a combination of skills to adapt employees to technological changes would be even more appraised. Therefore, acquiring creative, entrepreneurial, and technical skills that allow for a smooth transition from one occupation to another is becoming increasingly important (Berger and Frey, 2015).

The digital skills framework refers to digital competencies linked with different occupations and educational attainment so that a state and citizens can benefit from and contribute to the digital world. It is fundamentally designed to support service providers, organizations, and employers that offer training to guide citizens on the essential digital skills needed to act safely in a digital world (World Bank, 2021, p.8). While basic digital skills require being knowledgeable about how to use ICT or any digital tools (e.g., the ability to turn on the computer, use a mouse, or access the internet, as well as the ability to write an e-mail or prepare a resume) (Hecker and Loprest, 2019, p.2). Intermediate digital skills, on the other hand, cover skills such as Visual Basic macro programming or HTML and JavaScript-dependent web design (International Telecommunication Union, 2020, p.13). Advanced digital skills encompass a comprehensive understanding acquired through specialized programs, including advanced programming, machine learning, internet of things (IoT), networking, engineering, and hardware design. These abilities are typically imparted in higher education institutions but can also be obtained through professional experience and workforce skills development programs. Advanced abilities necessitate programming literacy, as the objectives, such as creating and programming novel digital tools and features, are beyond rudimentary or intermediate technological utilization (International Telecommunication Union, 2020). Figure 1 illustrates a categorization of digital skills into three levels: basic, intermediate, and advanced.

Figure 1: Continuum of Digital Skills



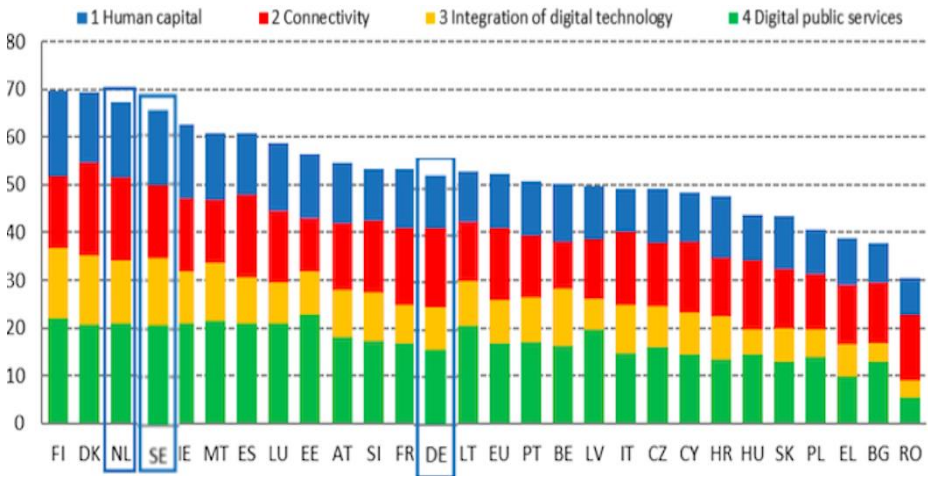
Adapted from: International Telecommunication Union (2020).

In a nutshell, digital technologies occupy our lives more and more, which naturally changes the way one accesses and uses information. Now, people seem to have to analyze complex data, think systematically, and make quick and accurate decisions. Moreover, people need to update their skills constantly to adapt to digital technologies widespread in their working lives. Yet, it should be noted that people need to be inclined to the right skills to be able to use digital technologies in a meaningful way and to catch new opportunities offered by these technologies (OECD, 2016). Thus, more emphasis should be placed on promoting basic and digital skills and higher-order thinking to enable one to participate in digital activities and adapt quickly to new occupations and skills needs. In the section below, we present our findings derived from various databases on the digital skills use in the Netherlands, Germany, and Sweden.

Dimensions of the Digital Skills Use in the Netherlands, Sweden, and Germany

The European Commission consistently monitors the digital advancements of its member states and has been annually publishing the Digital Economy and Society Index (DESI) since 2014. The study provides nation profiles that assist member states in identifying areas of significant action. Additionally, it includes thematic sections that offer an analysis at the EU level on significant digital policy areas, as depicted in Figure 2. Overall, DESI is measured by five main dimensions. The human capital dimension concerns citizens' internet use skills and experts' advanced skills, while the connectivity dimension covers indicators measuring the supply-demand of both fixed and mobile broadband technologies. The integration of digital technologies dimension consists of three sub-dimensions: digital intensity, adoption of selected technologies by enterprises, and e-commerce. Finally, the digital public services dimension includes e-government and open data policies (European Commission, 2022, p.5-8).

Figure 2: Digital Economy and Society Index (DESI) 2022 Ranking



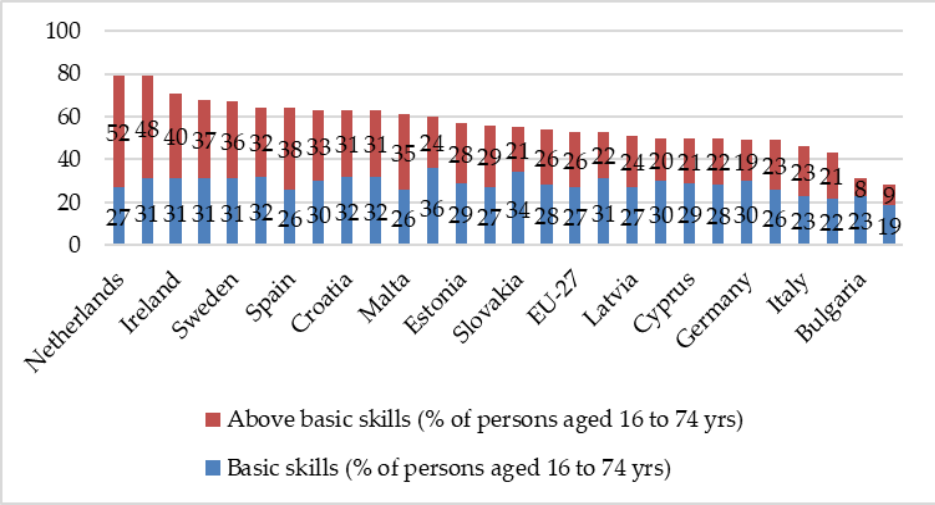
Source: DESI, 2022

According to the findings in DESI 2022, Germany has exhibited relatively considerable progress over the past five years (2017-2022) and now ranks 13th among 27 EU member states (DESI, 2022a). As the EU's largest economy, Germany's progress in digital transformation in the upcoming years seems critical to ensuring that the EU achieves its 2030 Digital Decade goals. In the same index, Sweden is mentioned for its remarkable digital performance, putting it fourth among the member states.

Sweden has achieved success in the digital transformation movement in the last few years and scores above the EU average. Yet, it regresses to ninth place and remains below the EU average in 5G coverage within the connectivity dimension. Indeed, Sweden scores 18% in 5G coverage of populated areas, well below the EU average (66%). Thus, it may be important that Sweden continues to improve its digital performance to remain the leading country in digital and contribute to the Digital Decade goals (DESI, 2022b). When it comes to the Netherlands, the findings reveal that it has also consistently been the best-performing country in the EU and continues to make progress in some key areas, granting it third place in DESI (DESI, 2022c).

Cross-country comparison of basic and above-basic digital skills seem to be guiding in digital skills use. In this sense, the Netherlands ranks first in surveys by the Dutch Central Bureau of Statistics (CBS) and Eurostat on the use of overall digital skills (computer, internet, software) in the EU-27 and the ICT use of households and individuals. Accordingly, about 80% of the Dutch population aged 16 to 74 years had basic or above-basic digital skills in 2021, compared to just 54% on average across the EU, which throws the Dutch almost a step beyond the European target of adopting 80 core competencies by 2030 (CBS, 2021). Compared to Finland, which drew with the Netherlands for first place, the digital skills of the Dutch seem above the basic proficiency level. The Dutch demonstrate the utmost proficiency in tasks such as sending and receiving e-mails, making internet calls, going online on social networking sites, and expressing opinions on social or political issues online (Rozing, 2022).

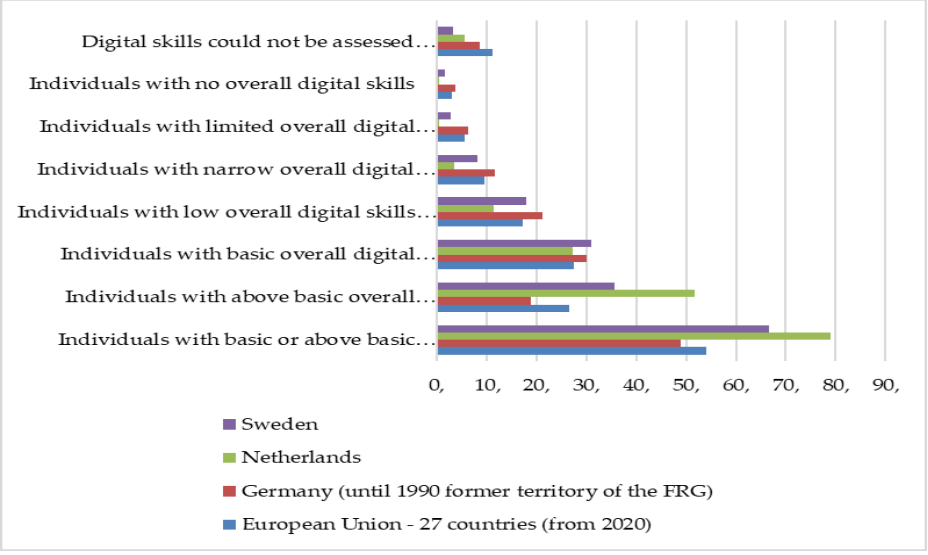
Figure 3: Overall Digital Skills in the EU-27, 2021



Source: Eurostat, 2021a

Sweden and Germany, both of which have scores below the average of the European Union, are positioned ahead of the Netherlands in the hierarchy of broad digital abilities that are considered basic or above-basic. Germany exhibits a notable 30% advantage over the Netherlands in terms of fundamental digital competencies. The Netherlands did better in the ranking of basic digital skills, following Finland, Ireland, Denmark, Sweden, Luxembourg and Spain. In addition, it is worth noting that Romania, Bulgaria, Poland, and Italy have performance levels that are significantly lower than the average of the European Union when it comes to basic skills throughout their respective populations (Figure 3).

Figure 4: Individuals' Level of Digital Skills (from 2021 onwards)



Source: Eurostat, 2021b

Individuals' level of digital skills (Figure 4) may be another key indicator of digital skills use in the Netherlands, Sweden, and Germany. Accordingly, the Netherlands shines out compared to the others in terms of basic and above basic general digital skills. Considering individuals with basic overall digital skills, while Sweden and Germany score above the EU average, the Netherlands remains at that average. It is also evident that Germany ranks first regarding citizens with low and narrow overall digital skills. In summary, Sweden, the Netherlands, and Germany have citizens with digital skills above the EU average. Indeed, the EU average of individuals whose digital skills cannot be evaluated since they have not been able to go online for three months is 11%, which is calculated to be quite high for the mentioned countries.

Table 1: Level of Internet Access – Households

GEO (Labels)	2012	2022	GEO (Labels)	2012	2022
European Union - 27 countries (from 2020)	74.54	92.52	**Netherlands**	93.55	98.28
Belgium	77.71	94.44	**Austria**	79.28	93.15
Bulgaria	50.92	87.31	**Poland**	70.49	93.33
Czechia	72.55	91.48	**Portugal**	61.02	88.15
Denmark	92.00	95.16	**Romania**	53.77	89.41
Germany (until 1990 former territory of the FRG)	85.50	91.41	**Slovenia**	73.94	92.60
Estonia	73.82	92.41	**Slovakia**	75.44	90.65
Ireland	81.09	:	**Finland**	86.80	97.59
Greece	53.58	85.49	**Sweden**	91.69	94.33
Spain	66.59	96.08	**Iceland**	94.60	:
France	80.00	92.53	**Liechtenstein**	:	:
Croatia	66.41	85.52	**Norway**	92.69	99.01
Italy	62.92	91.45	**Switzerland**	:	:
Cyprus	61.82	94.00	**United Kingdom**	86.80	92.74*
Latvia	68.68	91.39	**Montenegro**	54.99	80.96
Lithuania	60.12	87.71	**North Macedonia**	58.30	:
Luxembourg	93.08	97.64	**Albania**	:	:
Hungary	66.81	91.44	**Serbia**	:	83.24
Malta	76.70	93.39	**Türkiye**	47.20	94.15

*Retrieved from https://www.statista.com/statistics/553589/predicted-internet-user-penetration-rate-in-the-united-kingdom-uk/.
** Percentage of households with internet access at home. Any use of the internet is included. The population considered is between 16 and 74 years.

Source: Eurostat, 2022

Although internet access may be a fundamental means of improving one's digital skills, Van Deursen and Van Dijk (2019) argue that proper internet access at every home does not guarantee that everyone can enjoy such access to develop their digital skills. As shown in Table 1, 99.1% of Norway's population has internet access at home, followed by the Netherlands with 98.28%. The rate of household internet access is calculated to be 94.33% and 91.41% for the other focus-of-interest countries, respectively.

On the other hand, Table 2 presents the reasons for not having internet access at home

in the EU member countries. Accordingly, the most prominent reasons can be listed as follows: a belief that internet access is not needed, lack of necessary skills, high equipment costs, and high access costs. Each of the reasons explaining the lack of internet access applies to Germany, Sweden, and the Netherlands in descending order. On a global scale, the number of internet users increased from 410 million worldwide in 2000 to about 4.9 billion in 2021 and is expected to continue to grow in double digits (International Telecommunications Union, 2021).

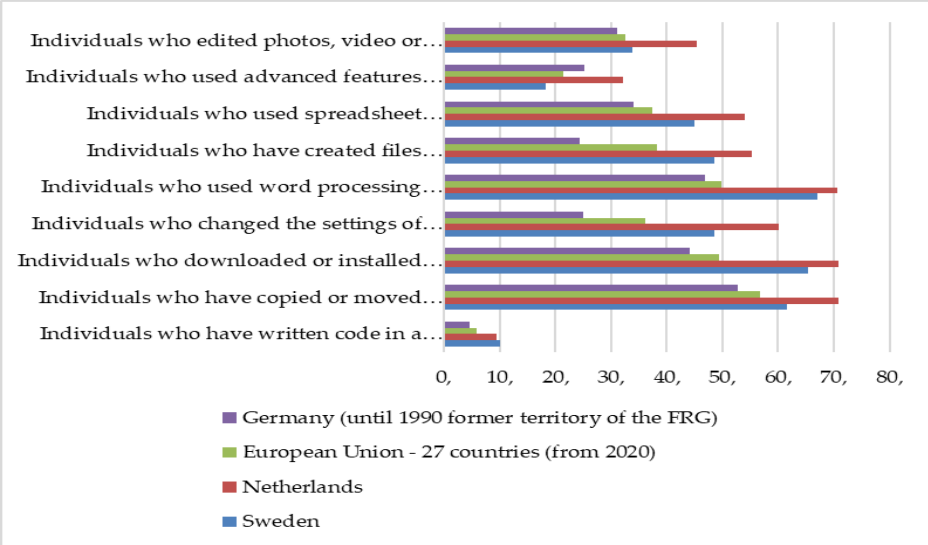
Table 2: Reasons for not having internet access at home (EU27)

Reasons for not having internet access at home (EU-27)	Germany	Netherlands	Sweden
Households without access to internet at home, because the access costs are too high (telephone, etc.)	1,45	0,45	0,58
Households without access to internet at home, because the access and equipment costs are too high	1,95	0,45	0,89
Households without access to internet at home, because of access elsewhere	0,78	0,06	0,43
Households without access to internet at home, because the equipment costs are too high	1,54	0,34	0,52
Households without access to internet at home, because access not needed (content is not useful, not interesting, etc.)	2,92	1,12	1,41

Source: Eurostat, 2019

Another prominent indicator in DESI is individuals' level of computer skills. In the given indicator, the Netherlands seems to be one step ahead of Germany, Sweden, and the EU average. In particular, the Netherlands performs better with 70% in the categories "individuals copying or moving files between folders, devices, or on the cloud," "individuals who downloaded or installed software or apps," and "individuals who changed settings of software, app, or device." On the other hand, the Netherlands is ranked second in the category "individuals who have written code in a programming language," following Sweden (Figure 5).

Figure 5: Individuals' level of computer skills (2021 onwards)



Source: Eurostat, 2021c

The indicators in Table 3 describe the use of mobile devices to access the internet on the move. Mobile devices in question often cover mobile phones (e.g., smartphones), portable computers (e.g., laptops and tablet computers), or any other mobile devices (PDAs and e-book readers) away from home or work. The internet era has revolutionized how people live, work, connect, and exchange information. In this sense, the use of internet-connected mobile devices can be considered an essential indicator when assessing individuals' digital skills use. Table 3 presents the indicator values in 2012 and 2022 to be able to demonstrate the stunning change in the use of digital technologies. Accordingly, the EU average of the indicator has increased more than twice (from 31.62% to 73.08%) between the mentioned years. While Sweden (70.8%) and Norway (74.47%) are among the countries with the highest indicator values in 2012, these values hit 93.48% and 93.34% for these countries, respectively. On the other hand, the said indicator values in 2022 are reported to be 89.07% and 76.96% for the Netherlands and Germany, respectively. Yet, Germany belongs the greatest difference in the indicator value between the said years.

Table 3: Individuals using mobile devices to access the internet on the move

GEO (Labels)	2012	2022	GEO (Labels)	2012	2022
European Union - 27 countries (from 2020)	31.62	73.08	Austria	44.96	81.80
Belgium	43.74	85.58	Poland	21.88	58.74
Bulgaria	12.52	64.41	Portugal	21.39	63.33
Czechia	:	72.53	Romania	7.26	69.74
Denmark	61.43	91.83	Slovenia	30.25	76.23
Germany (until 1990 former territory of the FRG)	31.09	76.96	Slovakia	37.67	70.69
Estonia	36.95	77.98	Finland	56.30	:
Ireland	51.11	84.47	Sweden	70.08	93.48
Greece	22.50	63.14	Iceland	59.73	87.56
Spain	38.37	86.77	Liechtenstein	:	:
France	43.38	81.08	Norway	75.47	93.34
Croatia	37.52	72.23	Switzerland	:	88.70
Italy	16.07	49.55	United Kingdom	63.37	88.37
Cyprus	24.54	79.47	Montenegro	33.74	71.43
Latvia	25.31	67.18	North Macedonia	17.28	73.67
Lithuania	17.25	69.95	Albania	:	68.01
Luxembourg	62.65	86.14	Serbia	:	62.20
Hungary	17.54	72.30	Türkiye	13.55	71.94
Malta	40.48	76.05	Bosnia and Herzegovina	:	56.75
Netherlands	54.98	89.07	Kosovo	:	78.94

Source: Eurostat, 2021d

In digital skills use, European countries are also compared by the digital skills gap index, which is measured relying on some digital-specific variables and is deemed important to be able to interpret the digital skills of individuals populated in the three countries.

Table 4: Digital Skills Gap Index 2021 (the Netherlands, Germany, and Sweden)

	NED	GER	SWE
Overall Score	7.2	7.1	7.3
Digital Skills Institutions	6.5	6.8	6.6
Digital Responsiveness	8.8	8.4	9.3
Government Support	6.4	6.2	6.9
Supply, Demand & Competitiveness	6.8	7.0	6.7
Data Ethics & Integrity	8.9	8.5	8.1
Research Intensity	6.1	5.4	5.5

Source: WILEY, 2021

Accordingly, the Netherlands, Germany, and Sweden have almost overlapping scores in the Digital Skills Gap Index 2021 (Table 4). Yet, Sweden has left the other two countries behind with 9.3 points in the digital responsiveness pillar. On the other hand, the Netherlands takes the lead in data ethics & integrity and research intensity pillars. Finally, Germany demonstrates its strength in the digital skills institutions and supply, demand & competitiveness pillars.

Strategies and Policies for Digital Skills Acquisition

Currently, the enhancement of individuals' digital competencies is a focal aspect of numerous educational initiatives implemented globally. Ensuring widespread and meaningful engagement with new technologies is a crucial component of government policy in numerous nations, as it serves to adequately equip society for the process of digital transformation (Schwab, 2016). Consequently, numerous nations globally are presently engaging in various endeavors aimed at cultivating and advancing citizens' capacity to utilize emerging technologies (Eynon, 2021; Helsper and van Deursen, 2015; Mansell, 2017). This section of the article deals with the strategies and policies adopted in the Netherlands, Sweden and Germany for the acquisition of digital skills.

The Netherlands

The Netherlands is renowned for its flourishing economy and high standard of living. Following a period of global economic crisis and prolonged slowdown, the Netherlands has experienced an acceleration in economic growth, with gross domestic product (GDP) surpassing its pre-crisis peak (OECD, 2022). The Netherlands boasts impressive employment and labor force participation rates while maintaining low unemployment rates in comparison to other countries on a global scale. The Dutch also enjoy a good quality of life with relatively low poverty rates and income inequality. The Netherlands

owes much of its success to actions it has taken in the past to nurture a highly skilled population.

Given the profound economic and social transformation that the Netherlands is currently undergoing, skills will be one of the key elements in the future. Technological developments in areas such as digitalisation, robotics and nanotechnology are reshaping the way people communicate, consume and work. Moreover, a proficient population with ample opportunities, encouragement, and drive to maximize their abilities will be imperative to tackle future challenges and capitalize on potential opportunities because the composition of Dutch society is evolving due to the aging population and growing immigrant population.

Skills are central to the Netherlands' capacity to thrive in an increasingly interconnected and rapidly changing world (OECD, 2017, p.21). Currently, the Netherlands ranks third in the DESI - an index for measuring the level of digitalization across EU nations (DESI, 2022d). Furthermore, it is regarded as one of the leading EU nations with the largest proportion of the population proficient in digital skills (e.g., the use of the internet, computers, and software) (Eurostat, 2021a). In this section, we seek relevant practices implemented in the Netherlands to reveal how it has attained its success in digitalization and what it does to enhance its citizens' digital skills.

It can be claimed that the Netherlands strategically planned and achieved its digital transformation through a set of specific policies. An excellent illustration would be the "*Dutch Digitalization Strategy 2021*," recognized as one of the Netherlands' most notable digitalization strategies. The report provided delineates the Dutch methodology for disseminating and embracing digitalization within the societal domain. It also highlights the nation's focal points, including artificial intelligence (AI), data science pertaining to social matters and economic advancement, digital engagement and competencies, digital governance, digital connectivity, and digital fortitude (Ministry of Economic Affairs and Climate Policy of Netherlands, 2021). Actions covered within the strategy include:

- *Digital skills for citizens:* The strategy emphasizes coping with digitalization (promoting citizens' developing their digital skills), creating digital awareness, and facilitating the use of digital services for all.

- *Digital skill for the workforce:* The proposed strategy entails implementing various measures to foster the acquisition of new digital skills in light of evolving job roles and responsibilities. These measures include the initiation of pilot projects through training and employment help desks, with the goal of cultivating a culture of continuous learning within small and medium enterprises (SMEs). Additionally, the strategy involves the exploration of a personalized digital portal that provides tailored training opportunities, as well as the establishment of more adaptable adult education programs.
- *Digital skills for ICT professionals:* Various organizations, including information institutions, educational entities, government agencies, and businesses, are working to increase their pool of ICT professionals and knowledge. There are intended efforts to foster collaboration between the business sector and the education domain through

targeted programs such as the Technology Agreement, human capital agendas, and the Smart Industry action program. The strategy additionally underscores the importance of cultivating a coherent methodology to enhance the retention rate of international students in the Netherlands.

- *Digital skills in education:* Educators, school administrators, and leaders enhance their practices through collaborative learning with one another and external partners. Thus, the strategy highlights structural measures for increasing digital literacy among students and teachers, providing access to digital learning resources, creating a future-ready infrastructure, and digitalization ethics in education.

The Netherlands has also introduced various training programs and projects to contribute to individuals' digital skills acquisition. For example, to expand the *Make IT Work* project, Amsterdam University of Applied Sciences (AUAS) and Nederland ICT are structurally working together to transform highly educated job seekers without an ICT background into ICT professionals. In this sense, AUAS and Nederland ICT collaborate to attract candidates and companies across the Netherlands. In addition, specific feedback on the curriculum to ensure that it aligns with their current demands for talent. Make IT Work makes it possible for highly educated people without a specific IT background to pursue an IT position and start working immediately (Make It Work, 2022). Besides, the European Commission has awarded the project as a "good practice" to make Europe digitally literate (Dutch Digitalisation Strategy, 2019, p.32).

Funded by over 80 organizations, the *Dutch EdTech Foundation* is dedicated to developing innovative solutions for the future of education. The foundation primarily aims to fortify the Netherlands' position in the digital world, attract talent, and encourage foreign investment by focusing on novel methods, tools, skills, and environments for teaching and learning in the 21st century. The foundation sets its vision to make lifelong learning accessible to everyone and scalable. It is then seen as a great potential both globally and in the Netherlands since the global EdTech investment is on the way to 50% growth (Dutch Edtech, 2021, p.3).

"*Give IT Door*," on the other hand, introduces the young to IT by allowing professionals to talk about their experiences in youth organizations. It offers practical education to secondary schools and gives a hand to the young on the way to digital literacy and career opportunities available in the ICT sector (hcaict.nl). More specifically, the program invites ICT professionals as guest lecturers in secondary schools to share their experiences about working in the ICT industry or discuss specific topics like big data, cybersecurity, and programming. The program's success can be attributed to the fact that over 250 schools have submitted applications for guest lectures (Dutch Digitalisation Strategy, 2019, p.29).

The "*TOMAS*," whose name is inspired by the initials of the words "talent development, match, and select," is a project designed to match the right skills with the right jobs. The primary objective of the TOMAS initiative is to establish a connection between the availability of retraining opportunities, further education programs, and talent development needs in order to bridge the gap between supply and demand. One of the primary goals of this project is to tackle the frequent problem of skill mismatch in the job market, with the aim of ensuring appropriate alignment between individuals' skill sets and the positions they are recruited for. The TOMAS platform offers a

comprehensive overview and facilitates access to many talent initiatives within the Amsterdam Metropolitan Area, encompassing the geographical region spanning from Haarlem to Hilversum and from Uitgeest to Uithoorn. It embodies more than 120 programs for training, retraining, and talent development, most of which focus on the technology sector (TOMAS, 2022).

Digital learning, or the digitization of education, will undoubtedly affect the knowledge and skills teachers need, which is needed to be addressed by schools. Moreover, digital skills education has become mandatory in primary school curricula since 2020. In this sense, the Netherlands implements a national training program called "*Digital Teacher*" (Digileerkracht), which aims to enhance the digital skills of primary school teachers by integrating programming and computational thinking into their teaching (Dutch Digitalisation Strategy, 2019, p.29).

Digicampus is a digital public service application in the Netherlands. Logius, TU Delft, ICTU, and NLdigital have launched Digicampus since discovering that the implementation of innovative ideas for public services often lags behind due to the fragmented nature of the innovation environment in the country. The goal is to utilize the innovation capacity of the Netherlands to implement innovative ideas and technological advancements with greater speed and efficiency. Digicampus adopts a mission-driven innovation approach (Mazzucato, 2016) focused on allocating more control over citizens' data and digital identities, making public services more proactive and inclusive, and transforming government.

Sweden

Sweden has become one of the top countries in spreading and utilizing digital technologies. Its capability to adopt digital transformation is believed to be the primary factor behind its impressive economic growth in recent times. Undoubtedly, the Swedish economy boasts the most substantial proportion of added value originating from the information and communication technology (ICT) sector compared to other member countries of the Organisation for Economic Co-operation and Development (OECD). Furthermore, Sweden has consistently positioned itself within the upper echelon of nations globally in terms of exporting ICT services, ranking among the top ten. Swedish companies have been able to elevate their position in global production value chains by utilizing digitization and prioritizing high value-added services (OECD, 2018a, p.13). The country has rapidly transitioned to an efficient knowledge economy, resulting in its status as an "advanced digital economy." The relevant reports document that while about half of the Swedish population has advanced digital skills, one-third adopt basic digital skills (Thelen, 2019). It also has the second highest number of ICT experts and problem-solving capacity among OECD countries (DESI, 2022a).

The pandemic has accelerated Sweden's transition to online activities, and the government has started to promote investments to expand broadband coverage to rural areas. However, the share of higher education graduates remains limited in ICT and data analysis, hindering the dissemination of big data analytics and restricting companies' digital and data-driven innovation. In Sweden, the share of commercial research and development (R&D) expenditures in the GDP is among the highest among OECD countries; yet, it is not the case for ICT expenditures, which may be because security breaches undermine trust in ICT tools and potentially slows their widespread adoption (OECD, 2021). With the ultimate goal of providing its citizens with digital

skills, Sweden focuses on the following practices.

Sweden's information society plan has a notable historical background that can be traced back to the 1980s, during which digital awareness initiatives were initiated. However, the first complete strategy that can be regarded as a significant milestone is "A Digital Agenda for Sweden," which was officially adopted in 2011. The primary objective of this strategy is to enhance the representation of young individuals, with a special focus on girls and young women, in the enrollment of ICT-related majors and programs within educational institutions at both the secondary and tertiary levels. Additionally, the approach emphasizes the importance of cultivating business and organizational abilities beyond the scope of higher education institutions, adult education programs, and digital learning in secondary schools. In 2015, the paper titled "A Digital Agenda for Sweden - ICT for Everyone" was revised, placing increased emphasis on the imperative for individuals of working age to acquire and maintain strong digital competencies in order to secure employment or sustain their current positions. The Swedish Innovation Strategy, published in 2012, strongly emphasises the development of digital skills within the workforce. This focus is intended to foster innovation, creativity, and entrepreneurship throughout an individual's lifetime, highlighting the importance of continuous learning (Ministry of Enterprise, Energy, and Communications, 2014).

Sweden believes in the need to digitalize education as the primary means to provide individuals with digital skills. The "*National Digitalization Strategy for the School System*," implemented in 2017, strives to equip children, students, and young people with high digital competence. Thus, it ultimately aims to improve knowledge, equal opportunity, and access to technology (Digital Skills & Jobs Platform, 2021). In 2018, Sweden witnessed the establishment of a multi-stakeholder partnership focused on skills acquisition and lifelong learning, the "*Digital Skills and Jobs Coalition*." The coalition's objectives include raising interest in informatics among young people and women and taking part in implementing the national strategy to digitalize the Swedish school system. The coalition is also considered among the milestones in Sweden to achieve its ultimate goal of becoming the best country in digitalization. Besides, it has engaged in a pilot project with universities to offer courses to re-skill professionals. In addition, the coalition and its partners are poised to support Sweden's immigration and integration policy to attract foreign talent to fill the digital skills gap (Nesta, 2018).

According to the Swedish National Digitalization Council (2017), its primary purpose is to facilitate the adoption of the Swedish government's digitalization plan, which is founded upon five key objectives: digital competence, digital innovation, digital security, digital infrastructure, and digital management. The primary objective of the plan is to facilitate Sweden's ability to seize the opportunities presented by the digital economy, while also ensuring that all Swedish citizens possess the necessary skills and resources to cultivate and utilize their digital competencies (Government Offices of Sweden, 2017).

The *e-Skills Council* has been established to eliminate the skills gap in the Swedish ICT sector. Key stakeholders in e-skills acknowledge the persistent and high demand for ICT professionals possessing the necessary skills to cater to the fast-changing needs of employers (Empirica, 2014). Hence, a significant objective of the e-Skills Council, overseen by IT&Telekomföretagen (2017), an association representing companies in the

IT sector, is to establish collaborative initiatives aimed at meeting the enduring demand for e-skills in both the commercial and public sectors. The authors of the study, Gekara et al. (2020), have conducted extensive research on the supply and demand of ICT practitioner skills in Sweden since 2010. This research has involved in-depth interviews and group discussions with various stakeholders, including human resource managers, employment agencies, and representatives from universities and educational institutions (p. 37). An initiative of the Swedish Agency for Government Employers, *Skills360* aims to bring together the entire labor market (government, business, academia, start-ups, and associations) to collectively tackle the challenges posed by digitalization. The stakeholders work to find ways to deliver relevant skills to today's labor market and to raise awareness of how inclusion can be achieved to give everyone access to digital skills. The Skills360 Hackathon, on the other hand, represents one of several initiatives designed to enhance public officials' digital skills and to lay the foundation for training public officials in data analytics (OECD, 2018a, p.8).

Germany

Germany is internationally recognized as one of the leading global economies, boasting a diverse range of technologically advanced industries such as complicated business services and mid- to high-tech manufacturing. Nevertheless, according to the Digital Economy and Society Index (DESI, 2019), Germany has continuously obtained relatively low to moderate rankings. Furthermore, Germany is currently encountering a more gradual implementation of cloud and big data technologies, which are widely recognized as crucial for fully harnessing the potential of the internet. Thus, it seems urgent for Germany to improve its infrastructure for digital skills acquisition (OECD, 2018b).

Data plays a crucial role in facilitating digital transformation, data analytics, data-driven innovation, artificial intelligence, and advancements in Germany's manufacturing processes. In addition, the enhancement of lifelong learning opportunities and the proactive anticipation of skills requirements are crucial factors for Germany's capacity to harness the digital transition. Germany is situated among the nations that own a proportion of employment opportunities that surpass the average, which are at a heightened risk of being automated. For this reason, Germany should recognize the need for innovations in many domains, which entails equipping students with problem-solving, basic ICT, and social skills through the education system and adapting the curriculum to meet changing skill requirements and to guide students accordingly (Digital Skills & Jobs Platform, 2022). Fortunately, Germany has started to take steps to close its digital skills gap with the help of the practices below.

The Digital Strategy 2025, which BMWi initiated, aims to provide guidance for the cultivation of talents and acquisition of skills necessary for effectively utilizing innovative technologies to facilitate the realization of a technologically advanced Germany. One of the key aims of digital education is to ensure its availability throughout all stages of life. The development and maintenance of a strong national skills base that connects vocational education, higher education, and the workplace is identified as a crucial priority in Germany's efforts to transition towards an intelligent knowledge society, as outlined in the Digital Strategy 2025 (2016). The strategy encompasses a range of actions that seek to not only facilitate the German economy's ability to adapt to emerging challenges but also to secure its dominant position in terms

of both quality and technology in the forthcoming years. This will be achieved by integrating traditional competitive advantages with state-of-the-art technology, contemporary methodologies, and targeted support initiatives.

The main objectives under the digital education pillar of the strategy can be listed as follows (Jakopsone, 2022):

- Every school student will have a basic knowledge of information science, how algorithms work, and programming by 2025. To achieve this objective, relevant subjects need to be incorporated into the curricula of primary and secondary education, teacher education, and continuing education.
- By the year 2025, Germany is expected to emerge as a prominent frontrunner in the realm of digital infrastructure within the field of education.
- Workplaces will be the number one place to acquire cutting-edge IT knowledge by 2025.

By the year 2025, it is anticipated that all educational institutions that receive public funding will ensure the availability of crucial teaching materials through online platforms.

The *Berufsbildung 4.0* initiative is a governmental program through which the government attempts to respond to the evolving skills needs in the vocational education and training system (VET). For the sake of this program, the government has established vocational training centers. Berufsbildung 4.0 also includes digital skills training for teachers (Hutfilter et al., 2018, p.30). The government generally holds the belief that enhancing the overall employability skills, namely cognitive skills, of the workforce can provide favorable consequences for the long-term learning of digital skills. The underlying reasoning behind this assertion is that employees with higher levels of expertise are more likely to effectively take advantage of the chances available for enhancing or acquiring new skills in the digital domain (Hutfilter et al., 2018, p.35). Now, Germany has a demand for about 700,000 people with digital skills and further interdisciplinary education requirements for more than 2 million (McKinsey & Company, 2018, p.11). In this sense, it is essential for the Bundesagentur für Arbeit to expand its existing tools, constantly analyze the accelerating demands of the labor market, and communicate these developments to the public. Moreover, to satisfy such demands and requirements, educational and career institutions should adjust their practices for future-required skills and design corresponding curricula and courses (McKinsey & Company, 2018, p.11).

In the future, it is predicted to be even more critical for Germany to integrate IT and media literacy in general and vocational schools, which highlights the significance of the Berufsbildung 4.0 initiative. The initiative attempts to take the following measures to ensure that VET is future-proof, attractive, and competitive:

- *Skilled Worker Training for a Digital World:* This research project delves into various professions from a digitalization standpoint and endeavors to pinpoint the areas where the training requirements of skilled workers are evolving at an early stage (BMBF, 2022).

- *Digital Media in VET:* The objective of this measure is to enhance the modernization and effectiveness of VET while also promoting digital media literacy through its integration into vocational and continuing education (BMBF, 2022).
- *The Digital Change Q4.0 Initiative*: The Federal Ministry of Education and Research supports developing and testing tailor-made qualifications for VET staff to prepare them for digital change (BMBF, 2022).

In 2019, the *Digital Pact for Schools* was established to enhance the digital infrastructure of schools in Germany. In this regard, school administrators are now responsible for securing the functioning of this infrastructure (Homrich, 2020). In the German context, the allocation of educational responsibilities lies primarily with the federal states. However, both the Federal Government and the federal states acknowledge the collaborative nature of addressing digitization in schools. Hence, the Digital Pact for Schools has witnessed a notable surge in investment, reaching a substantial sum of 6.5 billion Euros, as the Federal Government allocates considerable financing to the federal states. Funding is utilized, as an illustration, to acquire digital gadgets for educators and enhance the information technology infrastructure within educational institutions. In addition, schools can furnish digital devices to underprivileged children through this program (The Federal Government, 2021a).

Another practice is the *Stadt-Land-DatenFluss* - a learning application. This application ultimately aims to teach people of all ages to be confident data users by explaining the way new data-driven technologies work and how to stay informed about with whom their data are shared, and how to protect confidential data (The Federal Government, 2021b). Another example of digital learning policies may be the *School Cloud* application. The program facilitates the convenient and widespread access of digital teaching and learning content for students and educators, regardless of their location or educational institution. It has been significantly expanded and made available to all students during the pandemic (BMBF, 2018).

Discussion and Conclusion

In this study, the policies and strategies of the Netherlands, Sweden and Germany to provide digital skills to individuals are discussed with the help of multidimensional data sets. One could argue that Germany has made significant progress in its digital transformation journey, particularly over the past five years. Yet, despite being the largest economy in the EU, Germany still falls behind its competitors in digital transformation (inhuntworld, 2023). It is apparently not caused by any financial crisis but may be due to various infrastructure gaps, lack of motivation to adapt to innovation, negative approach to new technologies, or the lack of high-skilled staff. It is evident that Germany requires an all-encompassing digital overhaul considering its status as the leading industrial nation in Europe. The majority of German companies are willing to switch from IT to AI but need help with several obstacles, such as a shortage of skilled talent, difficulties integrating technology, and limited access to data. As emphasized in the Digital Strategy 2025, Germany centers “human” at the heart of its initiatives for a digital society. According to the ZEW (2023) - a research company -, data sovereignty is considered critical by 90% of companies in the knowledge economy and 84% of manufacturing companies in Germany.

Germany also falls behind its competitors in digital skills teaching. Indeed, German

schools have remained slower to adopt digital skills education than US schools over the past decade due to the influence of commercial actors and concerns about data protection. Yet, the pandemic has significantly amplified the pressure for reform in Germany (Hartong, 2021). A parent-report survey by Citrix (2020) during the pandemic revealed Germany ranked last compared to six other countries (Australia, UK, Italy, Canada, Mexico, and Singapore), with only one in ten students (10%) reporting no problems with distance education during the pandemic. Apart from such reasons, various statistical data also confirm Germany's poor performance in the DESI compared to its competitors (DESI, 2022). For example, Eurostat (2019) reveals that German citizens are hesitant to digitally manage administrative proceedings with public authorities even if public services are accessible with sufficient digital infrastructure (Digital Government Factsheet, 2019). In addition, structural insufficiencies, lack of high-speed internet, the inefficiency of federal and state governments, and the reluctance of Mittelstand companies to change their traditional working methods may be shown as other reasons for the slow digital adaptation in Germany (Reuters, 2018).

Policies for digital skills development have officially been voiced for the first time in Germany in the Digital Strategy 2025. The development of the digital infrastructure in the education sector and the updated curricula to enable students to acquire digital skills are important indicators of these policies. Another step to improve Germany's digital education infrastructure may be the introduction of the *Digital Pact for Schools* project, which attracts significant financial investments.

In this study, another focus-of-interest country is the Netherlands. Compared to Germany and Sweden, the Netherlands holds a robust position in acquiring and using digital skills. According to the data by the CBS and Eurostat, the Netherlands ranks first on the use of overall digital skills (computer, internet, software), which may imply that the Netherlands enjoys a tech-savvy workforce in its digital ecosystem and digital infrastructure (CBS, 2021; Eurostat, 2021a). It is also the case in the DESI indicators (DESI, 2022). The Netherlands has legalized its commitment to socially prepare for the digital future with the *Dutch Digitalization Strategy*.

The Netherlands does also not leave unanswered the talent needs of technology-oriented large companies for their growth. The Eurostat data shows that the Dutch population outperforms other European nations regarding digital skills, including proficiency in the internet, computer, and software use. Such skills are particularly introduced to the Dutch citizens by the Ministry of Economic Affairs and Climate Policy of the Netherlands. It should also be noted that there are a wide variety of training programs in private and public sectors for digital skills acquisition in the Netherlands compared to Sweden and Germany. Accordingly, Mendix (2021) shows that 77% of Dutch employees are willing to acquire new digital skills.

Despite being described as an "advanced digital economy," Sweden remains one step behind the Netherlands in the 2022 DESI. Although Sweden's efforts to embrace digital technologies are a noteworthy driver of its economic growth, it should take other initiatives to make digital technologies available to small enterprises and contribute to employees' digital skills (OECD, 2018c). Besides, Sweden performs better among OECD countries regarding the prevalence of internet use and the adoption of digital technologies in households and workplaces. Sweden's first comprehensive strategy was "*A Digital Agenda for Sweden*," adopted in 2011 (earlier than the Netherlands and

Germany). It focuses mostly on formal education and aims to increase the proportion of the young – particularly girls and young women – enrolling in ICT-related majors and programs in schools and higher education, implying that Sweden, like the others, relies on education as a primary means to ensure social acceptance of digital transformation.

It is prudent to assert that a hot topic in the agenda of the programs implemented in these countries for initiating digital transformation is that digital skills should be introduced to citizens through education. Overall, our findings imply that ensuring a social acceptance of digital transformation or every human-centric step toward such a transformation inevitably brings success in digitalization. Therefore, one critical tenet of digital transformation is "human." In this sense, it does not seem possible for countries to go through a successful digital transformation process without ensuring that citizens acquire essential digital skills. Skill development policies applied to individuals should be prepared by taking into consideration the technological, social and technical changes in today's world. It should not be forgotten that technological change does not affect only one field, but triggers change in every field with its multidimensional structure.

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Organizational Stress and Performance From the Perspective of Technological Developments

Cumali KILIÇ [1]

Abstract

Developments in communication and information technology have an immense impact on all facets of life. These changes have led to an increase in the causes of stress that people are encountering today and this situation inevitably affects individuals physically and psychologically negatively. The concept of stress is likely the most important of these negative impacts that affect individuals in a wide range. Stress, which has evolved as a result of technological developments in recent years, has an array impact on both organizations and individuals. The technological change and adaptation process that organizations are undergoing can have a negative effect on employees, and stress brought on by technology can affect employees' performance. In this research, the dimensioning of the stress levels of the employees and the effect of this situation on the employee performance are discussed from the perspective of globalization and technological developments. The survey technique used in qualitative research methods was preferred in order to collect information from the research participants in line with the study purposes. In this context, the research sample consisted of employees working in different roles and positions in an enterprise operating in the private sector. In the light of the findings discussed within the scope of the research, it has been determined that organizational stress affects employee performance in many ways in terms of individual and organizational aspects, and there is a significant (psychological and mental, organizational role, organizational structure and business environment) relationship between them. However, it should be noted that in the research, there were also findings in which organizational stress did not have a significant effect on performance (relational and social, external environment and job qualification).

Keywords: Stress, Organizational Stress, Technostress, Employee Performance, Globalization, Technological Developments.

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Teknolojik Gelişmeler Perspektifinden Örgütsel Stres ve Performans

Cumali KILIÇ[2]

Öz

Bilgi ve iletişim teknolojisinde yaşanan gelişmeler hayatın her alanında önemli bir etkiye sahiptir. Günümüzde bireylerin maruz kaldıkları stres kaynakları da bu gelişmelere bağlı olarak artmaktadır ve bu durum kaçınılmaz olarak bireyleri fiziksel ve psikolojik olarak olumsuz yönde etkilemektedir. Çalışanlar, örgütlerin içerisinde bulunduğu teknolojik dönüşüm ve adaptasyon sürecinden olumsuz etkilenebilmekte, teknoloji kaynaklı stres çalışanların performansları üzerinde etkili olabilmektedir. Bu araştırmada da, çalışanların stres düzeylerinin boyutlandırılarak incelenmesi ve bu durumun çalışan performansına etkisi küreselleşme ve teknolojik gelişmeler perspektifinden ele alınmıştır. Araştırma katılımcıları ile çalışma amaçları doğrultusunda bilgi toplamak amacıyla niteliksel araştırma yöntemlerinde kullanılan olan anket tekniği tercih edilmiştir. Bu kapsamda, araştırma örneklemi özel sektörde faaliyette bulunan bir işletmede farklı rol ve pozisyonlarda görev yapan çalışanlardan oluşmuştur. Araştırma kapsamında ele edilen bulgular ışığında örgütsel stresin çalışan performansını bireysel ve örgütsel açıdan birçok yönden etkilediği (psikolojik ve zihinsel, örgütsel rol, örgüt yapısı ve iş çevresi açısından) ve aralarında anlamlı bir ilişkinin olduğu saptanmıştır. Ancak araştırmada, örgütsel stresin performans üzerinde anlamlı bir etkisinin saptanmadığı (ilişkisel ve sosyal, örgüt dışı çevre ve yetkinlik açısından) bulgulara da ulaşıldığını belirtmek gerekmektedir.

Anahtar Kelimeler: Stres, Örgütsel Stres, Teknostres, Çalışan Performansı, Küreselleşme, Teknolojik Gelişmeler.

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Introduction

The ability of organizations to adapt to inescapable changes is crucial to their success in the continuously changing environment brought on by globalization and technological developments. The managers' ability to continuously monitor advance technologies and apply them to their organizations will determine how long those companies survive. With today's increasingly competitive organizational environments, new technological developments that are occurring more often in organizational processes have necessitated a reevaluation of some concepts and produced newer grounds for dialectical discussion. The stressors that workers are exposed to alter as a result of evolving technologies. To continue operating and adapt to the more intensely competitive environment, organizations must continuously monitor the evolving organizational stress sources.

Considering how noteworthy the concept of stress is, it has been thoroughly analyzed and researched. To examine the concept of stress, the stress causes that evolved as a result of globalization and technological developments, and the impact of this condition on employee performance, a questionnaire was used in this research. In this case, a sample of private sector organization were used to investigate the stress brought on by technology advancements and how this condition affected employee performance.

The main aims of the research are to contribute to the literature and to increase the level of awareness of countries, governments, organizations and individuals about the relationship between stress and performance in the changing world of the future. Because individuals involved and interested parties are eager to learn more about how the stressors brought on by technological advancements impact employee performance. Inferences were drawn in this context to help organizations adapt to changing production conditions and to provide illumination on some of the unanswered questions. In this regard, the research's findings are presented and compared to those found in the literature.

Since considering the literature about the subject, it was seen that the subject has been handled in many different samples and techniques before. The relationship between the concept of stress and performance is a topic that dates back to the past years and has been discussed more comprehensively. However, the relationship between technostress and employee performance is a relatively new issue that has gained importance in recent years. Therefore, the application area of the concept is more limited, new and distinct. Nevertheless, it has been discussed in many studies in local and international literature (Küçükdursun et al., 2022; Alvarez-Risco et al., 2021; Magistra et al., 2021; Upadhyaya and Vrinda, 2021; Kumar et al., 2017; Tagurum et al. al., 2017; Tarafdar et al., 2015; Funminiyi et al., 2014). However, the highlight of this study, unlike others, is the sample used. In this context, no research has been found that addresses the situation of agriculture employees, who are faced with high levels of stress due to technological developments, in terms of technostress and performance. In addition, this study reveals the stress factors by considering them in a wide variety of dimensions and so, the study differs from other studies in the literature.

While putting forth this research, there seem to be five sections. Thus, an overview of the research was provided in the first section, the introduction. The variables covered in

the research are theoretically examined in a theoretical framework in the next section. The research's methodology and results are presented in chapter 3. Then, the literature was used to interpret the results from the fourth chapter and finally, the conclusion and recommendations part, which is the last section of the research contains the overall findings.

Conceptual Framework and Literature Review

Globalization and technological developments have had a substantial impact on people's working life recently (Sun et al., 2022, p.3). Today's global environment affects both organizations and individuals, which contributes to the stress. To prevent, mitigate, or eradicate the harmful effects of stress and organizational stress, which are inescapable and unavoidable concepts, organizations must establish and implement stress prevention efforts (Aydın, 2004, p.49). Considering that stress may be considered as a factor in every aspect of life, its absolute abolition would lead to the cessation of existence. Therefore, just as people and organizations should learn to live with stress and its effects, they should also learn to manage that stress by keeping it under control. In order to manage stress, it is important to understand what this concept implies, its sources and effects, and what can be done to alleviate or mitigate them (Atilla and Kılıç, 2018, p.1353; Gümüştekin and Öztemiz, 2005, p.271). Because the concept of stress is a condition that affects both people and organizations (Eryılmaz, 2009, p.21), it is known as the social and psychological plague of our day (Korkmaz and Ceylan, 2012, p.314).

Organizations are trying to increase their productivity by using various instruments to achieve sustainable competitiveness (Ceylan and Ulutürk, 2006, p.49). At the basis of this effort, the individual and organizational performance factor takes place at every stage of the strategic management process. One of the most important variables of this problematic is the "human" factor, which is the main actor of the performance. In these conditions, it is not possible to think of people without stress. If the factors that create stress are of a nature that the individual cannot control, it becomes difficult for the individual to adapt to the environment (Kılıç and Sakallı, 2013, p.210). Changing organizational and environmental conditions, together with the irresistible effect of globalization and technological developments, cause stress and stress-related problems, which are called the diseases of our age (Hart et al., 2021, p.1; Tozkoparan, 2021, p.1899-1900; Balaban, 2000, p.188).

Therefore, the introduction of new technologies changes how organizations conduct their operations and define their jobs (Erer, 2021, p.81). Organizational learning and adaptation procedures are required because workers cannot perform at the desired level with their present knowledge and experience due to changing business methods (Türen et al., 2015, p.2). Because a deviation from the ideal conditions that the system cannot simply rectify or adapt emerges the concept of stress (Welford, 1973, p.567).

Stress, which has become one of the concepts that people encounter most in their daily and business life, can be briefly defined as "the pressure and tension that an individual feels on" in its most basic and simple form (Sandlund and Norlander, 2000, p.142). Every change that affects an individual's life can be a direct or indirect source of stress (Doğan and Eser, 2013, p.29). Stress, a concept that has been used more frequently in recent years, is a situation that has made its presence felt since the first day of human beings, even though it has led to an increase in research in this field (Tekingündüz et al., 2015, p.42; Ercan and Şar, 2004, p.218). While it is not known exactly where the starting

point is, it is thought that the origin of the concept comes from the Latin "estrictia" (Güçlü, 2001, p.92).

The stress experienced by employees in the business environment is defined as work stress or organizational stress (Bayramoğlu et al., 2020, p.116; Turunç and Çelik, 2010, p.186). In addition to work and organizational factors such as the structure of the institution, working conditions and interpersonal relations, home and family problems also have an effect on work stress (Kılıç and Sakallı, 2013, p.210; İştar, 2012, p.2). In this context, organizational stress can also be defined as the tension that arises as a result of situations such as work and interaction with the environment (Tekin and Deniz, 2019, p.71). However, the source of the research question in this study is that the stress factors that employees are exposed to emerge with the effect of globalization and technological developments. In this context, the concept of technostress emerges.

Technostress is a relatively new concept in the discipline of information systems and refers to the negative impact of technology use directly or indirectly on individuals' attitudes, thoughts, behaviors and even biological systems (Kopuz and Aydın, 2020, p.249; La Torre et al., 2019, p.13; Agogo and Hess, 2015, p.2). The concept was first introduced by the American psychologist Brod (1984). In the research, the concept is basically called an adaptive disease caused by the inability of individuals to meet new technologies in a healthy way (Abilleira et al., 2021, p.1) and expresses the negative effects that the individual has experienced related to technology (Akman and Durgun, 2022, p.488).

As our social and organizational lifes become more and more dependent on various technologies, it has become necessary to examine the unintended negative consequences of technology use (Agogo and Hess, 2015, p.2). Because the emergence of modern technologies obliges individuals to adapt to modern technologies, this situation creates pressures on individuals (Gül, 2022, p.2748-2749). Rapidly changing and developing technologies can cause changes in the work environment and negatively affect the competencies of employees. In addition, having to use these new technologies intensively can be perceived as a threat in the individual and in this case, it can cause stress (Kıncı and Özgür, 2022, p.1109; Şen, 2022, p.178).

When it comes to the concept of performance, although it tends to be used in the same sense as success in daily use, it actually refers to the effort made to reach the goals (Tutar and Altınöz, 2010, p.201). The accomplishment of goals by individuals or groups and the results in terms of organizational effectiveness should be understood when it pertains to employee performance on the organization's behalf (Magistra et al., 2021, p.76; Tekingündüz et al., 2015, p.45; Gümüştekin and Öztemiz, 2005, p.280). In this respect, the concept is most commonly defined as “the job description of behaviors and actions related to the goals of the organization” (Campbell, 1990). The performance put forward by the employees in organizations is of great importance in improving organizational activity and organizational success, because the criterion of employee performance is evaluated by the contribution of the individual to the organizational goals (Tekin and Deniz, 2019, p.71; Atilla and Kılıç, 2018, p.1353).

Employees must perform the task assigned to them in accordance with their characteristics and abilities. In order to be able to talk about the performance of an employee in an organization, it is necessary for the person to face a defined job, this job should be suitable for the characteristics and abilities of the employee, and there should

be a standard that indicates the degree of performance of the employee's job (Gümüştekin and Öztemiz, 2005, p.281). Taking into account that some causes of stress can also lead to the dynamism and growth required for success (Balaban, 2000, p.192), the problems that a person will experience at the point of fulfilling his/her duties and responsibilities will be a source of stress. Because organizations need high-performance employees to achieve their goals and gain competitive advantage (Rageb et al., 2013, p.37).

It is not possible to completely eliminate the stress factor because stress is a concept intertwined with life itself. It is obvious that performance anxiety commonly affects individuals positively and negatively (Çözvelioğlu, 2022, p.54-56; Hart et al., 2021; Baydağ and Başoğlu, 2018, p.2208; Agogo and Hess, 2015; Tarafdar et al., 2015). Most of the time, the negative effects of stress factors on individuals and organizations cannot be reduced and become inevitable (Westman, 1990, p.153). However, these negative outcomes can be managed and their relationship with organizational performance can be regulated by practices such as training individuals on stress coping techniques. In this context, the relationship between organizational stress and performance has been discussed by many researchers with different samples and different research techniques.

When the literature on the subject is examined, it has been seen that, organizational stress affects employees in terms of psychological and mental aspects, role conflict, organizational structure and business environment. However, no significant relationship was found between stress and performance in terms of the external environment and job qualification and relational and social aspects dimension. In the literature there are studies in which no significant or insignificant relationship found between stress and performance (Maipita et al., 2023, p.53; Olasanmi, 2016, p.799; Awadh et al., 2015; Odoh et al., 2013, p.100). Also, there are many studies in the literature that deal with the effect of stress sources on performance (Pradoto et al., 2022, p.345; Bayramoğlu et al., 2020, p.115; Güllü and Yıldız, 2019, p.146; Haşit and Yaşar, 2015, p.12; Kotteeswari and Sharief, 2014, p.23; Korkmaz and Ceylan, 2012, p.313; Erdoğan et al., 2009, p.459; Westman and Eden, 1996, p.171). On the other hand, there are many studies dealing with the relationship between technostress and performance (Küçükdursun et al., 2022, p.17; Alvarez-Risco et al., 2021; Magistra et al., 2021, p.75; Upadhyaya and Vrinda, 2021, p.1647; Kumar et al., 2017, p.403; Tagurum et al., 2017, p.312; Tarafdar et al., 2015; Funminiyi et al., 2014, p.27). Although these studies have applications in different samples, cultures and sectors, they are similar in terms of the results obtained and the common points of the result are that technostress negatively affects employee performance.

But, some studies in the literature differ from others. For example, in studies conducted by Karabay (2015, p.128) and Korkmaz and Ceylan (2012, p.313), it was determined that individuals' exposure to negative stress caused by physiological and psychological factors also affects their non-organizational life and performance. This situation can be given as an example of the psychological and social dimension of organizational stress. Also, in the research by Jex and Elacqua (2014, p.188), it was stated that the sources that cause the most tension in individuals and affect their work performance are "role conflict, excessive workload and responsibility, work-family conflict". This situation can be given as an example of the organizational role dimension of organizational stress. Similar results were obtained in the studies conducted by Hurbean et al. (2022, p.1) and

Tarafdar et al. (2014, p.51). Several researches (Çolak, 2017, p.810; Kılıç and Atilla, 2017; AbuAlRub, 2004, p.73-74) state that stress, which is kept at a certain level and managed, can be beneficial but can be harmful when it is at a high level. By comparing them with the research findings, the studies mentioned in the literature on this subject were provided in the discussion section of this research. But before that, the concerns of how the research findings were obtained at and how curiosity was assessed within the parameters of the research were addressed in the next part of the study.

Methodology

The research methodology being used explain the research questions is covered in this section.

Purpose of the Research and Hypotheses

The main purpose of this research is to examine the stress levels that employees are exposed to with the effect of globalization and technological developments and to investigate the effect of this situation on employee performance. Employees, who are already faced with many stress factors in their organizational life, have met with a different source of stress called technostress in recent years, with the effect of globalization and technological developments. However, it is not yet known exactly in which ways technology-induced stress affects employees, how it effect them individually and organizationally, and how changing conditions will shape organizational performance. Today, this situation is wondered by researchers and is discussed in many ways. In this research, inferences and suggestions were made in order to clarify some of the question marks mentioned here. In this respect, the study presents the results discussed with the literature findings and makes guiding suggestions about the policies that can be applied to those who are interested in the subject.

Before talking about the hypotheses created within the scope of the research, it is necessary to clarify the point on which these hypotheses are based. The hypotheses established within the scope of the research serve to investigate the relationship between the dimensions of organizational stress and employee performance. In this context, first of all, the dimensions of organizational stress should be mentioned.

The "psychological and mental" dimension, which is the first dimension of organizational stress, expresses the psychological and mental stress of employees (Ahuja et al., 2022). In other words, it can also be named as the psychological and mental reflection of the stress factors that individuals are exposed to, and perhaps it can be considered as one of the most important dimensions among the consequences of stress. Because one of the most crucial factors for both individuals and organizations is mental and psychological health. A mental and psychological disorder may hinder the individual's ability to work healthily and efficiently. The hypothesis established to probe this situation is as follows.

H1: There is a statistically significant relationship between psychological and mental dimension of stress and performance.

The second dimension called “relational and social” is also of great importance in terms of performance. If the individual, who is a social being, fails to cope with the effects and consequences of the negative stress a person is exposed to and cannot manage this

process, can witness the reflections of this situation both in their daily life and in his/her working life (Baltaş and Baltaş 2013, p.31). Due to today's working conditions, human beings lead a life in which they are in constant interaction with other individuals in relational and social terms. Moreover, this is also in the nature of human beings and they are a social being (Akbağ and Sayıner, 2021, p.760). Apart from exceptional examples, individuals interact with other people both in their organizational and social life. In this context, it is important to consider the relationship of the person with other individuals and the hypothesis formed in this direction is as follows.

H2: There is a statistically significant relationship between relational and social dimension of stress and performance.

The third dimension of the research is related to the organizational role. Problems such as role conflict, role ambiguity, and role overload are among the most common sources of stress in the literature and social workers are most affected by in organizational life (Uğur and Erol, 2015, p.989). In this context, it is important to address the issue of organizational role. The hypothesis that deals with the relationship between organizational role and performance is as follows.

H3: There is a statistically significant relationship between organizational role dimension of stress and performance.

Unlike the sources of stress that arise due to reasons common to organizations, there may also be stressful situations that occur only in a particular organization or that arise only from that sector or job (Ertekin, 1993, p.146). Such situations may vary according to the structure of each organization and organizational environment. Within the scope of the research, the fourth dimension of organizational stress examines this situation and provides an opportunity to evaluate the structure of the organization in which the employee is involved and the work environment. So, hypothesis 4 was formed in this context.

H4: There is a statistically significant relationship between organizational structure and business environment dimension of stress and performance.

Today, it has become an important success criterion for organizations to adapt rapidly to technological changes in order to survive in a competitive environment (Küçükdursun et al., 2022, p.17). If the impact of the competitive environment and the causes of stress cannot be controlled, individuals and organizations may have difficulty in adapting to these environments and cannot realize their plans and programs as they consider, they may have to make changes under the influence of the external environment. This situation paves the way for them to experience excessive and negative stress and can cause many problems (Serinkan et al., 2012, p.21). Therefore establishing a positive working relation between the workforce and the organization is always crucial (Wulantika et al., 2023, p.6). Hypothesis 5 was created to address this situation.

H5: There is a statistically significant relationship between the external environment and job qualification dimension of stress and performance.

Hypotheses above were formed in order to evaluate the relationship between the dimensions of organizational stress, which is the independent variable, and the

performance, which is the dependent variable, in order to achieve the purpose determined within the scope of the research.

Sample and Data Collection

The research was organized according to descriptive method and relational survey model. Data were collected without making any changes in the current characteristics of the individuals in the target sample, and their views on the current situation were tried to be taken. The descriptive method is a research approach that aims to describe a past or present situation as it is. The event that is the subject of the research is tried to be defined as it is, within the current terms and conditions. No attempt is made to change or influence the event. The important point here is to observe and try to determine what is aimed to known (İslamoğlu and Alnıaçık, 2016, p.40-41). Relational screening models, on the other hand, are research models that aim to determine the existence and/or degree of co-variance between two or more variables (Gürbüz and Şahin, 2017, p.105-108; Karasar, 2004, p.77-81).

The universe of the research consists of employees working in a private organization which operates in agriculture industry and located in Mardin province of Türkiye. Out of 148 (N) employees in the research universe,

$$n = \frac{N.t^2.p.q}{d^2(N-1)+t^2.p.q}$$*

a sample was drawn and this number was calculated as a minimum of 107 (n) result of the calculations made with the formula (Kocacık and Çağlayandereli, 2009, p.31). But, 126 of the distributed questionnaires were included in the research as questionnaires that were returned and found valid. This number of questionnaires is above the number needed for the implementation of the study.

The data required for the research were obtained as a result of the questionnaire applied to the individuals. During the brief in-person interviews with the employees, a short briefing was made about the research, then questionnaires were given and then collected. The survey results obtained in this way were transferred to the computer. Later, it was analyzed and reported with the help of SPSS 20.0 program. For the interpretation of arithmetic means; "Likert" type five-point rating scale used in the research was used. On this scale, 5 was rated as " Strongly Agree" and 1 as "Strongly Disagree". In order to determine the compliance of the meetings with the ethical principles legislation, a report of compliance with ethical principles and human rights was obtained with the decision of the E-79906804-020-96770 of the Ethics Committee of Mardin Artuklu University (Mardin / Türkiye).

Instruments

The purpose of the research is to quantify the level of stress that people experience as a result of their interactions with various elements, including the organization they are currently employed by, their working environment, their coworkers, the organization's internal and external environment, their organizational role, management levels and

* N: Number of individuals in the universe, p (0.5): The incidence of the investigated event, q (0.5): Frequency of absence of the investigated event, t (1.96): Table value at a certain level of significance, d (0.05): Accepted sampling error according to the incidence of the event, n: Minimum number of sample units.

units. The research also investigated at how this circumstance affected organizational performance. In order to measure this situation, a questionnaire was applied to the research participants. In order to determine organizational stress and its dimensions during the survey, the "technostress scale" which considers 14 questions and developed by Tarafdar et al., (2007), simplified by Alam (2016) and adapted into Turkish by Türen et al., (2015) was used. In order to measure performance, the "work performance scale" which considers 4 questions and developed by Kirkman and Rosen (1999) was used in accordance with its original form.

Both scales were adapted to be suitable for the purposes of this research. Because of this, validity and reliability analyzes of both scales were performed for the accuracy and health of the research results. As a result of the analyzes made in this direction, the Cronbach's Alpha coefficient for the job stress scale was calculated as 0.912 and for the employee performance scale was calculated as 0.886. In addition, the coefficient for the overall scale of the research, which emerged as a result of applying the combination of both scales as a single form and at the same time, was calculated as 0.910. The fact that the relevant values are greater than 0.700 is considered sufficient for the scales to be considered reliable (Kalaycı, 2010). As can be seen in the table below, Cronbach's Alpha coefficient values of all scales applied within the scope of the research are greater than 0.700. This leads us to the conclusion that the scales are reliable.

Table 1: Reliability Analysis of the Scales Used in the Research

	Cronbach's Alpha
Stress	0.912
Performance	0.886
Overall	0.910

While testing the problems of the research, "Factor Analysis" and "Correlation Analysis" were applied in order to determine whether there is a significant relationship between the organizational stress dimensions and employee performance. Correlation analysis is the analysis used to determine the relationship between the two metric variables examined (İslamoğlu and Alnıçık, 2016, p.40-41). Factor analysis (FA), on the other hand, can be explained as a multivariate statistical analysis that aims to reveal and discover a small number of but conceptually meaningful new variables (factors, dimensions) by bringing together a large number of interrelated variables (Çemrek, 2018, p.419-420). In order for these analyzes to be performed, the data must conform to the normal distribution. As can be seen in Table 2, as a result of the normality tests, both tests were significant (Gürbüz and Şahin, 2017, p.338-340) and it was concluded that the data conformed to the normal distribution.

Table 2: Normality Tests

	Kolmogorov-Smirnov	Shapiro-Wilk
Stress	0.200	0,112
Performance	0.200	0,139
Overall	0.200	0,180

In order to apply the necessary analyzes and to check whether the distribution is normal, the values required as a result of the normality analysis of the scales used are as above. All these values show that the data used in the research showed a normal distribution and do not constitute an obstacle for the application of factor analysis.

Findings

What the statistical analyzes used as a result of the research tell us about the relations between variables can be seen in the table below. In the table, there are indications that the relationship between the sub-dimensions of organizational stress and performance is significant or not. Before proceeding to the evaluation of these indicators, it should be reminded that the sub-dimensions of organizational stress are discussed from the perspective of globalization and technological developments and the research questions are updated in this context. Because this is important in terms of interpreting the relations between the variables.

Table 3: Stress–Performance Relationship

Variables		Psychological and Mental	Relational and Social	Organizational Role	Organizational Structure and Business Environment	External Environment and Job Qualification
Performance	Coef.	-0.251	-0.249	-0.270	-0.281	-0.294
	p	0.042	0.088	0.045	0.032	0.068

In this research, it was determined that there is a significant relationship between the "psychological and mental" dimension of organizational stress and employee performance (r=-0.251 and p=0.042) because the correlation coefficient is statistically significant since the "p" value is less than 0.05. In this context, hypothesis 1, which is the first of the hypotheses created within the scope of the research, was accepted. But, As can be seen above, the evaluation of this dimension becomes more important since the significance value is right at the border. This situation can be considered and evaluated as another research topic. Because the significance level is very close to the point that creates a difference. This may lead us to think that the psychological and mental performance of employees is not affected much. In this respect, it may be suggested that this dimension be considered as another research topic.

For the second hypothesis of the research, no significant relationship was found between the "relational and social" dimension of the stress and performance (r=-0.249 and p=0.088). Since the "p" value, which deals with the relationship between the mentioned dimension and performance, is more than 0.05, the correlation coefficient is not statistically significant and hypothesis 2 is rejected.

A statistically significant relationship was found between the third dimension of the research, which contributed to the research in terms of "organizational role" and employee performance (r=-0.270 p=0.045). Thus, hypothesis 3 was accepted. In cases where the role of the individual, which determines the duties and responsibilities and

draws the organizational boundaries, is not clearly defined, when the individual is not given the right role, uncertainty and disagreements about the role may arise between the subordinates and the superior. As a result of this situation, sources of stress related to the organizational role and the problems they bring may arise (Durna, 2004, p.193-194). So, in this research, it was concluded that the stress sources related to the organizational roles of the employees affect their performance. The significance level for this dimension produced a result just at the border, as in hypothesis 1. This situation can also be considered as another research topic which also mentioned as the results section of this research.

For the fourth hypothesis of the research, the relationship between "organizational structure and business environment" and employee performance was discussed. As a result, it's concluded that there was a significant relationship between this dimension and employee performance (r=-0.281 and p=0.032) because the correlation coefficient was statistically significant since the relevant "p" value was less than 0.05 and hypothesis 4 was accepted.

Individuals are not employed in accordance with their basic skills and abilities or that they are not compatible with the qualifications of the job they do can create organizational stress. However, although these situations are effective, they do not have an effect on the performance of the employees in terms of this research and its results. It was determined that there was no significant relationship between the "external environment and job qualification" dimension, which constitutes the fifth and final dimension of the research in terms of organizational stress, and employee performance (r=-0.294 and p=0.068). In this context, the correlation coefficient is not statistically significant and hypothesis 5 is rejected.

As is evident, according to the findings obtained within the scope of the research, statistically significant and insignificant results were obtained between the dimensions of organizational stress and employee performance. When the general structure and results of studies on organizational stress and its relationship with employee performance are examined, it has been observed that these concepts are applied to different working groups in different sectors and institutions, and the studies on the subject in Türkiye have been increasing in recent years. Stress factors or sources that have an effect on individuals as a result of the groups in which the applications were made and the results of the studies, and the similarities or differences between the findings obtained in terms of the effect of this situation on employee performance and this research were also discussed within the scope of the research. The obtained results and inferences are important in terms of whether the research is compatible with other sectors and occupational groups, whether the results are similar or not, and the results of the research can be compared with other studies in the literature that deal with the same concepts. In this context, the results of the findings obtained are discussed in the next part with the light of the other findings in literature.

Discussions

The findings obtained as a result of the research show that the relationship between stress and performance is a relationship that can lead to different results when considered from different aspects. When the literature review and the findings of the research are compared, the results show similarities with the literature and differ in some. Within the scope of this research, organizational stress affects employees in terms

of psychological and mental aspects, role conflict, organizational structure and business environment. However, no significant relationship was found between stress and performance in terms of the external environment and job qualification and relational and social aspects dimension. In the literature there are studies in which no significant or insignificant relationship found between stress and performance (Maipita et al., 2023, p.53; Olasanmi, 2016, p.799; Awadh et al., 2015; Odoh et al., 2013, p.100). In this context, the results of the research are similar to some of the studies in the literature in terms of dimensions in which no significant relationships is discernible.

There are many studies in the literature that deal with the effect of stress sources on performance (Pradoto et al., 2022, p.345; Bayramoğlu et al., 2020, p.115; Güllü and Yıldız, 2019, p.146; Haşit and Yaşar, 2015, p.12; Kotteeswari and Sharief, 2014, p.23; Korkmaz and Ceylan, 2012, p.313; Erdoğan et al., 2009, p.459; Westman and Eden, 1996, p.171). On the other hand, there are many studies dealing with the relationship between technostress and performance (Küçükdursun et al., 2022, p.17; Alvarez-Risco et al., 2021; Magistra et al., 2021, p.75; Upadhyaya and Vrinda, 2021, p.1647; Kumar et al., 2017, p.403; Tagurum et al., 2017, p.312; Tarafdar et al., 2015; Funminiyi et al., 2014, p.27). Although these studies have applications in different samples, cultures and sectors, they are similar in terms of the results obtained and the common points of the result are that technostress negatively affects employee performance. Considering the results of this research, similar to the studies above, it was determined that there is a significant negative relationship between stress and performance in terms of some dimensions of organizational stress.

Some studies in the literature differ from others. For example, in studies conducted by Karabay (2015, p.128) and Korkmaz and Ceylan (2012, p.313), it was determined that individuals' exposure to negative stress caused by physiological and psychological factors also affects their non-organizational life and performance. This situation can be given as an example of the psychological and social dimension of organizational stress. As a result of this research, a similar conclusion was reached with this situation. In the research by Jex and Elacqua (2014, p.188), it was stated that the sources that cause the most tension in individuals and affect their work performance are "role conflict, excessive workload and responsibility, work-family conflict". This situation can be given as an example of the organizational role dimension of organizational stress. Similar results were obtained in the studies conducted by Hurbean et al. (2022, p.1) and Tarafdar et al. (2014, p.51). Likewise, the findings obtained as a result of this research supports this situation. Because, when the relationship between organizational role and performance, which constitutes the third hypothesis of the research, is considered, a statistically significant relationship was found.

Several researches (Çolak, 2017, p.810; Kılıç and Atilla, 2017; AbuAlRub, 2004, p.73-74) state that stress, which is kept at a certain level and managed, can be beneficial but can be harmful when it is at a high level. Considering the results of this research, it was concluded that stress affects performance in some aspects and not in some. In this case, it can be said that the efficiency of the studies put forward in order to keep or manage the stress at a certain level throughout the organization selected as the research sample should be questioned. Or, if stress management strategies are being implemented late, it might be claimed that their effects have not yet been completely noticed. Another point that should be emphasized here is that the stress arising from technological developments is discussed in this research. This situation may affect the effect of stress

according to the level of use of technology in the organization or the reflection of stress factors arising from this situation. Fully automated and high-tech units are under higher stress, whereas units that operate in the opposite way are under less stress.

As could be observed, the research's findings differ from previous research in the literature in some ways while also conforming with them in some. This condition can be seen as normal considering that our planet is a very huge globe and has many distinct cultures. Because the characteristics of the culture in which each sample is applied, also directly or indirectly affect the individuals in that society. In this case, it is a result of the normal flow of life that the studies put forward will have similarities and differences. Moreover, the fact that countries are at different levels in technological development can also be a source of variability in terms of feeling the effects of technostress. While technostress resources are more in societies and organizations that are more integrated with technology, it is obvious that the opposite situation is in question in less integrated societies. In this context, in the next part of the research, a general evaluation has been made, which is the last link of the chain that has been processed step by step until this part.

Conclusions

In this research, which was carried out in a sample of employees operating in a private organization sample, the relationship between organizational stress and performance was discussed from the perspective of globalization and technological developments. Considering the relationship between the sub-dimensions of stress sources created as a result of the research, 3 dimensions (psychological and mental, organizational role, organizational structure and business environment) have an effect on employee performance, and 2 dimensions (relational and social, external environment and job qualification) are not.

Considering the results of the research, it is seen that employees are affected by the stress factors arising from technological developments and this situation is reflected in their performance in some aspects. For example, it has been determined that employees perceive a source of stress psychologically and mentally. It is thought that the fear of losing one's job with the effect of technological developments, the fear that the machines will replace him, the uneasiness and tension caused by the rapidly developing nature of technology can be counted among the reasons behind this situation. Also the organizational role and the organizational structure and business environment dimensions have an impact on employee performance. The reason behind this situation may be similar to the situation seen in the previous clearing. Because, it is expected that technological developments will affect employees in terms of organizational role and business environment. This result is also supported by researches in the literature as it can be seen the discussion part of the study. Also, as mentioned in the findings section of the study, it is important that the significance levels for hypothesis 1 and hypothesis 3 produce a result that is exactly at the border. This can be presented as a suggestion for further studies and researchers related to this topic can take this study further to investigate the underlying reasons for this situation.

On the other hand, employees don’t feel relational and social tensions about organizational structures, which have changed with the effect of technological developments highlight this instance. As a matter of fact, the external environment and job qualification, which is another organizational stress dimension, also supports this

situation. Considering that the stress factors arising from globalization and technological developments mostly occur in the external environment, a remarkable situation emerges. Because, it was determined that the outside of the organization environment and the qualification of the job dimension of the employees in the research sample did not reflect on their performance. Although there are studies in the literature in which there are no significant relationships between technostress and employee performance, this situation can be considered as a situation that should be addressed as a separate research question. In fact, a qualitative research can be carried out by conducting semi-structured interviews in order to discuss the opinions of the employees on this subject in more detail.

In summary, within the scope of this research, the views of the participants discussed the relationship between organizational stress and employee performance from the perspective of globalization and technological developments. While some of the participants' opinions agreed with the literature, others provided contradictory results. To generalize the results to the nation or the world, selecting an organization in a single province as the population and sample imposes limitations. It will be helpful to conduct future research with a larger or wider sample in order to acquire more generalized results. Another research subject that might be explored is the capability to examine research participants through in light of demographic characteristics.

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2023, 12 (4), 2344-2362 | Araştırma Makalesi

Bibliometric Analysis of Covid 19 and Industry 4.0 Studies Published in Web of Science Database

Neşe SALİK ATA[1]

Abstract

The Covid 19 pandemic, which emerged in 2019 and spread rapidly and became a hot topic in the world, has negatively affected people's lives in every sense. In order to eliminate these negative effects, many practices such as masks, curfews, distance education, working from home and vaccination have been implemented. Despite these, the Covid 19 epidemic has brought the production sector to a halt. It is thought that this situation can only be overcome with Industry 4.0 technologies, which envisage using robots instead of human factors. It is thought that the production style, which requires robots to work 24 hours a day, on which Industry 4.0 is based, may be a good method in combating the Covid 19 epidemic, as it reduces the need for humans. Even in the field of health, Industry 4.0 applications are expected to produce positive results in terms of both treatment and prevention of infection. The idea of benefiting from Industry 4.0 technologies during the Covid 19 pandemic period has been influential in academics turning to this field and many studies have been conducted on the subject. This study was conducted to examine the studies using the bibliometric analysis method. In this context, bibliometric analysis was conducted to determine the number of publications addressing Covid 19 and Industry 4.0 issues, the most cited articles, the most published authors, countries and journals. The Web of Science (WoS) database was used to obtain publications. The keywords used were subjected to a filtering process to prevent the inclusion of articles that did not meet the inclusion criteria, resulting in 305 publications. R statistical software was used to analyze the obtained data. According to the analysis results, India was found to be the country with the most articles on Covid 19 and Industry 4.0 according to the main affiliation of the author.

Keywords: Industry 4.0, Covid 19, Web of Science, Bibliometric Analysis, Fourth Industrial Revolution

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2023, 12 (4), 2344-2362 | Araştırma Makalesi

Web of Science Veri Tabanında Yayınlanan Covid 19 ve Endüstri 4.0 Konulu Çalışmaların Bibliyometrik Analizi

Neşe SALİK ATA[1]

Öz

2019 yılında ortaya çıkan ve hızlı bir şekilde yayılarak dünyanın gündemine oturan Covid 19 salgını insanların yaşamlarını her anlamda olumsuz etkilemiştir. Bu olumsuz etkileri yok edebilmek için maske, sokağa çıkma yasağı, uzaktan eğitim, evden çalışma, aşılama gibi pek çok uygulamaya gidilmiştir. Bunlara rağmen Covid 19 salgını üretim sektörünü durma noktasına getirmiştir. Bu durumun ise ancak insan faktörü yerine robot kullanmayı öngören Endüstri 4.0 teknolojileri ile aşılabileceği düşünülmüştür. Endüstri 4.0'ın esas aldığı 24 saat robatların çalışmasını öngören üretim tarzı, insana olan ihtiyacı azalttığından Covid 19 salgını ile mücadelede iyi bir yöntem olabileceği düşülmektedir. Hatta sağlık alanında da Endüstri 4.0 uygulamalarının hem tedavi hem de bulaşı önlemek açısından olumlu sonuçlar doğurması beklenmektedir. Covid 19 pandemi döneminde Endüstri 4.0'ın teknolojilerinden faydalanma fikri akademisyenlerin bu alana yönelmelerinde etkili olmuştur ve konuyla ilgli pek çok çalışma yapılmıştır. Bu çalışma da yapılan çalışmaların bibliyometrik analiz yöntemi ile incelenmesi amacıyla yapılmıştır. Bu bağlamda Covid 19 ve Endüstri 4.0 konularını ele alan yayın sayısını, en çok atıf alan makaleleri, en çok yayın yapan yazarları, ülkeleri ve dergileri tespit etmek için bibliyometrik analiz yapılmıştır. Yayınları elde etmek için Web of Science (WoS) veritabanı kullanılmıştır. Kullanılan anahtar kelimeler, dahil etme kriterlerini karşılamayan makalelerin getirilmesini önlemek için bir filtreleme işlemine tabi tutularak 305 yayına ulaşılmıştır. Elde edilen verileri analiz etmek için R istatistiksel yazılımı kullanılmıştır. Analiz sonuçlarına göre Hindistan, yazarın ana mensubiyetine göre Covid 19 ve Endüstri 4.0 hakkında en çok makaleye sahip ülke olduğu görülmüştür.

Anahtar Kelimeler: Endüstrisi 4.0, Covid 19, Web of Science, Bibliometrik Analiz, Dördüncü Endüstri Devrimi

Salik Ata, N. (2023). Web of Science Veri Tabanında Yayınlanan Covid 19 ve Endüstri 4.0 Konulu Çalışmaların Bibliyometrik Analizi . İnsan ve Toplum Bilimleri Araştırmaları Dergisi , 12 (4) , 2344-2362 . https://doi.org/10.15869/itobiad.1344615

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Introduction

There has been a global struggle against an invisible force, Covid 19. Although countries such as the USA, England, Italy, and France have developed medical systems, they have been greatly damaged, and millions of people from all over the world have been affected by the virus in a very short period. Covid 19 has affected the general structure of a country including healthcare, supply chain, industry, many other sectors, and has brought many changes in everyone's lifestyle. In order to cope with the current situation, governments, academics, and individuals sought innovative solutions (Rahman et al., 2021, p.2).

This study was carried out to systematically examine the researches dealing with the concept of Industry 4.0 in the context of Covid 19. With this study, it is aimed to reveal the deficiencies in the field, and to contribute to the scientific field. When the studies on the subject of "Industry 4.0 in the Context of Covid 19" were examined in the literature, no similar study was found on bibliometric analysis. In this context, it is thought that the study has an original quality. Examining the studies dealing with Industry 4.0 in the context of Covid 19, and determining which issues stand out; it is important for the use of Industry 4.0 technologies in the fight against the pandemic, unmanned production during restriction periods, and the effective use of the health system. In this context, the following research questions were formed:

1. How is the distribution of articles dealing with Industry 4.0 in the context of Covid 19 by years?

2. Which journals are the most published articles on Industry 4.0 in the context of Covid 19?

3. What are the most cited sources in the articles dealing with Industry 4.0 in the context of Covid 19?

4. What are the most repeated keywords in articles dealing with Industry 4.0 in the context of Covid 19?

5. What is the relationship between journal, author, and keyword in articles dealing with Industry 4.0 in the context of Covid 19?

6. What is the h/g/m index of the journals, and authors in which the articles dealing with Industry 4.0 in the context of Covid 19 are published?

7. What are the results of conceptual structure factorial analysis according to keywords?

8. How did thematic evolution occur according to author keywords?

9. How is the distribution of the articles according to the countries where the authors working on Industry 4.0 in the context of Covid 19 are located?

10. What is the total number of citations received by countries working on Industry 4.0 in the context of Covid 19?

Making a study in this direction in the study constitutes the main contribution of the study to the literature. In line with the purpose of the study, the concepts of Covid 19, and Industry 4.0 will be discussed in the context of the theoretical framework. Then, the bibliometric analysis of the articles dealing with the subject of Industry 4.0 in the

context of Covid 19 will be discussed according to the distribution by years, most published journals, most cited sources, the most repeated keywords in articles, journal, author, and keyword relationship in articles, h/g/m index of the journals, and authors in which the articles were published, distribution of articles according to the countries where the authors are located, the total number of citations received by the working countries.

Literature Review

Industry 4.0

The term "Industry 4.0" first appeared in an article published by the German government in 2011. After electrification, informatics, and mechanization, the fourth stage of the industry has been named "Industry 4.0". At an industrial fair in Hannover Germany in 2013, the term "Industry 4.0" came to the fore again, and quickly emerged as the German national strategy. The concept of "Industry 4.0" has been widely discussed in recent years, and is gaining importance for many information, and global industries. Industry 4.0 is a new industrial revolution that will have a great impact on the international industry (Zhou et al., 2015, p. 429).

In the fourth industrial revolution, which is based on human-machinization, the most efficient production in the economy is provided by the use of smart factories, and efficient production options provided by technological developments. There have been many events that have affected the social, cultural, political economy, and the world economy. The industrial revolutions in history are also these events (Şahin, 2007, p. 415). So far, four industrial revolutions have been the subject of research, although some authors question whether industrial systems came about by evolution or revolution. These revolutions are as follows (Satyro et al., 2023, p. 2):

- Industry 1.0 or the first industrial revolution, took place using steam power, and the mechanization of the loom in the 1780s, when industry succeeded in reducing reliance on human physical power, and reaching new levels of productivity.
- Industry 2.0, or the second industrial revolution, took place with the introduction of mass producion in steel mills in the 1870s.
- Industry 3.0 or the third industrial revolution, began in 1969 with the use of telecommunications, robotics, electronics, and computing.
- Industry 4.0 or the fourth industrial revolution emerged at the Hannover Fair in 2011 in order to increase the competitiveness of German companies.

Industry 4.0 is based on digital simulation, networking production data management, highly automated production processes, and transforming the entire process into access to information (Zhou et al., 2015, p. 431). Industry 4.0; It refers to smart production processes in manufacturing with the development of technologies related to the internet of things, artificial intelligence, cloud computing, and big data (Lu and Liao, 2022, p. 1). There are many terms commonly used to describe Industry 4.0. some of these terms are as follows (Hermann et al., 2016, p. 3923):

- **Smart Factory:** Autonomously controlled smart factories are developing by using smart technology related to holistically digitized product, and factory models, with production fully equipped with autonomous systems, sensors, and actors (Lucke et al., 2008, p.115 - 116).
- **Internet of Things, IoT:** The digital devices used need to transmit data to a digital device or another monitor via sensors during their operation. These digital objects have been named the Internet of Things (IoT) because they transfer their data over the network infrastructure of the Internet (Öztuna, 2017, p. 29).
- **Cyber-Physical Systems:** The digital, and physical level merge. When this encompasses the production level as well as products, systems emerge that can no longer reasonably distinguish between digital, and physical representation (Lasi et al., 2014, p. 4).
- **Autonomous Robots:** Unlike robots designed during Industry 3.0, robots in Industry 4.0 are designed to interact or work with humans, reducing effort, and risk while working (Soares et al., 2021, p. 7).
- **Cyber Security:** Due to the awareness that cyber threats cannot be completely eliminated, research, and technological development is essential to reduce the harmful effects of cyber attacks (Azambuja et al., 2023, p. 3).
- **Cloud Computing**: Cloud computing services allow on-demand network access to computing resources remotely provided by an internet service provider. It helps advanced decision making by connecting different devices, machines or items, and exchanging information in real time (Marinagi et al., 2023, p.11).
- **Augmented Reality:** It is a technology that allows virtual objects or data to enter the field of view of the observer, expanding the physical environment, and thus enabling people to interact with them in a superior way (Satyro vd., 2023, p. 3).

Covid 19

The coronavirus was first identified in 1966 when an experiment was conducted in the virus culture of patients with the common cold. There are four variants of the coronavirus: alpha, beta, delta, and gamma coronavirus. Among these variants, there are seven subtypes that can infect humans, three of which SARS-COV, MERS-COV, and SARS-COV-2 cause fatal respiratory infections (Acioli et al., 2021, p. 993).

In December 2019, an outbreak of novel coronavirus SARS-COV-2 (Covid 19) of unknown origin was reported in Wuhan, Hubei Province of China. Thousands of deaths caused by the novel coronavirus disease (Covid 19) led the World Health Organization to declare a pandemic on March 12, 2020 (Ciotti et al., 2020, p. 366).

The Covid 19 pandemic has affected almost all countries. The development of advanced technologies was needed to overcome the various problems associated with this pandemic. In the case of the implementation of Industry 4.0, which includes advanced manufacturing, and information technologies, all these technologies are interconnected, and medical stakeholders communicate with each other to decide the necessary actions with the production, and use of the vaccine, health equipment, and logistics, control, surveillance, detection, and less human physical power. It is assumed that it will install

(Javaid et al., 2020, p. 419). The expected benefits of Industry 4.0 technologies to the Covıd 19 pandemic are as follows (Haleem and Javaid, 2019, p. 4 ; Ren et al., 2020, p. 1):

- Planning activities related to Covıd 19,
- Precautionary production for the Covıd 19 virus,
- Using robotic-based therapy of the infected patient to reduce the doctor's risk,
- Providing a better experience without posing risks to health services, and other employees,
- Promoting a flexible working environment for treatment,
- Timely delivery of medical supplies using the smart supply chain,
- Digital technologies help people do their daily work during the curfew,
- Use of virtual reality for educational purposes,
- Researchers can use these technologies on social, and media platforms to identify unusual information,
- The emergence of many innovations with the help of advanced production, and digital Technologies.

Method

Research model

Studies on Covid 19, and Industry 4.0 were scanned through the "Title" in the Web of Science (WoS) database. In the research, the studies between the years 2020-2023 were examined within certain criteria, and subjected to bibliometric analysis. In order to collect the data (COVID 19 or covid 19 or cox19 or COVID-19 or cov-19 or pandemic or coronavirus), and "Industry 4.0", the results were examined. As a result of the search, 485 studies were reached. By filtering, the studies that were scanned in the SCI-Exp., SSCI, ESCI indexes, in English language, and open to access were included in the review. 305 articles were reached from the research universe WoS database, and the articles scanned on 30 June 2023 were published in a total of 178 sources. In the articles written, 19077 publications were cited. Table 1 presents general information about the articles used in the research universe

Table 1. Article Data

Description	Results
Maın Informatıon About Data	
Timespan	2020:2023
Sources (Journals, Books, etc)	178
Documents	305
Annual Growth Rate %	30,59
Document Average Age	1,3
Average citations per doc	12,04
References	19077
Document Contents	
Keywords Plus (ID)	636
Author's Keywords (DE)	1286
Authors	

Authors	1015
Authors of single-authored docs	15
Authors Collaboratıon	
Single-authored docs	15
Co-Authors per Doc	3,66
International co-authorships %	43,61
Document Types	
article	260
article; early access	45

Analysis of Data

Bibliometric analysis:

Bibliometrics is derived from the roots "biblio", and "metrics". The word “Biblio” derives from the Latin, and Greek word “biblion”, which is equivalent to the word “bybl(os)” meaning “book”. “Metrics”, on the other hand, comes from the words “metricus” or “metricos” in Latin; Greek, and means “measurement” (Yersüren and Özel, 2020, p. 1144). Bibliometrics, which is widely used in various fields, comes from information science, and the library. It is an effective tool for examining the current academic environment, reviewing historical evolution, and predicting future growth in the field (Wang and Ma, 2016, p.129).

Bibliometric analysis which was put forward by Derek J. De Solla in 1965 (Boyack et al., 2005, p. 351), was used for the first time in Turkey by Özinönü in 1970 (Hotamışlı and Erem, 2014, p. 3). Basically, performing bibliometric analysis is based on articles in large databases. A comprehensive quantitative analysis can be made from the basic features of the publications to the keywords, from the time range to the regional distribution, from the authors to the journal institutions (Qin et al., 2021, p. 168).

R statistical software used by many researchers was used for analysis. The data in the study were examined with bibliometrix, which is the R 4.2.2 package program add-on developed by Aria and Cuccurullo (2017). For the analysis results, R Studio, and R programs, biblioshiny application, and bibilometrix site were used.

Findings

The bibliometric analysis method helps to create a more objective literature review, and a wider scanning area. In addition, it allows authors to better know their fields, and develop a clearer publication policy (Zupic & Čater, 2015, p. 429). According to the results of the bibliometric analysis, it is seen that the studies on “Covid 19, and Industry 4.0” started to be published in 2020 with the occurrence of the “Covid 19 pandemic”, and there was a significant increase in the number of publications, especially in 2021, and 2022. In the table below, the distribution of the number of publications by years is given.

Table 2. Distribution of the number of publications by years

Year	Number of Articles	Percentage %
2020	22	%7.22
2021	97	%31.80
2022	137	%44.91
2023	49	%16.07

With the determination of the journals that publish the most, analyzes will be made for journals, authors, citations, keywords, and countries. Information on the journals with the highest number of publications is presented in Figure 1.

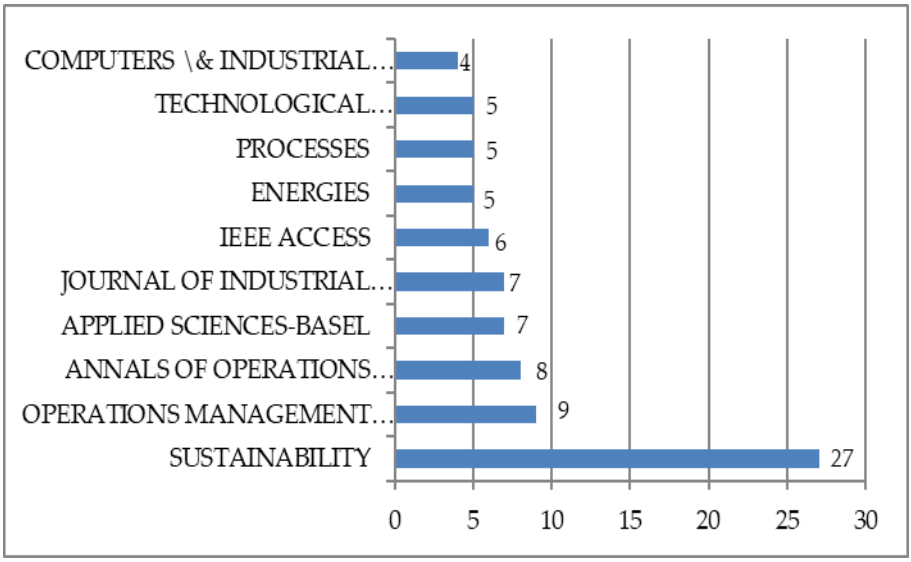

Figure 1. Top Publishing Journals

Between 2020-2023, a total of 83 of 305 articles were published in 10 journals shown in Figure 1. These articles published in 10 journals constitute 27.21% of the total number of articles. The journal "Sustainability" with 27 publications constitutes 8.85% of the total number of publications.

The Bradford scattering law is the most well-known, and popular law. Bradford's law of scattering, first published in 1934, is often associated with Zipf's law, and Lotka's law. The laws mentioned are the three most important bibliometric laws. It is generally accepted as the best scientific research model or example found in Library, and Information Science (Arsenova, 2013, p. 678-679). In this context, the data prepared according to the Bradford scattering law are given in the table below.

Table 3: Journal Table by Bradford Scattering Law

Rank	Journal Name	Frequency	Cumulative Frequency	Zone
1	Sustainability	27	27	Zone 1
2	Operations Management Research	9	36	Zone 1
3	Annals of Operations Research	8	44	Zone 1
4	Applied Sciences-Basel	7	51	Zone 1
5	Journal of Industrial Integration and Management-Innovation and Entrepreneurship	7	58	Zone 1
6	IEEE Access	6	64	Zone 1
7	Energies	5	69	Zone 1
8	Processes	5	74	Zone 1
9	Technological Forecasting and Social Change	5	79	Zone 1
10	Computers \& Industrial Engineering	4	83	Zone 1

The basic idea that still holds true today is that if a scientist reads an article, he or she will get an insight into which articles might cover a similar topic. It is thought that it would be useful to be able to reach other sources on the same subject by looking at the quotations made in the article as a result of an article read briefly. However, a scan made in this way can lead away from the main source, and cause to reach the works that are little quoted, and get away from the subject, and cause loss of time. Bradford's law of scattering provides an important method for directing journals that make extensive evaluations on the subject rather than journals with small citations (Thelwall, 2008, p. 606).

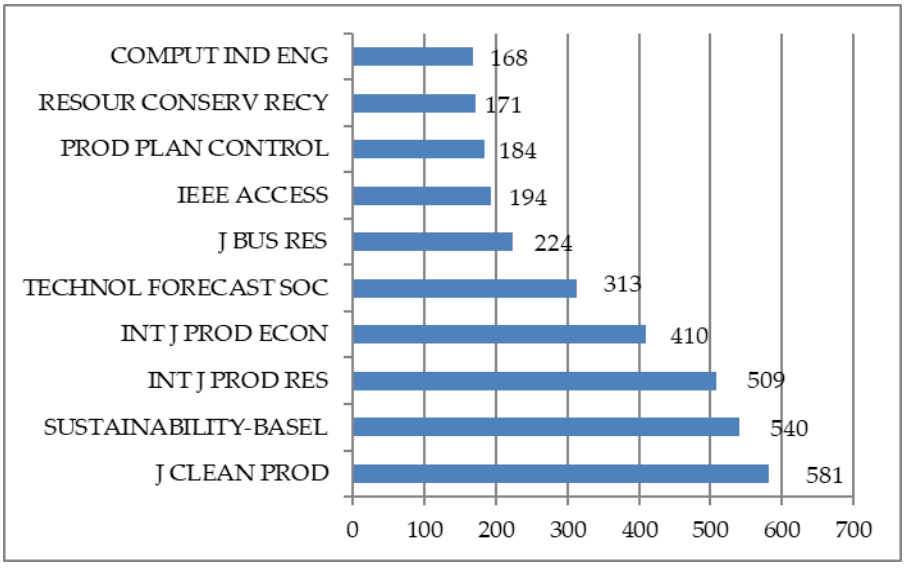

Figure 2. Sources Most Cited by Articles

J Clean Prod ranks first among the most cited journals with 581 citations. The top 10 most cited journals received 17.26% of the total citations. A total of 19077 citations were made in 305 articles, with an average of 62.5 citations per article.

The h index, which was defined by Hirsch in 2005, expresses the value of the scientist's index as h if each of a scientist's article gets the least number of citations, and the other articles get the most h. The H index provides information about the author's publishing activity, and the effectiveness of his publications (Hirsch, 2005). Developed by Egghe in 2006, the g index is an improved version of the h index. While the g index evaluates a particular article group, it shows the index value that also takes into account the highly cited articles in order to calculate the author's effectiveness (Egghe, 2006, p. 131). The median is the number of citations received by the publications in the Hirsch-core in the M index. This value will always be less than the h-index (Bornmann et al., 2008, p. 832). Table 3 presents information on the h/g/m indexes of the journals in which the articles were published.

Table 3. h/g/m Index Table of Journals

Journal Name	h index	g index	m index	Total Number of Citations	Number of Publication	Date of First Article Published
Sustainability	7	13	1,75	205	27	2020
Journal of Industrial Integration and Management-Innovation and Entrepreneurship	6	7	1,5	181	7	2020
Annals of Operations Research	5	8	1,667	110	8	2021
Operations Management Research	5	6	2,5	43	9	2022
Technological Forecasting and Social Change	4	5	1,333	394	5	2021
Applied Sciences-Basel	3	4	0,75	22	7	2020
Computers \& Industrial Engineering	3	4	1,5	42	4	2022
Energies	3	5	1	34	5	2021
Ieee Access	3	6	0,75	76	6	2020
International Journal of Logistics-Research and Applications	3	3	0,75	110	3	2020

It can be said that the h/g/m index of the published journals is affected by the number of journal publications. It seems that this effect stems from the indexes measuring the effectiveness of publications. However, the number of citations to publications is also an important indicator that provides information about the quality of the publication. In this context, it is seen that Sustainability magazine, which publishes the most, fell to the second place. The number of citations comes to the fore especially in the measurements related to indexes.

It is seen that the authors generally do not appear in more than one work. There are various indexes such as h/m/g index for scientific evaluation of productivity status of authors. The data prepared in this context are presented in Table 4.

Table 4. Authors' h/g/m Index Table

Author Name	h index	g index	m index	Total Number of Citations	Number of Publications	First Publication Date
Javaid M	7	7	1,75	455	7	2020
Haleem A	6	6	1,5	440	6	2020
Kazancoglu Y	5	5	1,667	82	5	2021
Kumar A	5	6	1,667	74	6	2021
Mangla Sk	4	4	1,333	55	4	2021
Sıngh Rp	4	4	1	137	4	2020
Belhadi A	3	3	0,75	426	3	2020
Grencıkova A	3	3	1	15	4	2021
Kumar S	3	3	0,75	69	3	2020
Singh Rk	3	3	1	28	3	2021

In Table 4, the index values of the published authors are given. It is seen that the h/g/m index of the authors differ according to the number of citations. Javaid M took the first place in the list according to the value of the g index. Among the authors on the list, it is seen that the first works of the authors who started production in the magazine were published in 2020, and the author who started production at the latest published their first work in the magazine in 2021. For example, although there are 3 articles in total, Belhadı A received 426 citations, while Singh Rk received 28 citations. For authors, the h/g/m index covers the efficiency of publications as well as the citation efficiency of others, making it possible to estimate the quality, and quantity of publications.

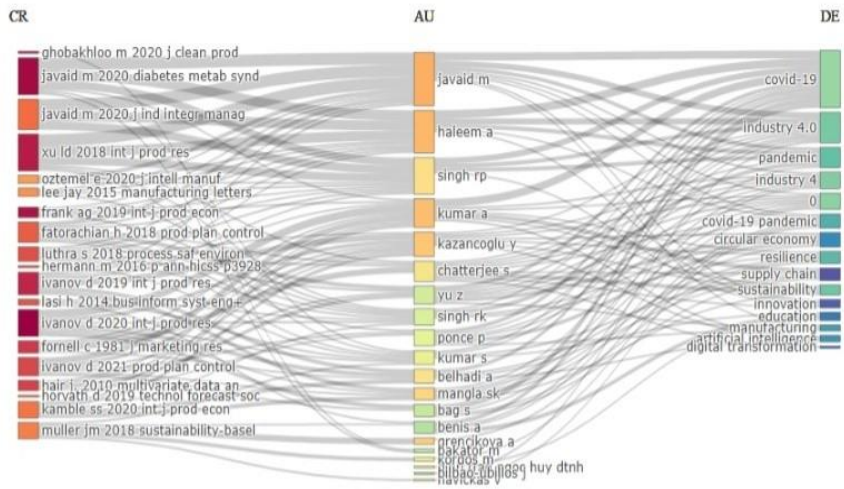

Figure 3. Tree-Field Plot

The distribution of keywords, authors, and bibliographies used is schematized in Figure 6. There are keywords on the right, authors in the middle, and references on the left. In the figure, "Covid 19", "Industry 4.0", "Pandemic", and "Covid 19 Pandemic" are the most common words in the keywords section. Its most prolific authors were previously mentioned in Table 4. It is understood that the keywords most used by Javaid M., the most productive writer, are "Covid 19", "Industry 4.0," and "Pandemic". In this way, the flow to the publications of Haleem A, Kazancoglu Y, Kumar A, and Mangla Sk, who are the authors who published the most on the research topic, and from there to the sources are visualized. In the sources section, it is understood that the works of Javaid M 2020, Xu Id 2018, and Ivanov D 2020 are used more intensively as sources compared to others.

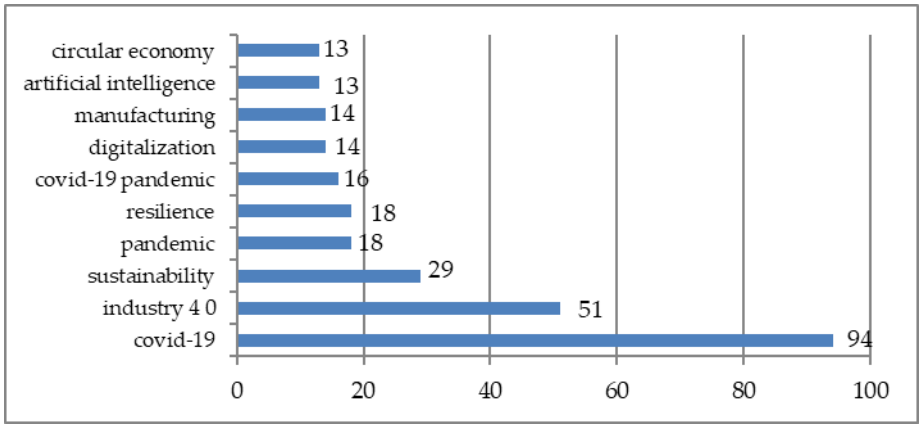

Figure 4. Most Repeated Keywords

As seen in Figure 4, among the keywords of 305 published studies, the word "Covid 19" was repeated 125 times, and the word "industry 4.0" 65 times. The word cloud for words is given in Figure 5.

Figure 5. Word Cloud of Most Repeated Keywords

When the word cloud is examined, it is seen that the word Covid 19 comes to the fore. Another way to understand the relationship between words is a network maps.

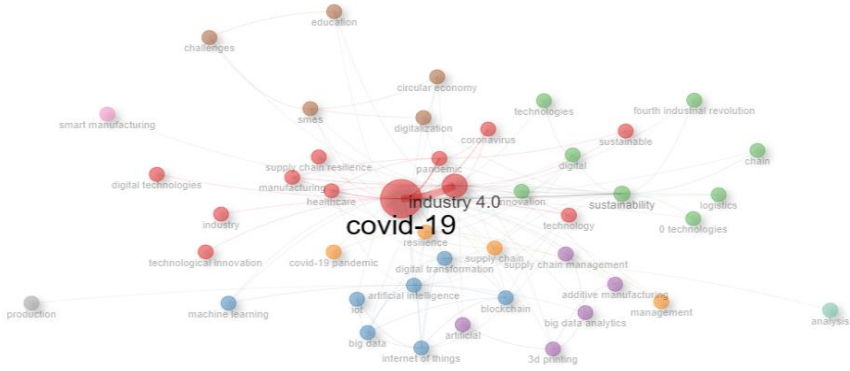

Figure 6. Network Map of Most Repeated Keywords

Network maps are visual forms that reveal hidden connections between words, and make it easier for the reader to understand. The network map of the keywords is shown in the figure above. The values for the nodes are seen in Table 5.

Table 5. Co-Association Network Analysis

Node	Cluster	Betweenness	Closeness	PageRank
covid-19	1	430,6952876	0,017857143	0,142893716
industry 4.0	1	126,1402595	0,013333333	0,06170822
sustainability	1	8,157885629	0,012345679	0,037754052
pandemic	1	3,966457249	0,012195122	0,025774615
digitalization	1	1,60882131	0,011764706	0,020590253
artificial intelligence	1	6,443936475	0,011904762	0,015519657
smes	1	0,474358974	0,010752688	0,013138739
education	1	10,91595936	0,011494253	0,014185284
digital transformation	1	0	0,010526316	0,008816565
innovation	1	0,272334406	0,011494253	0,011940199

When Table 5 is examined, it is seen that the most effective words of the red cluster according to the betweenness value are Covid 19 and Industry 4.0. Figure 7 shows the usage increase rates of the keywords used in the studies by year.

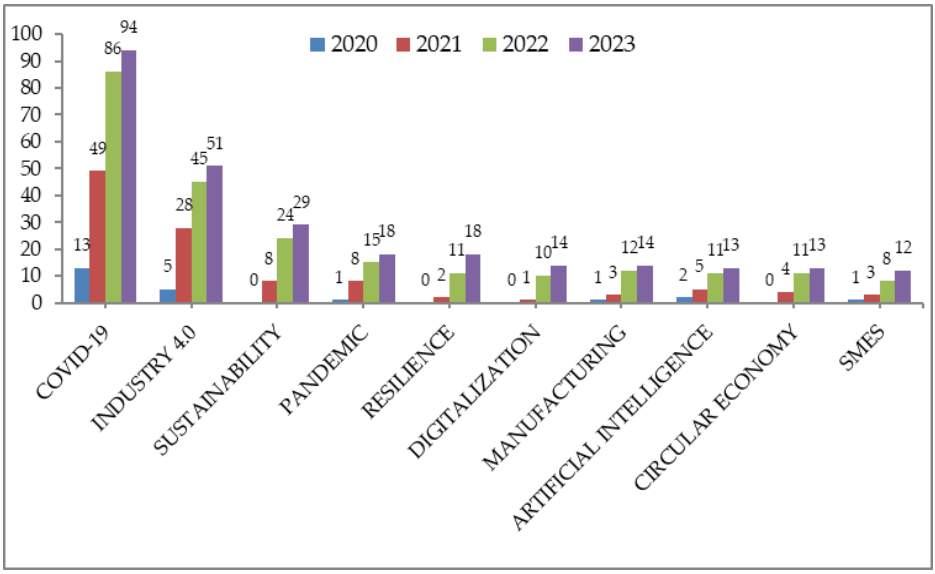

Figure 7. Increase in Words Over the Years (by keywords)

When Figure 7 is examined, it was observed that the most used keyword was "Covid 19". Covid 19 was first used in 2020, and gained momentum in 2022. The second most used keywords were the concepts of "Industry 4.0", and "Sustainability".

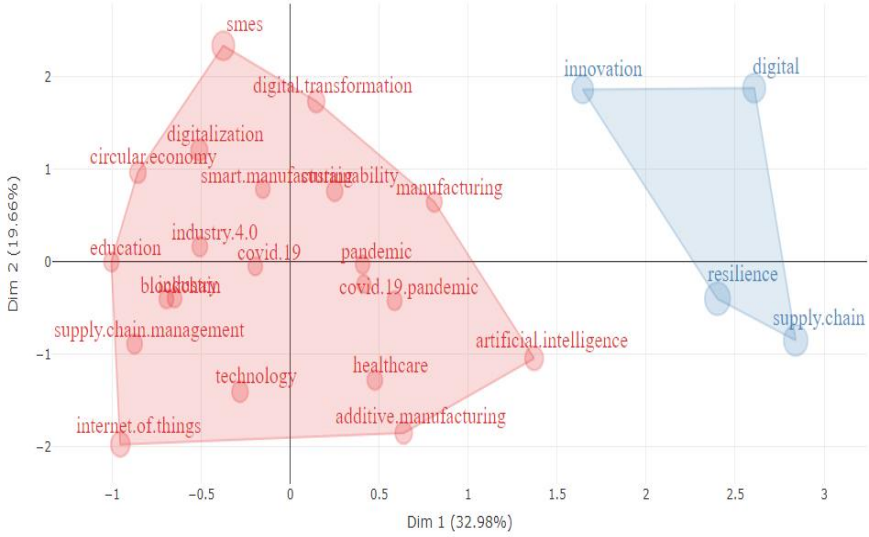

Figure 8. Conceptual Structure Factorial Analysis According to Keywords (Multiple Correspondence Analysis)

In the research, a multidimensional scaling analysis (Multiple Correspondence Analysis) was performed, where keywords were clustered through factor analysis depending on whether they were used together or not, their closeness or distance. Figure 8 shows that the conceptual structure of the studies conducted in this field consists of two main clusters (red, and blue colored region). It seems that this main cluster consists mostly of Covid 19, and Industry 4.0 (red zone), and supply chain, innovation (blue zone).

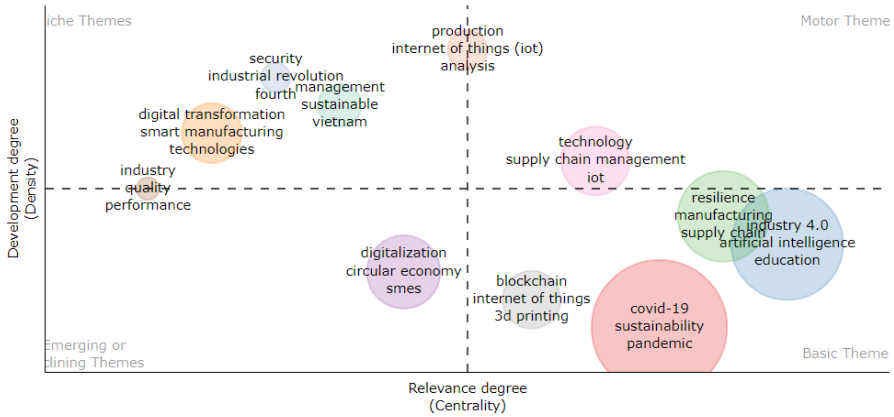

Figure 9. Thematic Evolution (by author keywords)

In Figure 9, the main topics according to the degree of interest in the center (central degree) consist of topics such as Covid 19, Industry 4.0, supply chain management, digitalization, industry, smart production, sustainability, quality. In this context, the most studied engine topics by the authors are technology, supply chain management, and the internet of things. Common topics include Covid 19, sustainability, pandemic, Industry 4.0, 3D printing, supply chain, resilience, manufacturing, artificial intelligence, and education. Among the niche topics, digital transformation, smart production, technology, sustainability, management, industrial revolution, Vietnam are among the common topics. Digitalization, circular economy, and SMEs, which are among the emerging, and clining topics, are among the common topics.

Table 6. Distribution of Articles by Country of Corresponding Authors

Country	Articles	SCP	MCP	Freq	MCP_Ratio	
INDIA		43	28	15	0,141	0,349
POLAND		17	12	5	0,056	0,294
CHINA		16	6	10	0,052	0,625
USA		13	7	6	0,043	0,462
FRANCE		12	3	9	0,039	0,75
ITALY		12	9	3	0,039	0,25
UNITED KINGDOM		11	1	10	0,036	0,909
AUSTRALIA		10	5	5	0,033	0,5
BRAZIL		10	5	5	0,033	0,5
SPAIN		10	8	2	0,033	0,2

When the countries where the responsible authors of the written works are examined, it is seen that 43 of 305 articles are from India. While 28 of the 43 articles were written by authors from the same country (SCP), 15 articles were written by authors from different countries (MCP). The total citations received by the publications of the countries, and the average citation values per article are given in the table below.

Table 7. Total Number of Citations by Countries

Country	Total Citation	Average Article Citations
INDIA	881	20,50
FRANCE	463	38,60
GERMANY	417	59,60
CHINA	223	13,90
AUSTRALIA	192	19,20
GREECE	166	33,20
UNITED KINGDOM	149	13,50
USA	107	8,20
TURKEY	88	9,80
VIETNAM	87	9,70

When Table 7 is examined, it has been determined that India has very important studies in terms of citation. It is seen that the majority of the total citations received from 305 works are made to authors in India.

Conclusion

Issues such as the fact that Covid 19 has become a global pandemic, its health, and economic effects, the use of Industry 4.0 technologies to combat Covid 19, unmanned production or online work to prevent the spread of the pandemic, the importance of industry 4.0 technologies in the health sector have attracted the attention of academics; researchers and many studies have been carried out in this area (Hussain et al., 2021, p. 2).

With this study, it is aimed to contribute to the literature by examining the studies on Covid 19, and Industry 4.0 in the WoS database with bibliometric analysis. In this context, the studies in the WoS database, which are the subject of Covid 19, and Industry 4.0 together, were evaluated within the scope of this research. 305 English articles in the database were examined.

According to the results of the analysis, it is seen that the Covid 19, and industry 4.0 researches conducted in 2022 cover 44.91% of the studies that are the subject of the research. This situation reveals that Covid 19, and industry 4.0 researches understand the academic importance of industry 4.0 technologies in combating the pandemic. In addition, it has been determined that the authors who publish on the subject are generally from India.

It is known that keywords give ideas about publications on the subject, and make the publications more visible, and frequently used word groups indicate the most studied concepts on that subject. In studies on Covid 19, and Industry 4.0 concepts, the most studied topics (when these concepts are excluded) are, according to keywords, internet of things, Pandemic, management, digitalization, 3D printing, healt care, supply chain, resilience, manufacturing, artificial intelligence, It has been observed that education, digital transformation, smart production, technology, sustainability, management, and industrial revolution are formed. Looking at the words, it can be said that conceptual studies focused on the concept of industry 4.0 in the field of health due to Covid 19.

In this research, studies on Covid 19, and Industry 4.0 in the WoS database were compiled. With this study, it is expected to present a different perspective to the authors in future studies on the subject by revealing the quantity of studies on Covid 19, and Industry 4.0 in the international literature. However, as in every study, this study also has some limitations. The foremost of these limitations is the scope of the research, and the focus on the WoS database in terms of the sample selected for the research.

However, when looking at the limitations of the study, it is seen that although important points have been tried to be revealed on Covid 19, and Industry 4.0, the data is limited only to the core collection of WoS and the data dated 30.06.2023. It is possible to obtain different results in studies conducted after this date. Therefore, combining the data with different international databases (e.g. WoS, PubMed, Google Scholar) may yield better results. Based on these limitations, further research and a deeper content analysis are recommended when characterizing subsequent bibliometric analyzes to be conducted.

Peer-Review	Double anonymized - Two External
Ethical Statement	It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited
Plagiarism Checks	Yes - Ithenticate
Conflicts of Interest	The author(s) has no conflict of interest to declare.
Complaints	itobiad@itobiad.com
Grant Support	The author(s) acknowledge that they received no external funding in support of this research.

Değerlendirme	İki Dış Hakem / Çift Taraflı Körleme
Etik Beyan	Bu çalışmanın hazırlanma sürecinde bilimsel ve etik ilkelere uyulduğu ve yararlanılan tüm çalışmaların kaynakçada belirtildiği beyan olunur.
Benzerlik Taraması	Yapıldı – Ithenticate
Etik Bildirim	itobiad@itobiad.com
Çıkar Çatışması	Çıkar çatışması beyan edilmemiştir
Finansman	Bu araştırmayı desteklemek için dış fon kullanılmamıştır.

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Digital Literacy Level and Career Satisfaction of Academics

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Abstract

Technology affects educational institutions like every other field. Higher education institutions, which are the main source of new knowledge creation and dissemination, are now dominated by digital technologies. The acquisition of digital literacy skills, which is among the 21st-century competencies, is possible with the positive attitudes and skills of academics, who are instructors in higher education institutions, towards the use of digital technologies. As role models in strengthening digital literacy, academics should develop themselves in line with strategies that include elements of the digital age and more active learning, and be able to transfer these strategies to educational practices. Otherwise, it will not be possible to increase the quality of education and it is inevitable for academicians to experience career dissatisfaction with the feeling of failure. Despite the importance of the subject, digital literacy of academicians has not been adequately addressed in the literature and the relationship between academics' digital literacy levels and career satisfaction has not been focused. Based on this gap, in this study, the concept of "digital literacy" is handled specifically for academics working in universities operating in Istanbul, Türkiye, and it is aimed to contribute to the literature by revealing the relationship between academics' digital literacy and career satisfaction. The cross-sectional survey method, a quantitative research technique, was utilized in the research as a data collection and analysis tool. For this purpose, the data collected through questionnaires from 304 academics with a simple random sampling method were analyzed. As a result of the analysis, it was found that academics' digital literacy explained the career satisfaction variable by 28.1% at a 0.01 significance level. Finally, the significant positive relationship between academics' digital literacy and career satisfaction can be interpreted as that academics who cannot develop digital literacy skills and transfer these skills to teaching environments will not be able to achieve career satisfaction by experiencing a sense of failure because they cannot provide an education in line with the expectations of the digital age. In addition, according to the research findings, it was found that the digital literacy and career satisfaction levels of the academicians differ according to age, working time, academic title, and having a personal web page.

Keywords: Digital Literacy, Academics, Digital Literacy in Academia, Career Satisfaction, Digital Literacy Level of Academics

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Akademisyenlerin Dijital Okuryazarlik Düzeyi ve Kariyer Tatmini

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Öz

Teknoloji, her alan gibi eğitim kurumlarını da etkilemektedir. Yeni bilgi yaratımının ve yayımının temel kaynağı olan yükseköğretim kurumları artık dijital teknolojilerin hakimiyetindedir. 21. yüzyıl yetkinlikleri arasında yer alan dijital okuryazarlık becerisinin bireylere kazandırılması ise öncelikle yükseköğretim kurumlarında eğitmen olan akademisyenlerin dijital teknolojilerin kullanımına yönelik tutum ve becerilerinin olumlu olması ile mümkündür. Dijital okuryazarlığın güçlendirilmesinde rol model olarak akademisyenler, dijital çağın unsurlarını içeren ve daha aktif öğrenmeyi barındıran stratejiler doğrultusunda kendini geliştirmeli ve bu stratejileri eğitim uygulamalarına aktarabilmelidir. Aksi halde eğitim kalitesinin artması mümkün olamayacağı gibi akademisyenlerin başarısızlık hissi ile kariyer tatminsizliği yaşamaları da kaçınılmazdır. Konunun önemine rağmen, alan yazında akademisyenlerin dijital okuryazarlığı yeterince ele alınmamış ve akademisyenlerin dijital okur yazarlık düzeyleri ile kariyer tatminleri arasındaki ilişkiye odaklanılmamıştır. Bu boşluktan yola çıkılarak bu çalışma ile "dijital okuryazarlık" kavramı, Türkiye'nin İstanbul ilinde faaliyet gösteren üniversitelerde görev yapan akademisyenler özelinde ele alınmakta, akademisyenlerin dijital okuryazarlıkları ile kariyer tatminleri arasındaki ilişki ortaya konularak literatüre katkı sağlamak amaçlanmaktadır. Araştırmada veri toplama ve analiz yöntemi olarak nicel araştırma tekniklerinden kesitsel tarama yöntemi kullanılmıştır. Bu amaçla, basit tesadüfi örneklem belirleme yöntemi ile 304 akademisyenden anketler aracılığıyla toplanan veriler analiz edilmiştir. Analiz sonucunda, akademisyenlerin dijital okuryazarlığının kariyer tatmini değişkenini % 28,1 oranında açıkladığı 0.01 anlamlılık seviyesinde bulunmuştur. Akademisyenlerin dijital okuryazarlığı ve kariyer tatmini arasında bulunan pozitif yönlü anlamlı ilişki, dijital okuryazarlık becerisini geliştiremeyen ve bu becerileri öğretim ortamlarına aktaramayan akademisyenlerin, dijital çağın beklentileri doğrultusunda bir eğitim sunamadıkları için başarısızlık hissi yaşayarak kariyer tatminine ulaşamayacakları şeklinde yorumlanmaktadır. Ayrıca araştırma bulgularına göre, akademisyenlerin dijital okuryazarlık ve kariyer tatmin düzeyi yaşa, çalışma süresine, akademik ünvana ve kişisel web sayfasının olma durumuna göre farklılaştığı da bulgulanmıştır.

Anahtar Kelimeler: Dijital okuryazarlık, Akademisyenler, Akademide Dijital Okuryazarlık, Kariyer Tatmini, Akademisyenlerin Dijital Okuryazarlık Düzeyi

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Introduction

In the 21st century, it is known that education and training are changing rapidly with the effect of technology, and this change affects the trainer/teacher/academics. Traditional literacy education covers essential reading, writing, listening, and speaking skills. However, today's digital echo requires these skills to have a broader meaning. Therefore, it is not sufficient for academics who train the workforce of the future to have only basic literacy skills; they also need high-level technology skills. In other words, academics are expected to make effective use of information and communication technologies by having 21st-century skills. For academics, digital literacy means understanding the content better and accelerating technological learning processes using data analysis tools. In addition, using technology in educational environments enables the development of digital literacy information, media, and technology skills (Holum & Gahala, 2001, p.4). In today's highly competitive markets, digital literacy is a life skill everyone should have. Digital literacy means that a person can create, manage, and collect information in digital environments and transform this information into a usable form.

On the other hand, it is not easy to be sure that students, academics, and university administrative staff are digitally literate in higher education institutions, which are the primary source of new knowledge production today. Therefore, research to determine the digital literacy levels of academics is necessary to plan applications for the technology development of digital literacy skills in higher education institutions. The more positive the attitudes of academics working in universities, which are the primary producers and disseminators of knowledge, towards the use of ICT (information communication technologies), the more efficient the use of such technologies in their teaching will be (Guillén-Gámez&Mayorga-Fernández, 2020, p.3). On the other hand, academics who cannot develop digital literacy skills in line with the expectations of the digital age and cannot transfer these skills to teaching environments will not be able to provide an education that meets the requirements of the age and will not reach career satisfaction by experiencing a feeling of inadequacy.

Based on these predictions, the study aims to determine the digital literacy levels of academics and to examine the relationship between digital literacy levels and career satisfaction variables. In this study, the effects of digital literacy of academicians on career satisfaction are examined by considering the variables of "digital literacy" and "career satisfaction", which have been little studied in the literature. The absence of a study that focused directly on the relationship between digital literacy of academics and career satisfaction in previous studies makes this study rare and important. The following part of the study is organized: First, the concept of digital literacy is framed, and the dimensions identified in the technology on digital literacy are discussed. Then, the related technology on digital literacy in higher education institutions, digital literacy of academics, and career satisfaction is reviewed. Then, the study's methodology and findings are given, and the study ends with discussion, practical implications, limitations and future studies, and conclusion.

Literature Review

Digital Literacy: Development and Dimensions

The capacity to use information and technology obtained via digital technologies is known as digital literacy. People who are digitally literate exhibit advanced critical thinking abilities, including investigating, speculating, solving problems, and making decisions (Yildiz, 2020, p.470). Digital literacy is the ability of individuals to use digital tools and resources effectively, evaluate, analyze, create knowledge, and communicate with others. This ability is based on using digital tools and understanding how to evaluate digital data. The ability to read and write through digital tools is also part of the definition of digital literacy (Maden et al., 2018, p.686).

Although the concept of digital literacy has gradually started to enter human life as personal products with the invention of the telegraph, telephone, radio, television, ENIAC, the first computer, and the first mobile phone, which are known as the ancestors of digital tools, the first known definition was made by Gilster in 1997. This definition defines digital literacy as "the ability of individuals to understand, interpret, and evaluate information in digital environments." Although the concept of digital literacy has not emerged suddenly, Gilster's definition is the most widely accepted one (Ozden, 2018, p. 27). Moreover, over time, digital transformation, such as digital use, innovation, and creativity, which includes technologies and disciplined practices, as well as digital competence, has been added to the definition of digital literacy (Gunay & Ozden, 2022, p.166).

On the other hand, using technology at the highest level cannot be defined as digital literacy. High-level critical thinking skills, such as research, questioning, and problem-solving skills, are required to be digitally literate. In technology, it is stated that digital literacy is a more comprehensive concept beyond using devices such as computers and tablets, mastering the software on these devices, and being a practical user (Karabacak & Sezgin, 2019, p.327). With digital literacy, people also gain the skills of using and transferring the information they have acquired and critically evaluating the information they have gained. People with these skills become more advantageous than others over time. For example, when we look at job postings in different sectors, expressions such as perfectly executed office programs, analytical thinking, etc., indicate digital literacy (Yildiz, 2020, p.470). Today, digital literacy includes making sense of digital activities by including social, cultural, and political contexts. In this direction, the concept of digital literacy consists of three levels (Gunay&Ozden, 2022, p.166):

* Digital Competence (skills, concepts, approaches, attitudes),

* Digital Usage (technologies/discipline applications),

* Digital Transformation (innovation, creativity).

"Digital competence" at the first level does not replace traditional forms of literacy; it represents only one of the new forms of contemporary literacy in the 21st century. The concept of digital competence has emerged in the last decade. It is the ability to read and understand digital, hypertext, and multimedia texts and use information technologies (Selimi&Useini, 2019). The second level, "digital use," is related to applying digital skills in a technological context. Finally, at the third level, "digital transformation" is a concept that refers to the process of developing and changing workflows and culture by finding solutions to social and sectoral requirements through the addition of digital technologies. Innovation and creativity are at the center of digital transformation (Gunay&Ozden, 2022, p.166).

In the European Commission's "Framework for Digital Competence and New Models," digital literacy is organized into different dimensions, which encompass various knowledge, skills, and attributes. These dimensions include the 'components of 'digital competence,' 'information and data literacy,' 'communication and collaboration,' 'digital content creation,' and 'security and problem-solving' (Yildiz, 2020, p.470). Another categorization by Payton & Hague (2010, p.6) presents eight headings that represent the dimensions of digital literacy, as depicted in Figure 1.

Figure 1. Dimensions of Digital Literacy

Source: Payton, S., & Hague, C. (2010). *Digital literacy in practice: case studies of primary and secondary classrooms*. Futurelab.

First and foremost, creativity includes inventive and creative thinking as well as the capacity to use technology to produce outputs and portray data in many kinds and formats.The critical thinking and evaluation dimension refers to using reasoning skills to engage with, question, analyze, examine, and evaluate digital media and content and formulate and support arguments about its use. The cultural and social understanding dimension refers to the ability to recognize social and cultural influences in the creation of digital content, while the collaboration dimension focuses on the ability to create shared meaning and understanding by collaborating with others.The skill of locating and choosing information involves recognizing the specific information required for a task or activity, understanding the methods and locations for accessing information, engaging in a critical evaluation of sources to determine their relevance, credibility, and worth, and demonstrating awareness of issues related to plagiarism, copyright, and intellectual property.Effective communication means expressing ideas and feelings clearly in a way that others can comprehend them. The e-safety dimension involves ensuring safety while using digital technologies such as the internet and mobile phones, as well as understanding appropriate usage and content. Lastly, the functional abilities dimension refers to possessing the knowledge and competence to proficiently utilize various technologies, as well as the flexibility to adapt this knowledge to learn new Technologies (Payton & Hague, 2010, p.6). Increasing the digital literacy skill level of the person

towards these dimensions will positively contribute to the gain and impact that the person will create in return for the time spent on digital platforms.

Academics, like many other professional organizations, place a high value on digital literacy. Considering that academics are expected to be digitally literate and to teach their students these abilities both formally and informally. Teachers and academics should be capable of instructing students on why and how to use technology through the usage of technology in the classroom (Gulay et al., 2022, p.238).

Digital Literacy in Higher Education and Academics

By manifesting its influence in education as well as in many other disciplines, digitalization brings about substantial changes. The Covid-19 pandemic in recent years, along with the capabilities provided by information and communication technologies and the distant learning system, have rearranged daily habits, making the incorporation of digitalization into education the center of attention (Sezgin&Karabacak, 2020, p.19). The ways of teaching and learning in traditional educational settings have changed, and today's education demands to focus on developing social skills, communication, creative thinking, and adaptability rather than just "knowing" (Khan et al., 2022, p.47). Transition to contemporary learning environments in higher education institutions, which are the greatest creators and spreaders of knowledge, is characterized by the following changes in the education system's learning, teaching, and management (Dinevski&Kokol, 2004):

- From the trainer who is the transmitter to the trainer who is the facilitator,
- From uniform teaching to personalized teaching,
- From instructions to building and exploring,
- From school to lifelong learning,
- From linear to hyperlearning,
- From content adoption to learning how to manage and learn content,
- The transition from forced learning to learning as fun.

For universities to fulfill their duties in the new age, academics are expected to keep up with these changes and, even more so, to foresee the future (Ayyildiz et al., 2021, p.17). As the transition to student-centered learning requires academics to act as guides and facilitators, there is an "evolution in learning" through the rise of competency-based education that tailors the academic experience to students' needs (Becker et al., 2018).

Every stakeholder, including students, academic institutions, and industry actors, must be ready to tackle constantly evolving technologies and ways of doing things with a strong willingness to learn and relearn due to the rapid pace of the digital age(Khuraisah et al., 2020). In the 21st century, the ability to interpret digital, visual, and audio media has become a primary type of literacy for all segments (Khan et al., 2022, p.56). In today's digital information societies, digital literacy skills are necessary for almost every line of work(Khuraisah et al., 2020). Future demand projections for general digital skills for business environments point to the significance of 21st-century talents, especially "interpersonal skills," "cognitive competencies," and "learning strategies," is growing(Kispeter, 2018). The digital literacy skill, which is required in the business environments of our age, appears as a type of skill that should be taught to students in

higher education institutions. However, no appropriate framework or guideline can be used as a blueprint for higher education institutions to prepare their graduates for the 21st-century workforce (Khan et al., 2022, p.46). On the other hand, it has been understood how necessary it is for all educators/academics who take part in all stages from early childhood to postgraduate education to have digital literacy skills during the Covid-19 pandemic. In distance education processes and face-to-face education periods, digital literacy creates almost unlimited options for alternative education approaches and resources that can be used to achieve the educational goals aimed at students (Gulay et al., 2022, p.245).

Having a different mindset that can adjust to new requirements with ever-changing technologies can help acquire digital literacy abilities(Coiro et al., 2008). Having this mentality makes it essential for academics who set out with the vision of raising qualified individuals, to have digital literacy and to be able to use this qualification for both learning and teaching. For academics to be digitally literate has deep meanings, such as having digital self-confidence, being competent users of digital technologies inside and outside the classroom, contributing to the development of workspaces by researching in digital environments, and being a role model for students, most of whom are digital natives (Ayyildiz et al., 2021, p.17). In other words, as role models in empowering digital literacy, academics should be able to teach their students such skills and acquire the basic literacy necessary to access, critically manage and evaluate information, create and share digital content (Esteve-Mon et al., 2020). Today, only academics with digital literacy can act as successful leaders, freeing their classes from being confined to a narrow space and motivating students toward the lesson (Gulay et al., 2022, p.238). In addition, they can train students to help them build the capacity to benefit from digital resources and information in safe, secure, and sustainable ways (Falloon, 2020).

Although there are some studies in the literature on the use of technology in education and academics' digital literacy abilities(Saeed et al., 2022; Cote&Milliner, 2018; Keles et al.,2018; Falloon, 2020; Guillén-Gámez&Mayorga-Fernández,2020;Isik et al., 2021; Gunay&Ozden, 2022), understanding of the various skills that include digital literacy and how to apply them to higher education settings (Kispeter, 2018), how to design a learning environment to improve students' digital literacy (Kaeophanuek et al., 2018) more research needs to have been done. Although academics are aware of the importance of using ICT in every aspect of university education, they still cannot use it adequately (Gunay&Ozden, 2022; Guillén-Gámez&Mayorga-Fernández, 2020). However, academics should adopt the most appropriate techniques, teaching methods, and assessments that encourage students to develop their thinking processes and question, discuss and create projects using proper digital tools (Kaeophanuek et al., 2018). From this perspective, it becomes necessary to make studies on how academics might improve their digital literacy skills(Goodwin-Jones, 2016; Santiago Campión&Sánchez-Compaña, 2021).

Academics Career Satisfaction and Digital Literacy

Career satisfaction is the positive emotions and attitudes that individuals have and express as a result of improving their professional skills and contributing to the development of their institutions and professions (Shawer, 2010). Factors such as salary, promotion, and growth expectations for an individual's career constitute career satisfaction (Kocoglu, 2012; Vatansever, 2008).On the other hand, technological changes

in the organization and its environment affect career satisfaction by affecting people's attitudes and causing career changes (Kocoğlu, 2012).

Developing technology is rapidly transforming the academic profession, like all occupations. Today, academics are expected to employ a variety of technological tools, including digital learning resources and courseware, as well as active learning techniques like project- and problem-based learning (Khan et al., 2022, p.47). However, academics, who cannot improve themselves in line with strategies that include the elements of the digital age and include more active learning, cannot transfer these strategies to educational practices, will not be able to improve the quality of education, and will inevitably experience professional dissatisfaction with a sense of failure (Kılınc et al., 2021). This situation can be explained by "Role Theory." According to the Role Theory, if the employees do not have sufficient knowledge and experience required by their position, this situation will bring dissatisfaction, increase anxiety, and decrease their performance (Rizzo et al., 1970).

Academics are not usually properly motivated or compensated to improve their teaching abilities since higher education institutions are frequently structured in ways that favor research above teaching (Becker et al., 2018). However, training and development opportunities offered to individuals and institutional support are essential factors affecting their career satisfaction (Armstrong-Stassen&Ursel, 2009; Kocoğlu, 2012). Furthermore, studies focusing on career satisfaction reflect that organizational support motivates individuals to reach their career goals and increases their career satisfaction (Alay, 2020). Conversely, lack of administrative support is associated with negative variables such as stress, burnout syndrome, and increased intention to leave (Aarons et al., 2009). In addition, it is known that employees with low career satisfaction mostly experience the feeling of burnout (Shanafelt et al., 2009).

Programs that recognize effective teaching approaches are becoming more and more vital as higher education shifts away from the conventional lecture-based structure and toward hands-on activities (Becker et al., 2018).Therefore, academics should engage in ongoing professional development in this area with the help of their institutions, just as there is a need to increase digital literacy among students(Becker et al., 2018). In this direction, Guillén-Gámez and Mayorga-Fernández (2020)'s study emphasizes that academics working at universities in Spain need to be motivated to increase their attitudes toward the use of ICT (Guillén-Gámez&Mayorga-Fernández, 2020).

Although numerous research has been conducted to disclose the levels of digital literacy among educators in the literature, it is evident that these studies often only analyze the levels of digital literacy among teacher candidates(Surjono et al., 2021; Yazıcıoglu et al., 2020; Rusydiyah et al., 2020; Kozan, &BulutOzek, 2019; Ocak&Karakus, 2019; Yontar, 2019). On the other hand, studies conducted on academics working at universities, which are the primary source of new knowledge creation, are limited (Dogan, 2022), and no study has been found in these studies that deal with the relationship between digital literacy and the career satisfaction of academics. In this respect, the study is believed to contribute to the literature.

In the current study, answers are sought for the following questions in line with the predictions made from the gap in the relevant literature:

- What is the digital literacy level of academics?
- Do digital literacy levels of academics show a significant difference according to gender, field of study, age, and academic titles?
- Is there a significant relationship between academics' digital literacy and career satisfaction?

Method

Model of the Research

The quantitative research methodologies relationship survey model was employed in the study.The screening model is the method used to reveal the situation of the problem to be investigated. Descriptive data is obtained through surveys, interviews, or observation (Fraenkel&Wallen, 2006). The research described digital literacy levels and academic career satisfaction with the single scanning model. With the relational scanning model, the differences in digital literacy levels and career satisfaction of academics in terms of gender, age, title, working time as academic staff, daily internet connection time, and having a personal web page were examined. Models for relational screening assess the relationship between two or more variables(Karasar, 2017). This study also examined the existence of a relationship between academics' digital literacy and career satisfaction.

Universe and Sample

The research universe consists of academics working at universities in Istanbul, Türkiye. Istanbul is home to 57 universities, 44 of which are foundation universities and 13 of which are governmental institutions. In the 2022-2023 academic year, the total number of academics working at state universities is 19539, while in foundation universities, 20462(https://istatistik.yok.gov.tr/). Survey data was collected online via Google Forms between November 2022—March 2023 using simple random sampling. While deciding on the sample size, the required sample size was determined as 381, and the number of people invited as 1905 by using the sample calculation formula in cases where the number of individuals in the population was known. The questionnaire form was sent to 2930 academics; 304 participants that answered the questionnaire and whose answers were considered valid were included in the analysis. The socio-demographic characteristics and other information of the academics participating in the research are given in Table 1.

Table 1. Socio-Demographical Characteristics of Academics

Socio-Demographic Variables		**Frequency**	**Percent %**
Gender	Male	173	56,9
	Female	131	43,1
	22-27	50	16,4
	28-33	32	10,5

Age	34-39	56	18,4
	40-45	88	28,9
	46-51	43	14,1
	52 and over	35	11,5
Title	Research Assistant	56	18,4
	Lecturer	16	5,3
	Specialist	12	3,9
	Lecturer (Ph.D.)	56	18,4
	Asst.Prof.	77	25,3
	Assoc. Prof.	54	17,8
	Prof.	33	10,9
Working time as an academic staff	1 month-2 years	25	8,2
	3-6 years	61	20,1
	7-10 years	111	36,5
	11-14 years	45	14,8
	15+ years	62	20,4
Daily internet connection time	up to 1 hour	26	8,6
	1-3 hours	66	21,7
	3-5 hours	129	42,4
	5+	83	27,3
Personal web page ownership	Yes	76	25,0
	No	228	75,0
Total		304	100

Data Collection Tools

Within the scope of the study, two measurement tools were used, the "Digital Literacy Scale" and the "Career Assessment Scale." The Digital Literacy Scale used in the research to determine the digital literacy levels of academics was developed by Ng (2012) and adapted into Turkish by Hamutoglu and colleagues (2017). The scale consists of 17 items and four factors (attitude, technical, cognitive, and social) and has a 5-point Likert-type rating as Strongly Agree (5), Strongly Disagree (1). As a result of the factor and reliability analyses, the questions related to the social dimension with low factor load were excluded from the analysis, and the digital literacy scale was handled as three sub-dimensions.

The second measurement tool used in the study is the "Career Satisfaction Scale," developed by Greenhaus et al. (1990). The scale consists of 5 items and has a 5-point Likert-type rating.

Analysis of Data

Descriptive statistics were used for the digital literacy levels and career satisfaction of the academics participating in the research. Kolmogorov-Smirnov test results were examined to decide whether the data were normally distributed. In the Kolmogorov-Smirnov test results obtained from both measurement tools, it was observed that the significance value was $p<0.05$. In order to decide the normal distribution of the data, the Skewness-Kurtosis test results were examined, and it was seen that Skewness=-0.14 and Kurtosis=-0.47 on the digital literacy scale, and Skewness=0.83 and Kurtosis=1.09 on the career satisfaction scale. According to Tabachnick and Fidell (2013), it is believed that the data are regularly distributed when the Skewness and Kurtosis values are between -1.5 and +1.5. In light of this, it was decided to use parametric tests, presuming that the data used in the studies were normally distributed.

Digital literacy levels and career satisfaction of academics; independent samples t-test and one-way analysis of variance (ANOVA) were applied to determine the differences between the variables of gender, age, title, working time as academic staff, and having a personal web page. The relationship between academics' digital literacy levels and career satisfaction was determined by the Pearson Correlation Coefficient (r). SPSS.21 package program was used in the analysis of the data. Research hypotheses were interpreted with a confidence interval of 0.95 (p=.05).

Findings

In the study, firstly, factor analysis was applied to the variables to test the construct validity. Kaiser-Meyer-Olkin (KMO) test was used to measure sample adequacy in factor distribution. The KMO ratio above 0.5 indicates that the data set is suitable for factor analysis (Cinko et al.,2012:54). The alpha model was used for reliability analysis. A Cronbach Alpha value of 0.70 and above indicates that the scale is reliable. In this study, the Cronbach alpha value was 0.911 for digital literacy and 0.918 for career satisfaction.

The descriptive statistics of the digital literacy levels and career satisfaction perceptions of the academics participating in the research are given in Table 2.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Digital Literacy Scale	304	2,53	5,00	4,0274	,53695	,288
Attitude	304	1,60	5,00	4,0178	,62623	,392
Technical	304	1,57	5,00	3,9751	,67296	,453
Cognitive	304	2,67	5,00	4,1656	,57128	,326
Career Satisfaction Scale	304	1,20	5,00	3,7947	,68494	,469
Valid N (listwise)	304					

Table 2 explains that attitude (=4.01), technical (=3.97), cognitive (=4.16), and digital literacy-general (=4.02) based on the average of the overall and sub-dimension scores obtained from the Digital Literacy scale are seen to have an average. Furthermore, according to the general average obtained from the Career Satisfaction Scale, it is seen that career satisfaction has an average of (=3.97).

To ascertain the distinctive impact of the academics' gender on the variables, an independent sample t-test was used. Table 3 below shows the results that were achieved.

Table 3. The Differential Effect of Academics' Gender and Web Page Ownership on Variables

Gender		**N**	**Mean**	**Std. Dev.**		**t**	**p**
Digital Literacy	**Women**	173	4,0451	,53993	≠Variance	0,659	0,510
	Men	131	4,0041	,53415			
Career Satisfaction	**Women**	173	3,7387	,69563	≠ Variance	-869	0,099
	Men	131	3,8687	,66600			
Web Page Ownership		**N**	**Mean**	**Std. Dev.**		**t**	**p**
Cognitive Digital Literacy	**Yes**	76	4,2807	,59143	≠Variance	2,039	0,042
	No	228	4,1272	,56049			
Career Satisfaction	**Yes**	76	3,9474	,76480	=Variance	2,258	0,025
	No	228	3,7439	,65005			

As seen in Table 3, the gender of academics does not have any differentiating effect on digital literacy and career satisfaction. On the other hand, cognitive digital literacy and career satisfaction differ according to the academics having a personal web page. Cognitive digital literacy and career satisfaction levels of academics with a personal web page are higher than those without.

ANOVA was applied to determine the differential effect of academics' age on digital literacy and career satisfaction levels. The results obtained are shown in Table 4 below.

Table 4. Differentiating Effect of Academics' Age on Variables

	Age	N	Mean	Std.Dev	F	Sig.
Digital Literacy	21-27	50	4,2587	,35113	4,231	0,001
	28-33	32	4,0229	,47823		
	34-39	56	4,1262	,58792		
	40-45	88	3,9561	,50579		
	46-51	43	3,9736	,58953		
	52+	35	3,7886	,60811		
Career Satisfaction	21-27	50	3,9840	,43301	3,25	0,007
	28-33	32	3,6438	1,09041		
	34-39	56	3,7429	,68619		
	40-45	88	3,6295	,61066		
	46-51	43	3,9163	,69588		
	52+	35	4,0114	,54437		

As seen in Table 4, academics' digital literacy and career satisfaction levels differ according to age. Tukey and Scheffe tests from Post Hoc tests were used to determine the difference between age groups. Academics aged 21-27 have a higher digital literacy than academics aged 52 and over. However, it was found that career satisfaction levels were higher in academics aged 52 and over. This situation is related to the perceived satisfaction level with increased titles in higher education institutions.

ANOVA was applied to determine the differential effect of academics' titles on digital literacy and career satisfaction levels. The results obtained are shown in Table 5.

Table 5. Differentiating Effect of Academics' Titles on Variables

	Title	N	Mean	Std.Dev	F	Sig.
Digital Literacy	Research Assist.	56	4,3036	,38663	3,648	0,002
	Lecturer	16	3,9875	,64370		
	Expert	12	4,2000	,62732		
	Dr lecturer	56	3,9560	,57914		

	Asist. Prof.Dr.	77	3,9359	,46232		
	Associate Prof.	54	3,9716	,51909		
	Professor	33	3,9414	,65251		
Career Satisfaction	Research Assist.	56	3,8107	,71800	7,915	0.000
	Lecturer	16	3,1750	,94057		
	Expert	12	3,5333	,76436		
	Dr. lecturer	56	3,7607	,69849		
	Asist. Prof.Dr.	77	3,6260	,58790		
	Associate Prof.	54	3,9889	,51310		
	Professor	33	4,2970	,48250		

satisfaction levels of academics differ according to the title. Tukey and Scheffe tests from Post Hoc tests were conducted to determine which titles differed. According to the findings, academics with the title of research assistant have a higher level of digital literacy than academics with the title of Professor. However, it has been found that the level of career satisfaction is higher in academics with the title of Professor. It was observed that the lowest career satisfaction was among the lecturers.

ANOVA was applied to determine the differential effect of working time as academic staff on digital literacy and career satisfaction levels. The results obtained are shown in Table 6.

Table 6. Differential Effect of Working Time as Academic Staff on Variables

	Working Time as Academic Staff	N	Mean	Std.Dev	F	Sig.
Digital Literacy	1 month-2years	25	4,3867	,22852	3.750	0,005
	3-6 years	61	4,0863	,53143		
	7-10 years	111	3,9682	,56888		
	11-14 years	45	3,9822	,48145		
	15+ years	62	3,9634	,56086		
Career Satisfaction	1 month-2years	25	4,0080	,43390	2,087	0.082
	3-6 years	61	3,6361	,82745		
	7-10 years	111	3,7459	,67794		
	11-14 years	45	3,9067	,63332		
	15+ years	62	3,8710	,63359		

As seen in Table 6, the digital literacy level of academics differs according to working time, but there is no difference in the level of career satisfaction. The digital literacy level of academics with a working period of 1 month and 2 years is higher than those with a working period of 15 years or more.

The research model's hypotheses were put to the test using correlation and regression analyses. Correlation is the coefficient showing the strength of the linear relationship between two variables. If the correlation coefficient is statistically significant, it is said that there is a linear relationship between the two variables. The strength of the association between the variables increases with the absolute magnitude of the correlation coefficient (Newbold, 2009:321). Regression analysis, on the other hand, tries to determine how one variable (dependent) is explained by another variable(s) (independent). Obtained regression models show the direction and effect level of the relationship for the variables (Durmus et al., 2012: 154). The correlation coefficients and statistics between the research variables are shown in Table 7.

Table 7. Results of correlation coefficients between variables

		Digital Literacy	Attitude	Technical	Cognitive	Career Satisfaction
Digital Literacy	Pearson correlation	1				
	Sig. (2-tailed)					
	N	304				
Attitude	Pearson correlation	,807**	1			
	Sig. (2-tailed)	,000				
	N	304	304			
Technical	Pearson correlation	,909**	,535**	1		
	Sig. (2-tailed)	,000	,000			
	N	304	304	304		
Cognitive	Pearson correlation	,725**	,495**	,547**	1	
	Sig. (2-tailed)	,000	,000	,000		
	N	304	304	304	304	
Career Satisfaction	Pearson correlation	,361**	,324**	,339**	,302**	1
	Sig. (2-tailed)	,000	,000	,000	,002	
	N	304	304	304	304	304
**. Correlation is significant at the 0.01 level (2-tailed).						

Table 7 shows the results of the correlation analysis applied to the digital literacy and career satisfaction variables in the research model. The results show a significant positive correlation between digital literacy and career satisfaction. Considering the absolute values of the correlation coefficients, it has been determined that academic career satisfaction is associated with digital literacy and its sub-dimensions at a low level. After the correlation analysis, multiple regression analysis was conducted to determine the effect of digital literacy on career satisfaction. Summary analysis results are given in Table 8.

Table 8. Regression Analysis Results Regarding the Research Model

	Digital Literacy		**Technical Digital Literacy**	
	Beta	t (p-value)	Beta	t (p-value)
Career Satisfaction	0.361	0.00	0.339	0.00
F	27.453		23.234	
R^2	0.281		0.212	
Adjusted R^2	0.264		0.188	
Standard Error	0.726		0.742	

As seen in Table 8, it was found at 0.01 significance level that the digital literacy of academics explained the career satisfaction variable by 28.1%. On the other hand, technical digital literacy explains career satisfaction by 21%. In other words, provided that other conditions remain constant, the academics' digital literacy level directly affects their career satisfaction.

Discussion and Conclusion

This study, which focuses on the digital literacy levels and career satisfaction of academics, revealed interesting and important findings. The study seeks to examine the digital literacy levels of academics and understand how it affects career satisfaction. For this purpose, the data collected through the scales were interpreted by subjecting them to statistical analysis. The findings showed that the digital literacy of academics is effective in career satisfaction. Furthermore, it has been determined that academic staff also include information and communication technologies in their professional life and care about digital literacy. In this context, academics with digital literacy skills experience more career satisfaction thanks to their ability to use digital technologies effectively. In today's world, where digital technologies are advancing rapidly, having digital literacy skills also increases the quality of education in higher education institutions (Karabacak&Sezgin, 2019, p.329). As a result, higher education institutions should prioritize digital literacy and provide opportunities for their employees to develop digital skills.

The results of this study indicate a positive relationship between digital literacy and career satisfaction. Nevertheless, it was determined that academics' career satisfaction was associated with digital literacy and its sub-dimensions at a low level (0.361). This is likely due to the fact that the factors affecting the career satisfaction of individuals are not limited to one dimension. In addition, the findings provide various evidence on the relationship between the socio-demographic characteristics of academics and digital literacy and career satisfaction.

According to the findings regarding the career satisfaction of academics, it is seen that the "age" factor affects career satisfaction among academics. People often go through different age periods throughout their careers and may have different expectations, goals, and priorities for each period. Therefore, career advancement can be a source of high motivation and satisfaction for a young person, while work-life balance and retirement plans can be necessary for an older person. Indeed, the existing literature supports this result(Judge & Higgins, 1999;Rasdi et al. 2011). With this viewpoint, the higher career satisfaction levels of experienced academics are related to the success and satisfaction they have achieved throughout their careers. In addition, young academics with low career satisfaction levels should be supported in terms of career satisfaction. At this point, universities can develop career support-mentoring programs that support young academics in planning their careers and determining their goals and opportunities for advancement.

As stated by Alay (2020), organizational support affects the career satisfaction level of employees. In addition, experienced, career-satisfied academics can share experience and knowledge by mentoring their young colleagues. Providing mentoring to young academics can increase their career satisfaction levels and help them steer their careers more effectively. Universities can develop practices that encourage cooperation and communication between academics of different age groups. These practices can benefit young academics' career satisfaction by facilitating the guidance and knowledge sharing of experienced academics with their young colleagues. However, contradictory findings have yet to be reached in the literature. Although a previous study revealed that young employees' career satisfaction levels are high (Yap et al., 2010), in a later study, it is stated that career satisfaction levels decrease in middle ages and increase again with age (Peluchette, 1993). In our study, the finding that the career satisfaction of academics with the title of professor is high is supported by the literature. However, studies also show that age is unrelated to career satisfaction (Ng et al., 2005; Punnett et al., 2007).

On the other hand, our research found that the digital literacy of young academics (research assistants between the ages of 21-27) is higher than that of experienced (52 and over Professors) academics. Considering the fact that the younger generation, which was emphasized in previous studies, follows the digitalization process and technological developments closely and is more open to learning, it is thought that the generation gap is a determining factor (Ivanova et al., 2020; Brink et al., 2020; Henderson et al., 2017).

There was no relationship between the gender of the academics and career satisfaction. When the literature is examined, the findings obtained in studies examining the relationship between career satisfaction and gender differ due to the selected sample. For example, while it was found that the career satisfaction of those working in the public sector differs according to gender (Rasdi et al., 2011), the career satisfaction of women working in banking and finance is higher than men (Yap et al., 2010), in another study examining workaholism and career satisfaction, no relationship was found between gender and career satisfaction (Ulukok &Akın, 2016). A similar result is valid for digital literacy. The gender of academics does not have a differentiating effect on digital literacy.

The interesting finding of the study is that lecturers exhibit the lowest career satisfaction. This result may be related to the importance of the lecturer position in higher education institutions and the particular expertise of the person working in this title. Therefore, this

finding we obtained for lecturers is interpreted as a detailed examination of factors (workload, limited advancement opportunities, or other contextual factors specific to the lecturer role) that can contribute to career satisfaction for lecturers.

Within the scope of the research, it has been found that those with the highest career satisfaction are the academics with the title of professor. On the other hand, when the differentiating effect of academic titles on digital literacy was examined, it was found that academics with the title of research assistant had the highest digital literacy level. In contrast, those with the title of professor had the lowest level of digital literacy. As educators, academics must closely follow technological advances with the use of ICT, which is necessary for the digital age (Triana & Nugroho, 2021)—adopting lifelong learning as a philosophy, which are the primary conditions of digital literacy, knowing where, when, how to use and how to obtain information are essential for academics to keep up with the rapid development of science and technology (Tezer & Aynas, 2018; Fauzan et al., 2022). However, according to Günay and Özden's research from 2022, academics at different state universities in Türkiye perceive distance learning and digital literacy as being closely related, and some of the academics feel lacking in functional skills. They also perceive the boundaries of digital literacy to be ambiguous. In addition, it has been determined that the digital literacy level of academics with shorter working hours is higher. This conclusion might be explained by the fact that young academics who have just entered the academic world tend to be more familiar with digital technology. Also, our research findings revealed that academics with a personal web page exhibited higher cognitive digital literacy and career satisfaction than those without a personal web page. Therefore, this finding can be interpreted as having a personal web page and actively interacting with online platforms can increase both digital literacy skills and career satisfaction among academics.

As a result, the digital literacy of academics impacts their career satisfaction. This finding also coincides with the results of a rare number of previous studies conducted in this context. For example, a study conducted with academic library staff in Nigeria discovered that digital literacy skills, which are vital for employees, increase individual job satisfaction and career progression (Adekola, 2011). Same results have been obtained in a study conducted with the instructors of a university in Indonesia. In addition to the willingness of the instructors to adapt to the e-learning system, policymakers' attitudes at the university level are also effective in the high level of digital literacy (Ninaus et al., 2021).

Practical Implications

Our research findings add to the existing literature on digital literacy and career satisfaction among academics and provide a basis for practical implications in this field. In addition, it aims to examine the relationship between the digital literacy of academics and career satisfaction and offers various suggestions to policymakers in universities.

The capacity to access, organize, analyze, create new information, and use digital technology to communicate in digital literacy is considered one of the 21st-century abilities. There is no doubt that technology has come under the dominance of digital technologies by causing significant changes in educational institutions as well as in every field. These conditions require higher education institutions, the primary source of new

knowledge creation and dissemination, to complete their digital transformation quickly. Achieving this transformation is possible with the positive attitudes and skills of academics as instructors in higher education institutions towards the use of digital technologies. The more positive the academics' attitudes toward adopting digital technologies and using them in their teaching, the more efficient the educational environments will become (Zhao et al., 2021). On the other hand, academics who cannot develop their digital competencies in line with the expectations of the 21st century will be in the position of individuals who cannot satisfy their digital native students and cannot achieve career satisfaction due to the feeling of inadequacy they experience.

Since employees with career satisfaction feel optimistic about their careers, they can reflect these feelings into practice and develop their careers. Therefore, it may be possible for academics with good digital literacy to reach career satisfaction faster in the digital age and transfer these positive attitudes and skills to the teaching environment. Organizational support emerges at the point of gaining this competence in academics. Since organizational support is seen as one of the essential precursors of career satisfaction and positively related to career satisfaction, training, and development practices adapted to the needs of employees are essential for perceptions of organizational support and career satisfaction (Armstrong-Stassen &Ursel, 2009). In this direction, higher education institutions are expected to support academics by presenting a development map so that they can integrate technology into their teaching approaches in the digital age. Furthermore, continuous in-service training activities can be organized through cooperation with expert institutions to raise the awareness of digital literacy among academics and increase their skills on this subject. These educational activities can be designed for both learning and teaching.

Limitations And Future Studies

The current research has some limitations. First of all, the scope of the research is limited to foundation universities in Istanbul, Türkiye. Future research in different regions and countries may enable us to evaluate the impact of contextual factors on our results. Moreover, in future studies, examining the key factors that lead to lower career satisfaction among lecturers with a qualitative study will provide a deeper understanding of the challenges faced by academics with this academic title and provide potential interventions to increase career satisfaction. In the future, researchers can conduct longitudinal studies examining changes in digital literacy and career satisfaction. Thus, presenting an idea about these variables' dynamics can contribute to determining the factors affecting the development and maintenance of digital literacy skills and career satisfaction among academics.

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2023, 12 (4), 2388-2410 | Research Article

Systematic Literature Review of Publications on Digital Twin Topics in Certain Research Areas

Rabia ÖZAT [1] **Mualla AKÇADAĞ** [2]

Abstract

One of the key strategies adopted by companies that wish to compete in a sustainable fashion is the idea of the digital twin, which combines the physical product with virtual technology. The development of production models, cost reduction, and keeping up with shifting client wants and needs all depend on the digital twin. In this way, organizations can exhibit a development trend by utilizing the advancements in information and communication technologies, by utilizing techniques like the internet of things, big data, artificial intelligence, and the digital twin, coupled with other technologies. The systematic organization of prior studies on this topic is considered beneficial in terms of both illuminating the present trend and directing future study because the digital twin has grown in importance as a result of the development and dissemination of technology in every field. In this paper, a thorough literature assessment of digital twin research is intended. Vosviwer analysis was used to examine 60 studies from the Web of Science database that were published for this reason. Data on author partnerships, keyword density, support status, institution, country, language, citation, year, publication type, and field of study were investigated using Vosviwer analysis using the Web of Science database. The concept of the digital twin gained popularity as of 2019 when the years in which the studies in the Web of Science database were published were looked at. It was known that the majority of the associated studies were published in the USA, as articles, and in English. The analysis revealed that the most often used keywords in the 60 studies on digital twin were data, digital twin, and industry. According to the survey, research is primarily conducted in fields like smart production, supply chains, and business economy. The systematic literature review has led to an understanding that, in contrast to the domains of smart production, supply chain, and business economics, other topics are less investigated in transportation, public administration, economics, and social sciences. Publishing in less researched regions will close the gap in the literature in this direction.

Keywords: Digitization, Digital Twin, Digital twin Techniques, Cythematics Literature Analysis, Bibliometric Analysis.

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2023, 12 (4), 2388-2410 | Araştırma Makalesi

Belirli Araştırma Alanlarında Dijital İkiz Konulu Yayınların Sistematik Literatür İncelemesi

Rabia ÖZAT [1] **Mualla AKÇADAĞ** [2]

Öz

Fiziki ürün ile sanal teknolojinin birleştirilmesinden oluşan dijital ikiz kavramı, sürdürülebilir rekabet etmek isteyen işletmelerin başvurduğu yeni yöntemlerden biridir. Maliyetlerin azaltılması, üretim modelleri geliştirmesi ve değişen müşteri istek ve ihtiyaçlarını karşılayabilme hızını yakalamada dijital ikiz kritik önem taşımaktadır. İşletmeler bu anlamda bilgi iletişim teknolojilerindeki gelişmelerden faydalanarak nesnelerin interneti, büyük veri, yapay zeka gibi yöntemleri dijital ikiz ile birlikte kullanarak gelişme trendi gösterebilmektedir. Her alanda teknolojinin gelişmesi ve yaygınlaşması sayesinde dijital ikiz önemini artırdığından bu konunun irdelendiği geçmişteki çalışmaların sistematik bir şekilde düzenlenmesinin hem mevcut eğilimin ortaya konulması hem de gelecekteki araştırmalara yön verilebilmesi açısından değerli olduğu düşünülmektedir. Bu kapsamda çalışma ile dijital ikiz konulu araştırmaların sistematik literatür incelemesi yapılması amaçlanmıştır. Bu amaçla yapılan çalışmada Web of Science veri tabanında yayınlanan 60 araştırma Vosviwer analizi ile incelenmiştir. Vosviwer analizi ve Web of Science veri tabanı kullanılarak yazar işbirlikleri, anahtar kelime yoğunluğu, desteklenme durumu, kurum, ülke, dil, atıf, yıl, yayın türü, çalışma alanı ile ilgili veriler incelenmiştir. Web of Science veri tabanındaki çalışmaların yayınlandığı yıllar incelendiğinde dijital ikiz kavramının 2019 yılı itibariyle ivme kazandığı görülmüştür. İlgili çalışmaların en çok İngilizce dilinde, makale olarak ve Amerika'da yayınlandığı anlaşılmıştır. Analiz sonucunda dijital ikiz konulu 60 çalışmada en çok veri, dijital ikiz ve endüstri anahtar kelimelerinin kullanıldığı bulgusuna ulaşılmıştır. Yine çalışma ile araştırmaların ağırlıklı olarak akıllı üretim, tedarik zinciri, iş ekonomisi gibi alanlarda yapıldığı saptanmıştır. Sistematik literatür incelemesi sonucunda akıllı üretim, tedarik zinciri, iş ekonomisi alanlarının aksine taşımacılık, kamu yönetimi, ekonomi, sosyal bilimlerde diğer konuların daha az çalışıldığı anlaşılmaktadır. Bu doğrultuda daha az çalışılan alanlarda yayın yapılması literatürdeki eksikliği giderecektir.

Anahtar Kelimeler: Dijitalleşme, Dijital İkiz, Dijital ikiz Teknikleri, Sistematik Literatür Analizi, Bibliyometrik Analiz.

Özat, R. & Akçadağ, M. (2023). Belirli Araştırma Alanlarında Dijital İkiz Konulu Yayınların Sistematik Literatür İncelemesi, *İnsan ve Toplum Bilimleri Araştırmaları Dergisi*, 12 (4) , 2388-2410 . https://doi.org/10.15869/itobiad.1344962

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Introduction

Utilizing technology, facilitating market entry and sustainability, adapting rapidly to changing conditions, improving operational performance, and offering innovative products and services are just a few of the ways that Industry 4.0 benefits organizations. The digital twin is one of the ideas that emerged with Industry 4.0. Grieves initially suggested the idea of a digital twin in 2003 when he unveiled the "Mirror of Information Model". According to Coralla et. al. (2021, p.24), Grieves defined a digital twin as a sensor-effective digital representation of a physical thing. Also digital twin referred to a life cycle that integrates all data with additional knowledge about physical assets (Hartmann & Auweraer, 2020, p.4).

Businesses can gain from the digital twin by improving the value of their market position, taking advantage of the synergy between production management, acquiring a competitive market, improving the efficiency of logistical operations, and speeding up the process of developing new products. Businesses that want to succeed in all of these industries can use the digital twin to their advantage by utilizing techniques like simulation, the internet of things, business models, know-how, and big data. Despite the fact that it was first utilized in the early 2000s, the number of research determining the effects on results obtained when digital twin technology is supported is limited. As a result, the goal of this study is to identify unused or underutilized areas by conducting a thorough literature evaluation of digital twin studies. In the digital twin investigation, a small number of literature reviews were discovered. It is believed that the digital twin is the focus of a certain area of research. Smart manufacturing (Warke, et. al. 2021; Corallo, et.al. 2021), smart buildings (Ghansah and Lu, 2023; Hou, et. al. 2023), and supply chain and logistics (Abideen, Sundram, Pyeman, Othman, and Sorooshian, 2021) are among these studies. According to the review, a study (Wang and Liu, 2022) is a literature review on the notion of digital twin. In this context, it is hoped that studies in the disciplines of economy, business, management, marketing, transportation, public administration, and other social sciences relevant to the notion of digital twin would be comprehensively examined.

In this part of the study, conceptual definitions are developed in this section of the study to explain the significance of the digital twin in light of the development of technology. The flow chart for the study is provided at the conclusion of the section that conceptualizes the digital twin. Within this framework, studies on digital twins were investigated and data were analyzed using Vosviwer in line with the bibliometric analysis sought after by the research. With the interpretation of the findings from the analysis of the collected data and recommendations for further investigation, the study was concluded.

Digital Twin Conceptual Framework

The digital twin is defined as a system that offers the appropriate degree of data at the appropriate time and establishes modeling by connecting the virtual world and information technologies (Hartman & Aureweraer, 2020). Although there are different definitions of digital twins, they all have one thing in common: there is a link between actual entities and virtual twins. In a nutshell, a digital twin is a digital clone of a living or inanimate entity (Holopainen, Saunila, Rantala, & Ukko, 2022). The digital twin's

relevance grows as a result of its use in all industries and technological advancement. Businesses who engage in digital twin technologies are expected to gain 30% (Pettey, 2017). In this regard, it is critical for firms that wish to compete sustainably to employ digital twins in a variety of operations such as organization, sales, manufacturing, and innovation.

As previously stated, the digital twin is employed using a variety of technologies. 3D printing, big data, artificial intelligence, and the internet of things are the most commonly employed of these technologies. Among these approaches, 3D printing converts computer designs into real objects (Fukawa & Rndfleisch, 2023). One of the most prevalent approaches employed by firms employing digital twins is 3D printing, which brings digital ideas into reality. 3D printing is favoured in many industries, including manufacturing, automotive, aerospace, and new product development. Businesses that use digital twins in conjunction with 3D printing reap several benefits, including cost savings, increased manufacturing efficiency, and improved customer satisfaction.

Big data is another technology connected to the digital twin (Aktan, 2018). Big data is described as huge and heterogeneous data in various quantities that cannot be handled using typical databases. It has become an essential component in delivering a competitive edge for firms as a result of advancements in big data, information, and communication technology. Diversity, speed, volume, realism, and value are all components of big data. The variety of these components is due to the fact that there are several sorts of data (structural, semi-structural, and unstructured). Speed, on the other hand, indicates that the data is always moving and that the pace of production is high. Volume refers to the magnitude of data that cannot be handled using standard means, such as terabytes and petabytes. Another aspect of big data is reality, which refers to how much of the data gathered is correct and dependable. Analyses based on dependable and correct data produce success and efficiency. Finally, the idea of value is tied to the data's meaning and accuracy. Big data is employed in a variety of industries, including banking, communication, insurance, health, education, manufacturing, public, marketing, logistics, and energy.

Another technology employed with the digital twin is artificial intelligence. Shankar (2018) defines artificial intelligence as "a machine ability created by humans to benefit from experience, adapt, and perform." While big data allows for the merging of the real and digital worlds, artificial intelligence focuses on streamlining processes and limiting the usage of human resources. As a result, both strategies are tied to the digital twin. It delivers benefits in fields such as energy, autonomous systems, health, marketing (application of artificial intelligence in promotional brochures), and manufacturing by combining artificial intelligence with digital twin.

One of the most popular approaches for using the digital twin is the internet of things. The digital twin and the internet of things were used to generate the bulk of the models in the research found in the literature review (Chen, L. et. al., 2021; Feng et. al., 2023). The Internet of Things idea is described as the creation, sharing, and exploitation of information using various technological devices (Bahçekapılı, 2018). The Internet of Things is made up of three main components. These components are items, connections, humans, and processes. While objects are made up of multiple sensors, triggers, converters, and hardware, connection refers to the communication mechanisms utilized

in data transfer. People and processes, on the other hand, are service marketing mix elements, and everything generated or sold is realized for the person or process.

The most important advantage of the digital twin, which can be used in almost every sector, is that it enables the copy of complex processes to be checked before they are produced, thanks to its simulation capability. In addition, reducing operating costs and expenses, prolonging the product life, and making analyses are among its other advantages.

Technology is the most prevalent use of digital twins. Companies in the technology sector (Microsoft, IBM, GE, and others) utilise digital twins for their goods and services. Recently, TESLA, which has distinguished itself from its competitors by producing electric vehicles, has begun to employ a particular vehicle digital twin for each chassis number it creates, and the cars may be upgraded in accordance with the demands of the consumers (https://www.hcltech.com/). The digital twin can also be used in the field of medicine. In health care, the digital twin is employed in two ways. The first is hospital layout, and the second is patient care. The digital twin is used in hospital design to develop the hospital building, operating room, patient beds, and service planning. In terms of patient follow-up, digital twins are used to determine patient health information, process control of processes in the patient's body (holter, etc.), and therapy results using sensors. The construction sector, which involves significant investment and labor, has likewise made a swift shift to digitization. The digital twin is crucial in this digitization. The digital twin is employed in the construction sector from the beginning of the design process. All information about the construction is supplied by the digital twin in the interaction between the equipment, the project, and the user (Ceylan, 2019). Aside from these industries, the digital twin is used in agriculture (Raba et. al., 2022; Purcell et al., 2023; Liu et. al., 2023;), renewable energy, energy production, energy infrastructure improvement, metering, and other areas to protect the environment, grow sustainable plants, and produce organic products. It is employed in the field of energy (Meske, Osmundsen & Jubglas, 2021; Teng et. al., 2021; Yu et. al. 2022; Bucullo et. al. 2023; Li et. al., 2023; Korotkova et. al., 2023) in terms of processes such as monitoring. Furthermore, the digital twin is frequently employed in the education, public, manufacturing, and logistics sectors.

The term of digital twin was initially explained in the study, followed by a literature review. In accordance with the systematic literature review, the Web of Science database, which has recognised scientific validity, was searched for related publications in the methodological section of the research. As a consequence of the scanning, the Vosviwer Program examined 60 articles with the terms digital twin in the headline. The findings and discussion section finished the study. Figure 1 depicts the study's flowchart.

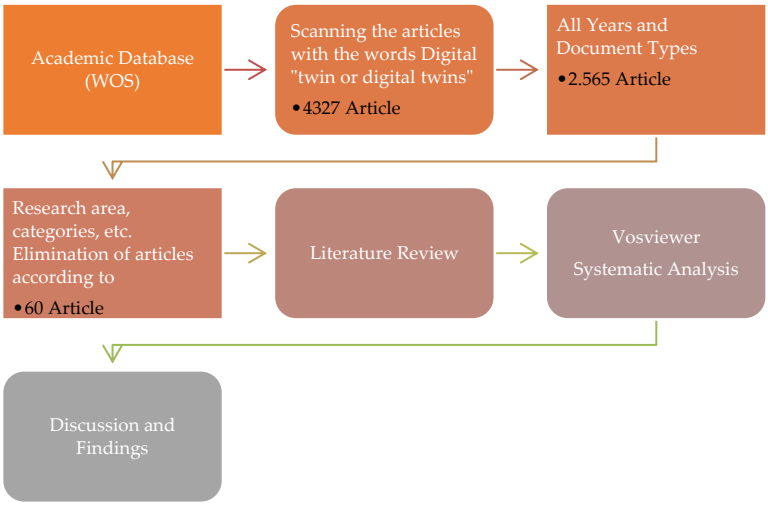

Figure 1: Research Flow Chart

Literature Review

Digital twins are techniques that provide information in real-time by fusing physical and virtual systems with emerging technologies. According to Kamble et. al. (2022) digital twins can improve quality, save time, and aid in the development of sustainable and intelligent manufacturing systems. Digital twins replicate how physical, social, and economic systems operate in real time. More than ever, companies, cities, and communities have been impacted by digital revolutions such as cloud computing, big data, smart cities, machine learning, artificial intelligence, etc. (Batty, 2018, p. 817).

Recent research on digital twins has been done as a result of the digital revolution in many areas, including smart city planning, machine learning systems, logistics and transportation, and smart manufacturing systems. The literature from the WOS database was organized in this fashion for this section of the study, and the papers were reviewed. The words "digital twin" and "digital twins" which are used interchangeably in the literature were added to the WOS database as keywords. Even though the earliest research on the topic date from 1973 and 1993, they were conducted in the engineering discipline. As of 2017, studies on digital twins are widely available. 2022 saw 1615 studies recorded, making it the year with the most research in the WOS database.

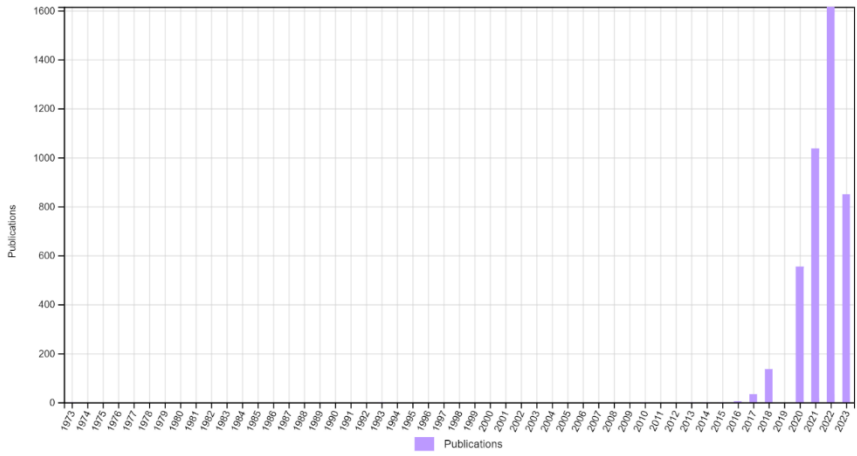

Figure 2: Number of Studies on Digital Twins Published in WOS Database by Years

When 4237 studies were assessed generally, it was discovered that engineering, computer science, automation control systems, and communications systems were the primary study fields. It has been noted that 1449 of the studies are in the field of computer science, 2443 of the studies are in engineering, and the number of research in disciplines like energy, environment, and transportation is constantly rising.

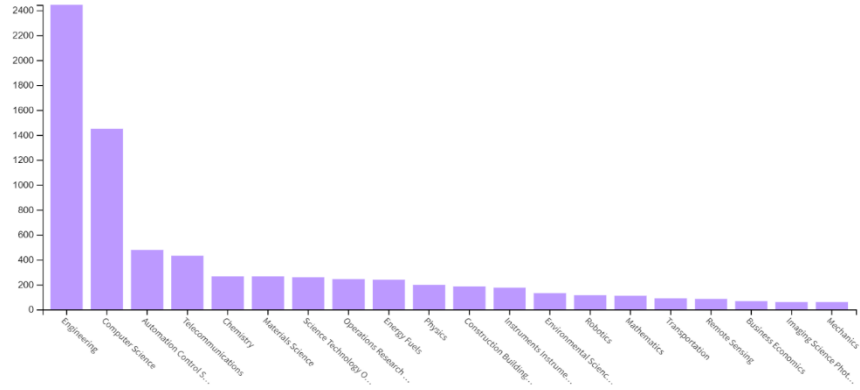

Figure 3: Research Areas of Studies on Digital Twins Published in WOS Database

It can be noted that 98% of the research on the digital twin are written in English when the Table 1 in the WOS database is assessed in terms of the language in which they are published. There is one research written in Turkish, compared to 55 papers written in German.

Table 1: Publication Languages of Studies on Digital Twins Published in WOS Database

Languages	Record Count	% of 4.237
English	4158	98.135
German	55	1.298
Korean	7	0.165
Russian	5	0.118
Italian	4	0.094
Spanish	4	0.094
Chinese	3	0.071
Croatian	1	0.024
French	1	0.024
Portuguese	1	0.024
Turkish	1	0.024

Examining the different study types revealed that 60% of the research were presented as papers, while 30% were published as articles. 25 of the research that were addressed were published as book chapters, and 4 were published as books.

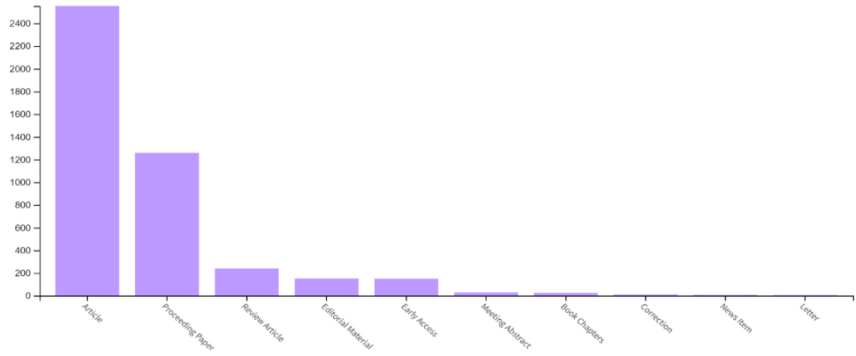

Figure 4: Document Types of Studies on Digital Twins Published in WOS Database

In the WOS database, studies on digital twins are categorized according to study topics, publishing languages, and document types in light of all these broad criteria. This categorization resulted in the retention of 60 studies.

Documents By Publication Citations in Web of Science Database

Table 2 displays the total yearly citations of research-related publications. All years were chosen when looking at the WOS digital twin. Between 2020 and 2023, a publication regarding the digital twin was produced in WOS, and 348 citations were made in this time period. The top 10 most referenced studies as of 2022 are listed in Table 2. The most popular studies are in 2022.

Table 2: Top Ten Publications from WOS Databases with The Most Citations

No	Title	Authors	Journal title	Year (Y)	Total citation (TC)	Citation per Year (TC/Y)
1	Food retail supply chain resilience and the covıd-19 pandemic: a digital twin-based impact analysis and improvement directions	Burgos, D & Ivanov, D	Transportatıon research part e-logıstıcs and transportatıon revıew	2021	118	39,33
2	Digital twin for sustainable manufacturing supply chains: current trends, future perspectives, and an implementation framework	Kamble, SS; Gunasekaran, A. et. al (...); Sharma, R	Technologıcal forecastıng and socıal change	2022	40	20
3	Building an organizational digital twin	Parmar, R; Leiponen, & Thomas, LDW	Busıness horızons	2020	27	6.75
4	Digital twin ıntegrated reinforced learning in supply chain and logistics	Abideen, AZ; Sundram, VPK; (...); Sorooshian, S	Logıstıcs-basel	2021	21	7
5	Metrics development and modelling the mixed reality and digital twin adoption in the context of ındustry 4.0	Sepasgozar, S; Ghobadi, M; (...); Delzendeh, E	Engıneerıng constructıon and archıtectural management	2021	20	6.67
6	Deploying 3d scanning based geometric digital twins during fabrication and assembly in offsite manufacturing	Rausch, C; Lu, Rd; (...); Haas, C	Internatıonal journal of constructıon management	2023	19	6.33
7	Multi-aspect applications and development challenges of digital twin-driven management in global smart ports	Wang, K; HU, QQ; (...); Qian, Xm	Case studıes on transport polıcy	2021	17	5.67
8	Bibliometric analysis of digital twin literature: a review of influencing factors and conceptual structure	Wang, J; Li, XC; (...); Liu, Ql	Technology analysıs & strategıc management	2022	12	6
9	Digital twins in infrastructure: definitions, current practices, challenges and strategies	Broo, DG and Schooling, J	Internatıonal journal of constructıon management	2023	10	3.33
10	Analyzing the ımplementation of a digital twin manufacturing system: using a systems thinking approach	Loaiza, JH and Cloutier, RJ	Systems	2022	7	3.5

The majority of management-related research are found when we examine the assessment of 60 studies in terms of the literature. It is noteworthy that studies are conducted in the management field in the areas of supply chain and logistics, construction, strategic, information, energy, innovation and technology, public management, warehouse, human resources, and production management. Through the use of digital twins in linked disciplines, theoretical and practical explanations were provided.

Numerous case studies are possible because to the ability of the digital twin approach to build a simulation using the real-time data at hand. Akinyemi et. al. (2022) provide a case study for digital twin management that makes use of digital tools including machine learning, artificial intelligence, and data analytics for business operations in the

construction industry. Korotkova et. al.'s (2023) case study, which looked at the use of digital twins for knowledge management from the point of technological adoption via the oil and gas sector, is another example. They suggested a practical strategy for fostering confidence in overstated technologies as a consequence of the study. To use digital twins in an advanced strategic decision-making process in the digital age, another case study has been set up. In the dynamic and ever-changing business environment, Yan et. al.'s (2022) strategic management study aids in making both operational and strategic company choices a more coherent and effective model. In a case study by Pivnicka et. al. (2022), digital twins were used to simulate a human resources management process. A case study has been done on flexible human resource planning in accordance with the best production and logistics plans, and a model for the physical-digital-physical cycle has been proposed. The management of manufacturing and logistics is one area where the digital twin approach is used. Daabrowska et. al. (2022) created a case study on the sugar sector in this area. Digital twin modeling, used for productivity and logistics efficiency in production, has highlighted the impact of internal and external influences on sugar line packaging operations.

The areas where firms may leverage technology and innovation have expanded along with the availability of more digital resources. By demonstrating that digital twins have applications that are both process- and product-oriented, Fukawa and Rindfleisch (2023) stressed that the digital twin is a crucial step of the evolving digital revolution for firms that incorporate Industry 4.0 technology. According to Parmar et. al. (2020), digital twins could have digital representations both in institutions and in physical items. The process of digitalizing corporate operations and merging the data flow made up of institutions, people, and activities is described as being necessary for the creation of corporate digital twins. Timperi et. al. (2023) revealed that digital twins significantly influence the business models of manufacturing companies, producing benefits like cost savings, improved operations, a focus on core competencies, and job growth. This information was revealed in a qualitative study that looked at how the manufacturing sector can benefit from digital twins in a way that adds value to companies. Digital twins will be the main technology of future digital manufacturing systems, a system that maximizes performance and decision-making, according to Van Dyck et. al. (2023), in their work depicting a potential future of digital manufacturing in 2030. It was also stressed that solid governance frameworks, data sharing, balancing the contributions of humans and machines, and balancing value generation are all necessary for the adoption of linked digital twins to be effective.

Feng et. al. (2023) looked at the applicability of digital technology to transportation systems in the realm of transportation, one of the application areas for digital twins. According to their study, the transportation system's capacity to adjust to unpredictable occurrences will improve, communication costs will be reduced by more than 50%, and operational efficiency will rise by around 20%. Yang et. al. (2023), on the other hand, emphasized that digital twins can be effective in real-time monitoring of transactions in automated container terminals, real-time transaction analysis, and real-time loading and unloading in order to benefit from the advantages of digitalization in the transportation system.

The digital twin system is the topic of theoretical and practical investigations in several disciplines, including engineering, energy, management, business, and transportation.

A total of 60 research on digital twins were looked at after the topics of business, economy, transportation, public administration, and other social sciences were ruled out. Out of 60 investigations, 7 studies used bibliometric analysis to perform a literature review on digital twins. The business, economic, scientific, and technological domains include the research topics of bibliometric studies on digital twins. The literature review for the digital twin system for sustainable manufacturing supply chains was created by Kamble et. al. (2022), which among bibliometric research contributed the most to the body of knowledge.

Table 3: Bibliometric studies on digital twins

Authors	Article Title	Times Cited	Publication Year	WoS Categories	Research Areas
Sachin S Kamble, Angappa Gunasekaran, Harsh Parekh, Venkatesh Mani, Amine Belhadi, Rohit Sharma,	Digital twin for sustainable manufacturing supply chains: Current trends, future perspectives, and an implementation framework	40	2022	Business; Regional & Urban Planning	Business & Economics; Public Administration
Abideen, Ahmed Zainul, Veera Pandiyan Kaliani Sundram, Jaafar Pyeman, Abdul Kadir Othman ve Shahryar Sorooshian	Digital Twin Integrated Reinforced Learning in Supply Chain and Logistics	21	2021	Management; Operations Research & Management Science	Business & Economics; Operations Research & Management Science
Wang, J; Li, XC; Wang, P; Liu, QL	Bibliometric analysis of digital twin literature: a review of influencing factors and conceptual structure	12	2022	Management; Multidisciplinary Sciences	Business & Economics; Science & Technology - Other Topics
Dhar, S; Tarafdar, P and Bose, I	Understanding the evolution of an emerging technological paradigm and its impact: The case of Digital Twin	1	2022	BusinessRegional & Urban Planning	Business & EconomicsPublic Administration
Hou, HY; Lai, JHK; Wu, H; Wang, T	Digital twin application in heritage facilities management: systematic literature review and future development directions	0	2023	Engineering, Industrial; Engineering, Civil; Management	Engineering; Business & Economics
Xin, C; Wang, YS	Digital twins and innovation management: a literature review, framework, challenge, and future direction	0	2022	Management; Multidisciplinary Sciences	Business & Economics; Science & Technology - Other Topics
Xin Li; Yuanfei Shen; Haolun Cheng; Fei Yuan; Lucheng Huang	Identifying the Development Trends and Technological Competition Situations for Digital Twin: A Bibliometric Overview and Patent Landscape Analysis	0	2022	BusinessEngineering, IndustrialManagement	Business & EconomicsEngineering

The WOS database contains 56 publications from studies on digital twins in the fields of commerce, economics, transportation, public administration, and other social sciences. Four papers were released as review articles, while 19 studies were released as early

access. Studies on digital twins have shown that there are fewer book chapters than in other genres.

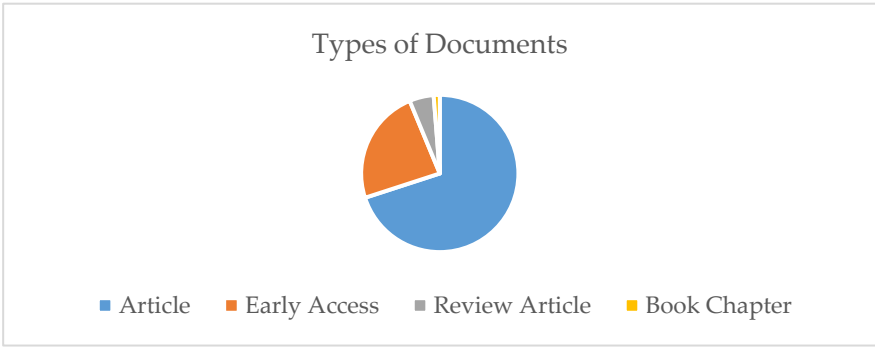

Figure 5: Types of documents in Web of Science

The Table 4 provides an examination of the digital twin studies in the WOS database by year. It can be shown that research on the digital twin have been published in the WOS database as of 2020, and the number of studies has grown significantly in the years that have followed. The most research were conducted between 2020 and 2023 in 2023. It can be seen from the table and the graphic that there were more publications on digital twins published in 2021 than in 2022, but that research done in 2022 earned more citations than those conducted in 2021.

Table 4: Year-Wise Publications in WOS Database

Publication Years	Record Count	% of 60
2023	23	38.333
2021	19	31.667
2022	17	28.333
2020	1	1.667

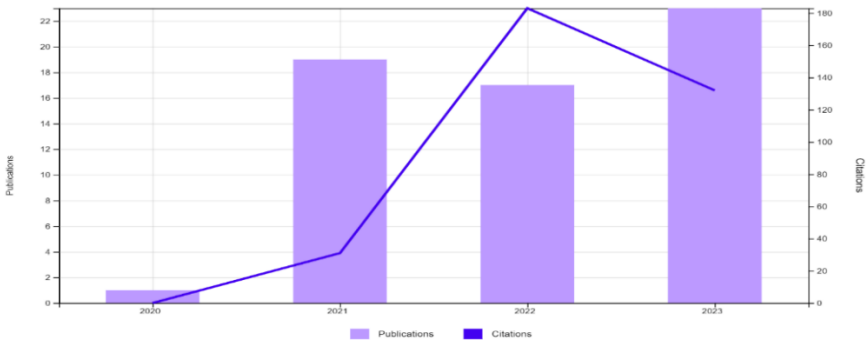

Figure 6: Times Cited and Publications Over Time

The figure lists the fields where references to the research under consideration are most frequently found. The most often mentioned studies are in the area of design and manufacturing, as seen in the table. The studies that have been examined in the research on the disciplines of design and manufacturing have undergone a great deal of evaluation. The demand for topics relating to supply chain and logistics, management, human geography, operations research, and management science is therefore evident.

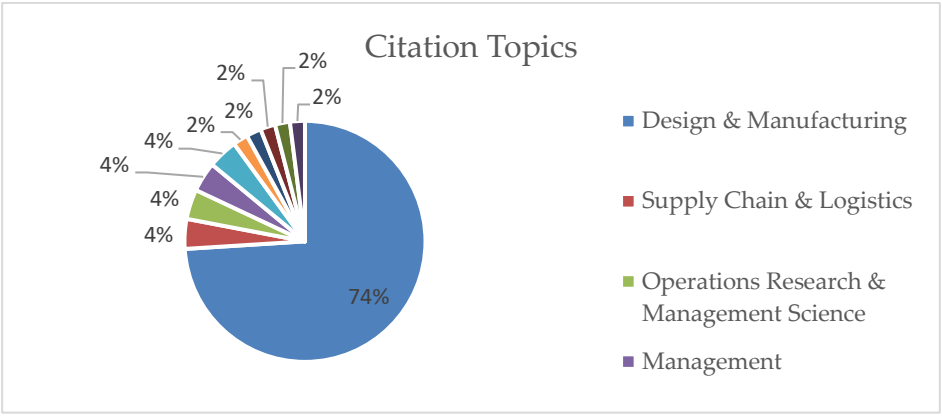

Figure 7: Citation Topics

The table looks at the intensity of 60 digital twin studies in the WOS database. The table indicates that the majority of the studies between 2020 and 2023 is seen in the subjects of engineering, business economics, and other social sciences.

Table 5: Research areas of documents in WOS

Research Areas	**Record Count**	**% of 60**
Business Economics	45	75.000
Engineering	12	20.000
Social Sciences Other Topics	11	18.333
Operations Research Management Science	5	8.333
Science Technology Other Topics	5	8.333
Transportation	5	8.333
Public Administration	4	6.667
Computer Science	2	3.333
Development Studies	2	3.333
Information Science Library Science	2	3.333
Environmental Sciences Ecology	1	1.667
Geography	1	1.667

The universities that made the top 10 out of 115 institutions and the number of associated publications are listed in the table when the 60 research on digital twins analysed in the WOS database are examined in terms of the institutions the authors are affiliated with. The top spot went to Lut University, which had 5 publications.

Table 6: Institutions to which the authors are affiliated (top 10)

Affiliations	**Record Count**	**% of 60**
Lut Univ	5	8.333
Birmingham City University	2	3.333

Edhec Business School	2	3.333
Hong Kong Polytechnic University	2	3.333
Indian Institute of Management Iim System	2	3.333
Minist Nat Resources North Sea Bur	2	3.333
Norwegian University of Science Technology Ntnu	2	3.333
Shanghai Maritime University	2	3.333
State University of Management	2	3.333
State University System of Florida	2	3.333

The table lists the sources of funding for the 60 digital twin studies that were looked at in the WOS database. The organization that has supported digital twin research the most is China's National Natural Science Foundation. Then, it becomes clear which organizations give financing assistance for the research that have been looked at more than time, including Innovation England, UK Research Innovation Ukri, and Fundamental Research Funds for Central Universities. It can be shown that 60 studies received financial backing from 36 distinct entities.

Table 7: Funding Agencies of documents

Funding Agencies	**Record Count**	**% of 60**
National Natural Science Foundation Of China Nsfc	4	6.667
Fundamental Research Funds For The Central Universities	3	5.000
Innovate Uk	2	3.333
Uk Research Innovation Ukri	2	3.333
Bru21 Ntnu Research And Innovation Program On Digital And Automation Solutions For The Oil And Gas Industry	1	1.667
Bundesministerium Fuer Wirtschaft Und Energie Federal Ministry For Economic Affairs And Energy	1	1.667
Business Finland The Finnish Innovation Funding Trade Investment And Travel Promotion Organization	1	1.667
Catalan Agency For Management Of University And Research Grants	1	1.667
Centre For Digital Built Britain Cdbb General Research Project	1	1.667
Centre For Systems Engineering And Innovation Csei Imperial College London	1	1.667
China Postdoctoral Science Foundation	1	1.667
Engineering Physical Sciences Research Council Epsrc	1	1.667
Eu Iof2020 Project	1	1.667
Fundamental Research Funds Of The Educational Department Of Liaoning Province For The Colleges And Universities	1	1.667
German Research Foundation Dfg	1	1.667
Hamburg University Of Technology Tuhh	1	1.667
Hksar	1	1.667
Hong Kong Polytechnic University	1	1.667
Humanities And Social Sciences Youth Foundation Of The Ministry Of Education Of China	1	1.667
Institute Of Business Excellence Ibe Universiti Teknologi Mara	1	1.667
Lloyds Register Foundation Data Centric Engineering Programme The Alan Turing Institute	1	1.667
Mitacs Accelerate And Edge Architects	1	1.667
Nanjing University Of Posts Telecommunications	1	1.667
Natural Science Foundation Of Jiangsu Province	1	1.667
Natural Science Foundation Of Liaoning Province	1	1.667
Natural Sciences And Engineering Research Council Of Canada Nserc	1	1.667
Netherlands Enterprise Agency Rvo	1	1.667
Projekt Deal	1	1.667
Rgc Hk Trs	1	1.667
Russian Science Foundation Rsf	1	1.667
Shanghai Key Projects Of Soft Science	1	1.667
Social Science Program Of Beijing Municipal Education Commission	1	1.667
Spanish Government	1	1.667
State Key Laboratory Of Explosion Science And Technology In Bit China Institute Of Communications Education	1	1.667
Technische Universitat Ilmenau	1	1.667
Tu Berlin	1	1.667

Methodology of the Study

As opposed to other databases, Web of Science has a higher volume of published data, hence that was chosen as the database for the study. The Web of Science database's search function was applied to include articles regarding "digital twins or digital twins" as

keywords or phrases. Added title option to these keywords. 4327 articles were eventually read as a result. 2565 items were found after filtering by Document Types and All Years. Early-looking articles and book chapters have been identified, and the filtering now includes an option for all years. Later, as WOS categories, the filtering was expanded to include business, green sustainable scientific technologies, management, interdisciplinary social science studies, transportation, economics, and development studies. A total of 148 studies were found after the filtering. It was shortened to 60 papers by the writers, who filtered the research to include only studies relevant to their field of expertise in fields including business economics, transportation, public administration, social sciences, and others. The systematic review was selected to use a Vosviwer analysis. The first set of data includes tabular data on the number of studies, research topics, publishing languages, document kinds, bibliometric summary, citation status by years, financing status, data on the ten most cited studies, and affiliation data for the authors' universities. Next, network visualization of the nations, organizations, author partnerships, and common keywords in which the papers were published was carried out using Vosviwer analysis.

Network Analysıs of Author and Co-Author

The Web of Science database is evaluated in Figure 8 in terms of author and co-author collaborative viewpoints. The author collaborations are based on the visual network made using Vosviwer. An author's association with other writers is shown by the total number of co-authoring links. Ten writers were used as thresholds out of a total of 188 authors. There were thus 2 co-authorship clusters discovered. Additionally, this network has created two products. 25 linkages between writers have been made. The clusters that were discovered are as follows, and they demonstrate the authors' active collaboration. It appears that Gunasekarak, A., Kamble, SS., Mani, V., Parekh, H., and Sharma, R. participated on the initial cluster. Belhadi, A., Gupta, S., Kumar, S., Maheshwari, P., and Kamble, SS. seem to be in the second cluster.

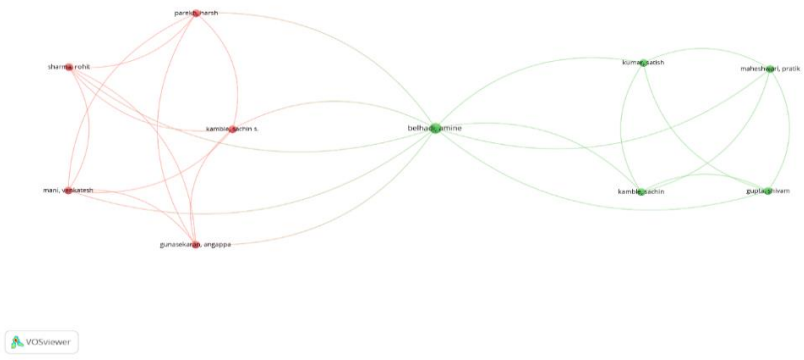

Figure 8: Network visualization of author and co-author for WOS documents

The network visualization of the authors' institutions is shown in figure 9 of research on digital twins. According to the network visualization of the authors' institutions, there are two clusters of institutions. The first cluster includes Edhec Business School, Indian Institute of Management Jammu, and Indian Institute of Management, while the second cluster includes Cadi Ayyad University of Marrakech, Jaipuria Institute of Management, Louisiana State University, Montpellier Business School, Penn State Harrisburg. University Internationale De Rabat, Management Nagpur, and Neoma Business School. Institutions in both clusters are affiliated with Edhec Business School. Studies for the years 2022 and 2023 were conducted in the second cluster.

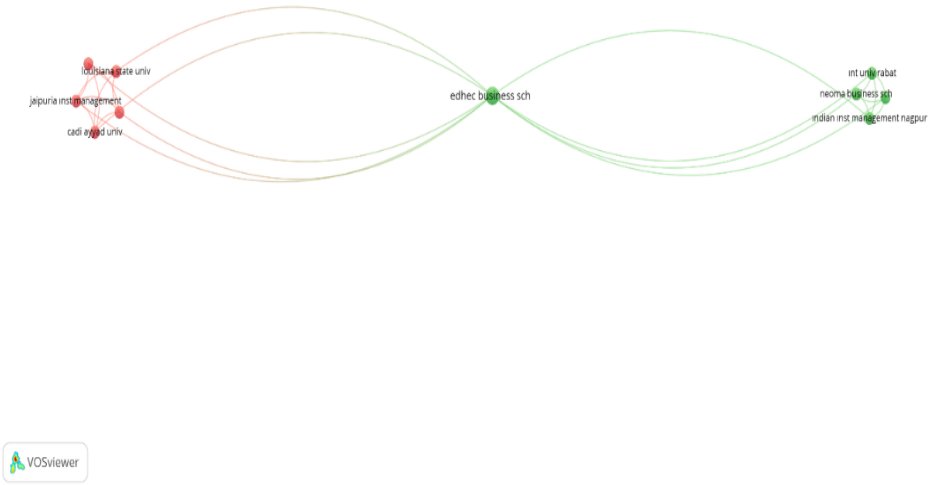

Figure 9: Network visualization of authors' institutions

Network of Co-Occurrence of Author Keywords

Figure 10 and Table 8 show the findings of the study of the existence or proximity of the keywords, which enables the analysis of the keywords in the authors' collaborative works. The keywords used in the source names of the articles are displayed in each circle, per these findings. The circle's size grows in proportion to the writers' increased use of keywords. Associating circles for links display the separation between two keywords. Out of the 274 keywords that were extracted from the chosen articles, 20 keywords with at least two frequent terms were therefore found. Bibliometric analysis, data, digital twins, and industry are highlighted in the first cluster of the network analysis in Figure 1. The second cluster highlights the industries (digital manufacturing, digital transformation, service firms, etc.) where the digital twin is applied. The third cluster highlights the significance of using the digital twin in conjunction with technologies like artificial intelligence and the internet of things. Big data and Industry 4.0 are both featured in the fourth cluster. It concentrated on keywords associated with digital twin application model designs in the last cluster.

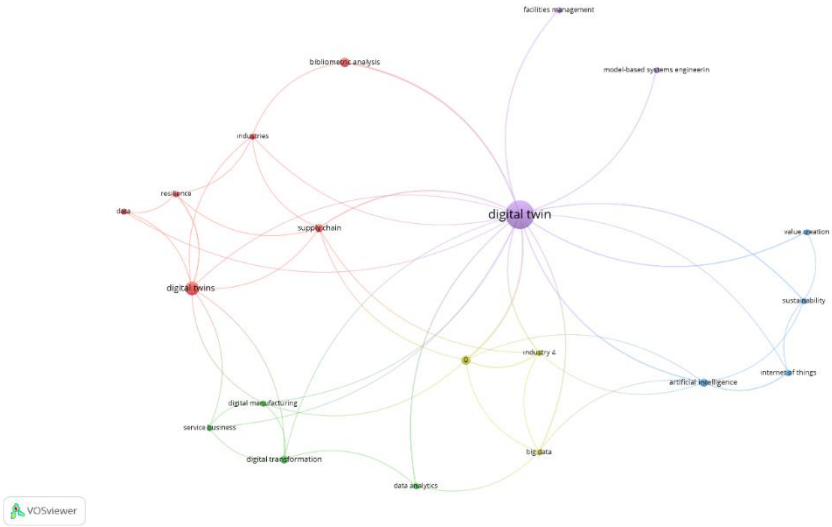

Figure 10: Network analysis of co-occurrence of key words in WOS

The keywords connected to the utilization areas of the digital twin and the methodologies employed in conjunction with them in the research related to the digital twin have been concentrated, as can be seen from the network analysis and clustering table.

Table 8: Results of co-occurrence of author keywords in the Web of Science database

Cluster	Co- Occurrences	Links	Total Link Strength	Author- Keywords
1 Red (6 Items)	9	8	9	Digital Twins
	4	2	5	Bibliometric Analysis
	2	3	3	Data
	2	5	5	Industries
	2	4	5	Resilience
	3	6	7	Supply Chain
2 Green (4 Items)	2	3	4	Data Analytics
	2	5	5	Digital Manufacturing
	3	5	5	Digital Transformation
	2	4	4	Service Business
3 Blue (4 Items)	3	6	8	Artificial Intelligence
	2	3	4	Internet of Things
	2	4	5	Sustainability
	2	2	3	Value Creation
	4	6	10	0 (4.0)

4 Yellow (3 Items)	2	5	6	Big Data
	2	5	7	Industry 4
5 Purple (3 Items)	38	18	33	Digital Twin
	2	1	2	Facilities Management
	2	1	2	Model- Based Systems Engineering

The picture shows a network depiction of the geographic locations of 60 research on digital twins found in the WOS database. The writers' nations' networks were visualized, and it can be seen that there were 27 connections made overall and that 16 countries formed 5 clusters. There have been eleven digital twin studies conducted in the US. The USA ranks top among the studies evaluated with this number, followed by China and Germany with 10 studies each. Studies carried out in the United States have been linked to writers from nine other nations, including China, Germany, Norway, England, Spain, Sweden, India, France, and Morocco. It has been noted that the research carried out in China had authors from five different nations: The United States, Netherlands, Australia, India, and Sweden. It has been observed that the research carried out in Germany had authors from six different nations (United States, Netherlands, England, Taiwan, Poland, and Norway).

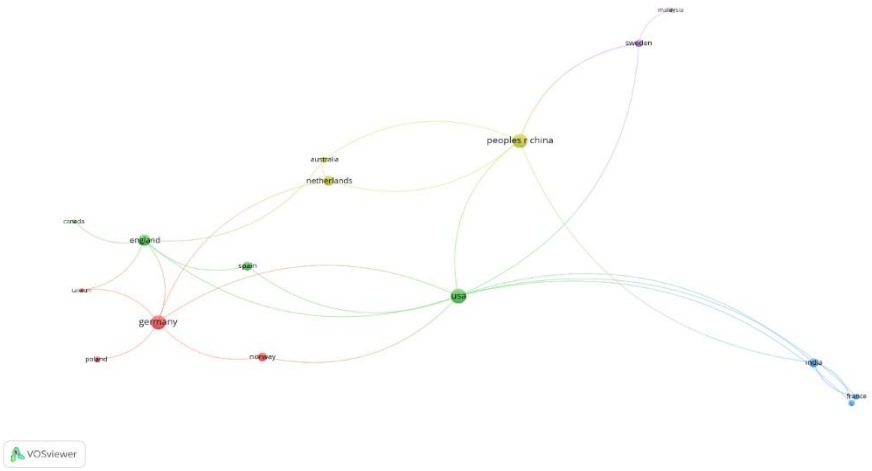

Figure11: Documents by Geographic Locations

Table 9: Clustering network analysis of documents by geographic location

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Germany	Canada	France	Australia	Malaysia
Norway	England	India	Holland	Sweden
Poland	Spain	Morocco	China	
Taiwan	USA			

Conclusion and Discussion

The purpose of this study is to conduct a systematic evaluation of the studies on the notion of the "digital twin," which has been in use since 2003, that have been published in the WOS database. The Vosviwer tool was used in the study to examine the studies in the WOS database. According to research, there are 4327 studies on the idea of a "digital twin" in the WOS database. After filtering all years, research disciplines, and document formats linked to the authors' domains, 60 publications were submitted to a systematic review. The study revealed that 98% of the publications were written in English, 60% were articles, and Burgos & Ivanow (2021) had the most citations (118). Again, as a consequence of the investigation, it was discovered that production-related papers received the most citations, and business economics received the most (75%) in terms of research fields. It was determined that 10 writers out of a total of 188 authors made more joint publications as a result of the study for author and author collaboration in digital twin research in the Vosviwer program, and two clusters were found. There were 25 links found that linked to the writers. There were 274 keywords in all, according to the examination of the keywords the writers had used in their research. It is understood that at least two common keywords are present in 20 of these 274 keywords. The primary focus of the keywords is on data, digital twins, and industry. It is known that the National Natural Science Foundation of China provides the majority of funding for the investigations, which are mostly conducted at Lut University (5). It was also discovered that 60 research, the most of which were published in the USA. Finally, business economics has been investigated the majority of the research fields.

The study's limitations include the preference for using WOS as the database, the collection of data from 20 July 2023 to 5 August 2023, and the filtering of WOS categories (business, green sustainable science technologies, etc.) for business economics, transportation, public administration, social sciences, and other research fields based on document types (book, article, book chapter, etc.). Comparison is challenging due to the lack of a study that is comparable to this study in the literature review. However, it was discovered that a study (Warke et. al. 2021) that was discovered while scanning with the concept of the digital twin in the Wos database and was not subjected to systematic analysis because it was outside the research area was similar in terms of making a bibliometric literature review by using Voswier systematic analysis.

Seven papers that conducted a systematic review of the literature were discovered. It has been acknowledged that these investigations are only in-depth literature surveys. The supply chain and logistics are covered in two of the seven studies that are literature reviews on the digital twin (Abideen et. al., 2021; Sachin et. al., 2022), while field of technology is covered in two more (Xin et. al., 2022; Dhar, Tarafdar & Bose, 2022). The remaining 3 articles (Wang et. al., 2022; Hou et. al., 2023; Xin & Wang, 2022) all take the form of literature reviews and describe the digital twin theoretically. However, this study is a comprehensive evaluation of studies on digital twins from the social sciences, business economics, transportation, and other related domains. Therefore, it is believed that by using these study findings, researchers who intend to publish in the aforementioned disciplines will close the knowledge gap. The literature analysis on the digital twin has revealed that case studies in the form of simulation and model building are common in studies pertaining to businesses, particularly those that focus on production. It is recognized that there have only been a relatively small number of

research on the idea of a digital twin in WOS up until 2019. Furthermore, researches are largely undertaken in the United States, China, and Europe, but although there are studies on digital twins in other countries, they are not published in the WOS indices.

Future research can provide comparisons in terms of efficiency, performance (business performance, export performance, market performance), sustainability, and competition in manufacturing, as well as marketing components (pricing, promotion, product and distribution), logistical operations, and multinational firms that employ or do not use digital twins. In this paper, it is expected to provide benefits in terms of cost reduction, improved production and efficiency, warehousing activities, decision support systems and operational process success, and responding quickly to customer requests and needs in the field of marketing, thanks to the use of digital twins in logistics and supply chain.

Peer-Review	Double anonymized - Two External
Ethical Statement	It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.
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Etik Bildirim	itobiad@itobiad.com
Çıkar Çatışması	Çıkar çatışması beyan edilmemiştir.
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