ORIGINAL RESEARCH

Curr Res Soc Sci (2024), 10(2) • 230-269

A Qualitative Research on the Awareness of Trend Technologies Used in Digital Transformation of Businesses Across G20 Countries

İşletmelerin Dijital Dönüşümünde Kullanılan Trend Teknolojilerin G20 Ülkeleri Genelindeki Farkındalığı Üzerine Nitel Bir Araştırma

İsmail YOŞUMAZ*

Kütahya Dumlupınar University, Social Sciences Vocational School, Kütahya, Türkiye

Abstract

Businesses that fail to adapt to the digital transformation process and the disruptive innovation that it brings are likely to lose their competitive advantage and operational efficiency. In order to adapt to this process, a digital transformation culture should prevail within the organization. Corporate culture is influenced by national culture. Therefore, the social awareness of the technologies used in businesses' digital transformation processes and the dominance of digital transformation-oriented corporate culture in businesses are related. In this context, this study aims to investigate the social awareness of globally accepted technologies in the digital transformation process of businesses in G20 countries. To this end, the study presents 19 technologies that have become known in the Industry 4.0 process through a literature review. These technologies were also categorized according to their areas of application. The study used descriptive content analysis from qualitative analysis techniques. The Google Trends database was used to determine the awareness of these technologies in the G20 countries. In this context, the average awareness data for each year and country was obtained by taking the search intensity data between 01 May 2011 and 20 December 2023 from the Google Trends database for G20 countries. This data was analysed separately for each technology. As a result of the study, the countries with the highest and lowest awareness of each technology were identified, the results were verified with the existing studies in the literature, and the points that contradicted the literature were explained. In addition, the awareness ranking of the G20 countries was revealed.

Keywords: Digital Transformation, Technology and Innovation Management, Corporate Culture.

Jel Codes: M10, M15, M19

Öz

Dijital dönüşüm sürecine ve bu süreçte kullanılan yıkıcı inovasyon etkisi yapan teknolojik gelişmelere uyum sağlayamayan işletmelerin rekabet avantajlarını ve operasyonel verimliliklerini kaybetmeleri muhtemeldir. Bu sürece uyum sağlayabilmek için dijital dönüşüme uygun olarak yapılandırılmış bir kurum kültürünün işletme içerisinde hâkim olmalıdır. Kurum kültürü ulusal kültürden etkilenen bir yapıdadır. Bu sebeple işletmelerin dijital dönüşüm sürecinde kullanılan teknolojilere olan toplum genelindeki farkındalık ile dijital dönüşüm odaklı kurum kültürünün işletmelerde hâkim olabilmesinin ilişkili olduğu düşünülmektedir. Bu kapsamda çalışmanın amacı işletmelerin dijital dönüşüm sürecinde dünya genelinde kabul görmüş teknolojilerin toplum genelindeki farkındalığını G20 ülkelerinde araştırmaktır. Bu amaç doğrultusunda Endüstri 4.0 süreci ile meşhur olmuş 19 teknoloji literatür taranarak çalışma kapsamında sunulmuştur. Bu teknolojiler kullanım alanlarına göre de kategorize edilmiştir. Çalışma kapsamında nitel analiz tekniklerinden betimleyici içerik analizinden faydalanılmıştır. Bu teknolojilerin G20 ülkelerindeki farkındalıklarını tespit edebilmek için Google Trends veritabanı kullanılmıştır. Bu kapsamda G20 ülkeleri için Google Trends veri tabanından 01 May 2011 – 20 Dec 2023 tarihleri arasındaki arama yoğunluğu verisi alınarak her bir sene için ve ülke için ortalama farkındalık verisi elde edilmiştir. Bu veriler her bir teknoloji için ayrı ayrı incelenmiştir. Çalışmanın sonucunda her bir teknoloji için farkındalığı en yüksek ve en düşük ülkeler ortaya çıkarılmış, sonuçlar literatürde var olan çalışmalarla doğrulanmış, literatür ile çelişen noktalar açıklanmıştır. Ayrıca G20 ülkeleri arasında farkındalık sıralaması ortaya çıkarılmıştır.

Anahtar Kelimeler: Dijital Dönüşüm, Teknoloji ve Yenilik Yönetimi, Kurumsal Kültür.

Jel Kodları: M10, M15, M19

* Corresponding Author / Sorumlu Yazar: ismaily@dpu.edu.tr

Article Info / Makale Bilgileri:

Received / Gönderim: 20.11.2023 Accepted / Kabul: 20.08.2024

To cite this article / Atıf için:

Yoşumaz, İ. (2024). A qualitative research on the awareness of trend technologies used in digital transformation of businesses across G20 countries. *Curr Res Soc Sci, 10*(2), 230-269.

To link to this article / Bağlantı için:

http://dx.doi.org/10.30613/curesosc.1393698

A Qualitative Research on the Awareness of Trend Technologies Used in Digital Transformation of Businesses Across G20 Countries

Digital transformation initiatives in businesses accelerated after the announcement of the Industry 4.0 process in 2011. Digital transformation refers to a data and knowledge-oriented transformation that covers the processes of obtaining, storing, analysing and sharing the data and information needed by businesses with the help of technological developments (Ellström et al., 2022; Lichtenthaler, 2021; Papanagnou et al., 2022; Rogers & Zvarikova, 2021). These processes ensure that business functions such as production, human resource management and marketing are carried out more efficiently by providing data and knowledge cycles (Planing et al., 2016; World Economic Forum, 2016).

The use of technology is associated with the digital transformation process (Baraković & Baraković Husić, 2022; Daecher et al., 2018; Deloitte, 2015; Garcia-Perez et al., 2023; Mendhurwar & Mishra, 2021; Tagarev, 2019; World Economic Forum, 2016). However, it is impossible to explain digital transformation with this relationship alone (Yavaşgel & Turdubaeva, 2021). If the relationship between the digital transformation process and the use of technology alone were sufficient to explain digital transformation, the Industry 3.0 process would be ongoing (Schrauf et al., 2016). This is because the technological development that began with the Industry 3.0 process has automated businesses in a one-way fashion. One-way automation is based on sending commands from humans to machines, and the machines do the work. With the Industry 4.0 process, cooperation between humans and machines, machines and humans, and machines and machines have begun (Davies, 2015; Deloitte, 2018; Ford, 2015; Heynitz et al., 2016; Rifkin, 2014). This collaboration has led to multi-directional automation. The basic building block of this collaboration is data and the knowledge that emerges from data analysis. The ability to efficiently obtain, store, and analyse data and transform it into knowledge is based on the technology-oriented digital transformation of businesses. For this transformation to be successful, all components must be combined with a digital transformation-oriented corporate culture and awareness (Capgemini Digital Transformation Institute, 2018; Inamdar, 2022; Pavlova, 2020; Yavaşgel & Turdubaeva, 2021). Organisational culture is influenced by national culture (Khan & Smith Law, 2015; Mandal, 2022). National culture and public perception are related (Mancı, 2019; Mandal, 2022). In this context, it is essential to increase public awareness to foster a digital transformation-oriented corporate culture needed in businesses' digital transformation process.

This study investigates the social awareness of trending technologies used in the digital transformation process in G20 countries. Establishing this awareness is crucial for fostering a corporate culture that prioritises digital transformation in businesses' digital transformation processes. This approach enables insights from social awareness studies of technologies with limited societal recognition (Capgemini Digital Transformation Institute, 2018; Cherian et al., 2021; Hautala-Kankaanpää, 2022; Leal-Rodríguez et al., 2023; Pavlova, 2020; Sedliaková, 2013; Shin et al., 2023; Yavaşgel & Turdubaeva, 2021). For this purpose, 19 technologies that can be used in the digital transformation process of businesses and have become famous with the Industry 4.0 process were identified by reviewing the literature (Abbasi, 2022; Akanmu et al., 2021; Almurisi & Tadisetty, 2022; Altaf et al., 2022; Anyoha, 2017; Attaran & Celik, 2023; Balderas et al., 2021; Benotsmane et al., 2019; Cobb et al., 2018; Deloitte, 2015; Duo et al., 2022; Filipov & Vasilev, 2016; Gabriel & Pessl, 2016; Gaub, 2016; Goss, 2022; Hoske, 2015; H. C. Koch et al., 2021; V. Koch et al., 2014; Küsters et al., 2017; Liao et al., 2017; Malavasi & Gabriele, 2017; Mertes et al., 2022; Montanus, 2016; Nandhini & Lakshmanan, 2022; Nyberg & Nilsen, 2016; Pecorari, 2023; Piccarozzi et al., 2021; Prasad Agrawal, 2023; Ratten & Jones, 2023; Rifkin, 2014; Ryalat et al., 2023; Sætra, 2023; Sima et al., 2020; Tucci, 2021; Yao et al., 2017). In order to raise awareness of these technologies, they are referred to as trending technologies in this study. An attempt was made to establish a relationship between the search intensity data of trending

technologies in 18 G20 countries (Türkiye, United States of America, Germany, Argentina, Australia, Brazil, Indonesia, France, Republic of South Africa, India, Italy, Japan, Canada, Republic of Korea, Mexican, Russian Federation, Saudi Arabia, United Kingdom) (T.C. Dışişleri Bakanlığı, 2023) and the social awareness of trending technologies used in the digital transformation process of businesses (Ertürk, 2022). Since Google is banned in China (Sheehan, 2018) and the European Union within the G20 consists of many countries, it could not be included in the study. No other study in the literature examines awareness of trending technologies in the digital transformation process through search intensity data. For this reason, it is considered a contribution to the literature.

In the literature review part of this study, the digital transformation process of businesses and the trend technologies that can be used in the digital transformation process are categorised according to their application areas and presented in tables. In the methodology part of the study, trend data in the Google search engine was used to measure awareness within the borders of the G20 countries according to search intensity data on-trend technologies. The third part of the study evaluates the results of the research.

Literatur Review

Technologies such as the Internet of Things (Gilchrist, 2016; Hoske, 2015; Kovacova & Lewis, 2021) and the Internet of Behaviour (Sun et al., 2023) are used to obtain the data needed in the digital transformation process. Cloud computing resources and data storage systems are needed to store the obtained data (Cobb et al., 2018; Gilchrist, 2016; Minelli et al., 2013; Zhang, 2021). Once the data are obtained, they are analysed using software technologies (Stojanov et al., 2021; Toorajipour et al., 2021). The knowledge resulting from this analysis is shared with resources within the business, such as machinery equipment, employees, business management and resources around the business, such as suppliers, customers, and government (Davies, 2015; Deloitte, 2018; Ferber, 2013; Kuznaz et al., 2015; Langlois & Benjamin, 2017). This shared knowledge is used in decision support systems and business intelligence applications (Ahmad et al., 2020; Garcia & Pinzon, 2017; Vercellis, 2009), production processes and smart factory structures (Joppen et al., 2022; Schrauf, 2016; Shi et al., 2020), metaverse infrastructures (Bourlakis et al., 2009; Young Lee, 2021), human resources (Murugesan et al., 2023) and finance (Passi, 2015). Infrastructures such as virtual reality, augmented reality, user-friendly mobile applications and websites, and application programming interfaces (APIs) in software technologies (Amazon Web Services, 2023; Apilioğulları, 2018) make sharing and understanding knowledge easier. As a result, a data and knowledge cycle is established, facilitating vertical integration within the business and horizontal integration with the business environment (Bartodziej, 2017). All components of the horizontal and vertical integration process should be connected to a corporate culture focused on digital transformation (Wang et al., 2016, 2021).

The trending technologies that can be used to ensure the data and knowledge cycle in the digital transformation process of businesses and their areas of use in businesses are categorised in Table 1. The concept of big data, well-known in the Industry 4.0 process, is not included in this category. This is because the concept of big data is not a technology. The technologies used in the Industry 4.0 process have increased the volume (size) and variety of data. Thanks to developments in the communication infrastructure, data is quickly transmitted from the source where it is obtained to the source where it is stored. Large data sets with increased volume, diversity and acquisition speed are called big data (Cobb et al., 2018; Minelli et al., 2013).

Table 1

Trending Technologies and Their Categories

Manufacturing	Communication	Internet and Information Technologies	Data Acquisition, Analysis and Automation Technologies in Businesses
Digital Twin (DT)	Wifi v6	Web 3.0	Internet of Things (IoT)
Cobot	5G	Blockchain (BC)	Internet of Behaviours (IoB)
Cyber-Physical Systems (CPS)	LoRa Networks	Metaverse (MV)	Artificial Intelligence (AI)
Addictive Manufacturing (AM) (3D Printing)		Non-Fungible Token (NFT)	Generative Artificial Intelligence (Gen AI.)
4-D Printing		Cloud Computing (CC)	Robotic Process Automation (RPA)
			Cognitive Automation

Note: Prepared by author (Abbasi, 2022; Altaf et al., 2022; Anyoha, 2017; Attaran & Celik, 2023; Benotsmane et al., 2019; Deloitte, 2015; Duo et al., 2022; Pecorari, 2023; Piccarozzi et al., 2021; Prasad Agrawal, 2023; Ratten & Jones, 2023; Rifkin, 2014; Ryalat et al., 2023; Sætra, 2023; Schwab, 2016; Sima et al., 2020; Tucci, 2021; Yao et al., 2017)

Methodology

This research aims to investigate the awareness of trending technologies used in the digital transformation process in 18 G20 countries (Türkiye (TÜR), United States of America (USA), Germany (GER), Argentina (ARG), Australia (AUS), Brazil (BRA), Indonesia (INDO), France (FRA), South Africa (SOA), India (INDI), Italy (ITA), Japan (JAP), Canada (CAN), Republic of Korea (KOR), Mexican (MEX), Russian Federation (RUS), Saudi Arabia (SAR), United Kingdom (UK)) based on search intensity data. This study could not include the European Union and the African Union within the G20 because they include too many countries. Furthermore, China was not included in this study because access to the Google search engine is prohibited in China (Sheehan, 2018). Due to this reason, it was concluded that search intensity data for China would not be meaningful. Technologies were prioritized over countries when selecting the sample for this study. This decision was based on the lack of existing research on varying levels of technology awareness across different countries. Therefore, the study emphasized technologies known to play significant roles in the digital transformation processes of businesses. In this context, technologies that gained prominence during the Industry 4.0 process and form the foundation of digital transformation were selected using a convenience sampling method.

Content analysis, one of the qualitative research methods, was used as the analysis method. The descriptive analysis method was used within the content analysis. Descriptive content analysis was chosen because it is used to determine general trends from the studies examined on the subject under investigation (Ültay et al., 2021). The data obtained were analysed manually.

In order to understand the awareness of trending technologies in G20 countries, the study covers 152 months of Google Trends search intensity data between 01.05.2011 and 20.12.2023, the first month after the Hannover Messe, held between 4 and 8 April 2011, when the Industry 4.0 process was first announced. Search intensity data can be obtained from the Google Trends infrastructure as monthly averages for large time intervals. Once the data was obtained, the average search intensity data for each year was determined by taking the arithmetic mean of the monthly average data for that year.

Google Trends search intensity data is numbered by Google from 1 to 100 according to search interest. One indicates the lowest level of interest (awareness), and 100 indicates the highest. Google Trends divides search intensity data into topic and search criteria. Topic relevance data represents search intensity data related to the same topic, regardless of language. Due to the importance of language in search criteria data, this study only analysed the data of trending technologies that fall within the scope of the topic (Google Trends, 2023). All data collected during the study is presented in the appendices.

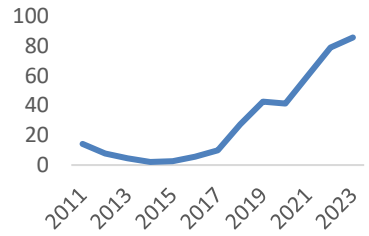
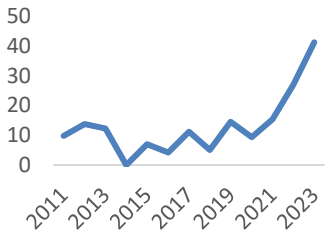
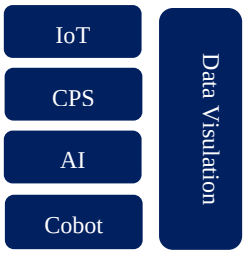
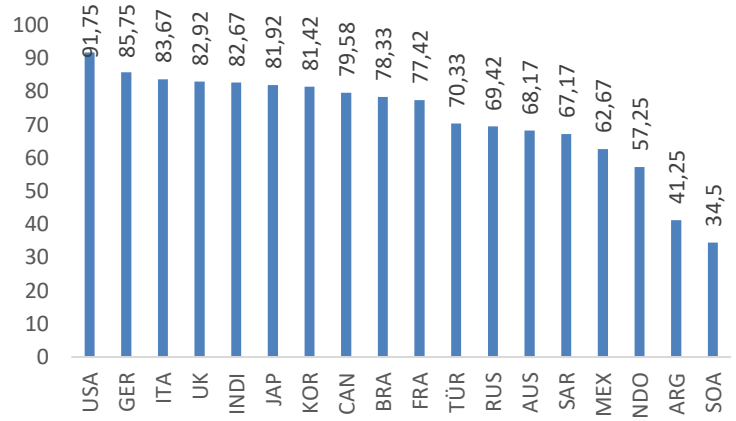
When evaluating the data collected within the scope of the study on 5G technology, it was understood that the search intensity data was generally formed within the scope of 5G-supported phone models and was excluded from the scope of the analysis as it was not suitable for the purpose of the study. As there is no search intensity data in the Google Trends database related to the Internet of Behaviour, Wifi v6, LoRa networks, and cognitive automation technology, these technologies are excluded from the scope of the study. As a result, meaningful search intensity data could be obtained for 14 out of the 19 selected trend technologies. The arithmetic average of all search intensity data per year is presented in the appendix. However, only the definitions and related technologies of the trend technologies that were excluded from the scope of the study are provided.

Findings and Results

This section briefly describes the relevant trending technology, related technologies, and the countries with the highest and lowest awareness according to 13-year average search intensity data. In the graph showing the countries with the "13-year average of highest and lowest awareness levels", the X-axis shows the years, and the Y-axis shows the awareness data with values between 1-100 taken from the Google Trends database. In addition, the awareness ranking of the relevant trend technology for 2023 is shown country-by-country.

Table 2

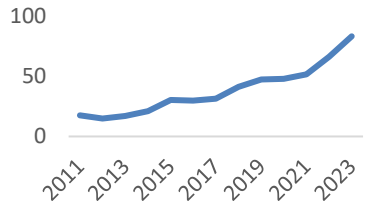
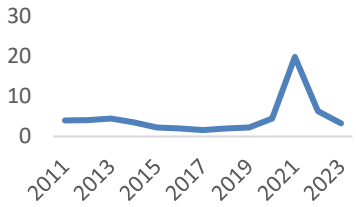
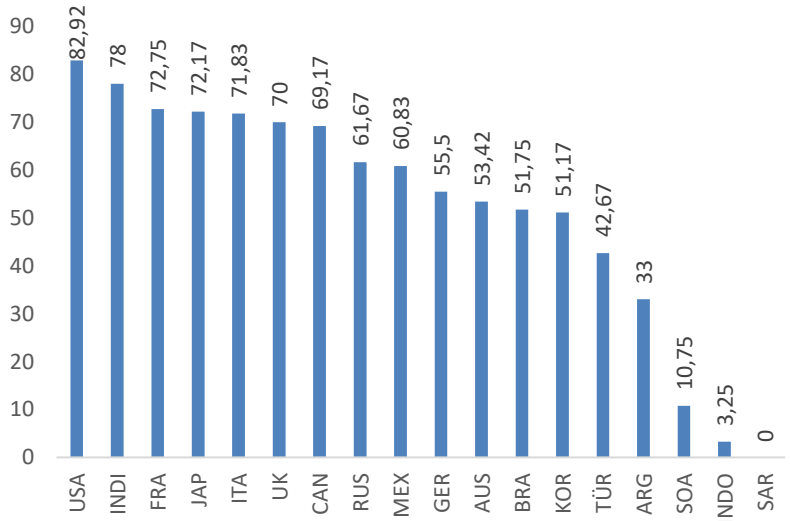
Awareness Analysis of Digital Twin Technology According to Search Data Density

Digital Twin	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness: Germany	Lowest Awareness: Argentina
Digital twin technology models an object in the physical world by creating its twin in the virtual world. The object's behaviour can be simulated throughout its life cycle (Akanmu et al., 2021; Attaran & Celik, 2023; Balderas et al., 2021).		
Related Technologies	Awareness Ranking According to Search Data in 2023	
		

According to the data on the search intensity of digital twin technology in the G20 countries, it can be seen that the awareness of digital twin technology has been continuously increasing since 2018. Argentina has the lowest average awareness, while Germany has the highest. The fact that Germany has the highest average awareness parallels that the Industry 4.0 process was first announced in Germany (Deloitte, 2018). According to the 2023 data, South Africa had the lowest awareness, while the USA had the highest. In 2022, Altair conducted a Digital Twinning survey of 2000 managers and engineers in the USA, France, Germany, India, Italy, China, Japan, the Republic of Korea, Spain, and the UK. According to the results of this study, the percentage of businesses using digital twin technology and planning to use it within one year parallels the awareness values for the countries with the highest awareness for 2023 in this study (Altair, 2022). Looking at the 2023 search intensity data for the digital twin, we see that all countries in the study except Argentina and South Africa have awareness levels above 50.

Table 3

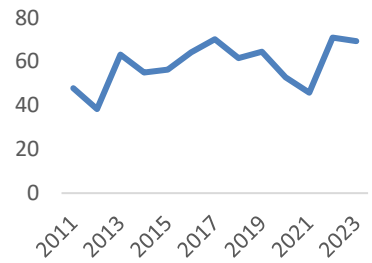
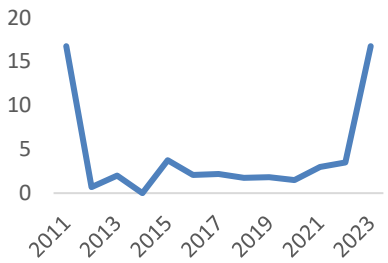
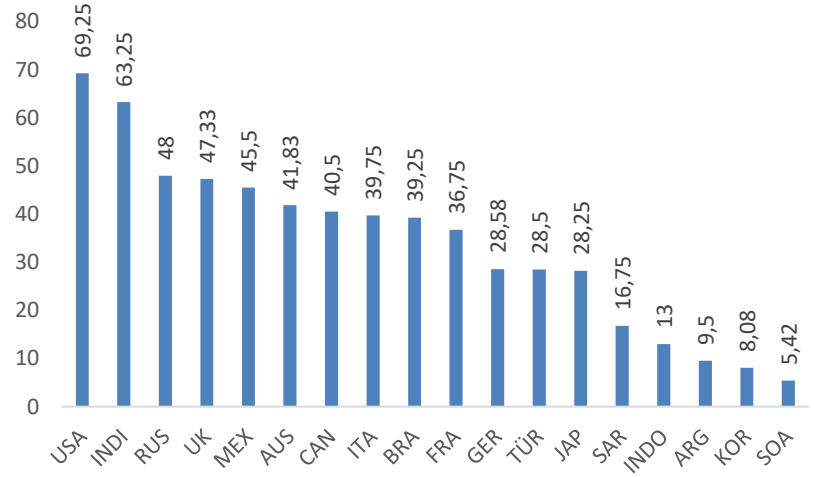
Awareness Analysis of Cobot Technology According to Search Data Density

Cobot	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness: USA	Lowest Awareness: Indonesia
A cobot can be defined as a robot that can work in cooperation with the worker. Cobots are used in businesses to improve quality and productivity, ensure occupational safety and take over repetitive tasks from employees (Gilchrist, 2016; Pfeiffer, 2016; Rifkin, 2014).		 As there was no search intensity in Saudi Arabia, Indonesia was selected as the following country with the lowest average search intensity data.
Related Technologies	Awareness Ranking According to Search Data in 2023	
IoT AI CPS DT		

According to the data on search intensity for cobot technology in the G20 countries, the lowest average awareness was in Indonesia, and the highest average was in the USA. The next highest level of awareness after the USA was in India. The level of awareness in the USA and India is consistent with research that these two countries have the largest manufacturing sectors in the world (Biswas, 2023; Thomas, 2023). Looking at the search intensity data for cobots, all countries except South Africa, Indonesia and Saudi Arabia have an awareness score above 40.

Table 4

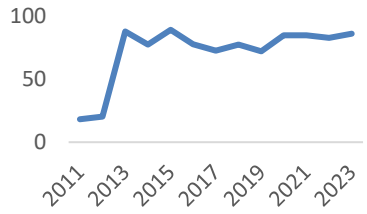
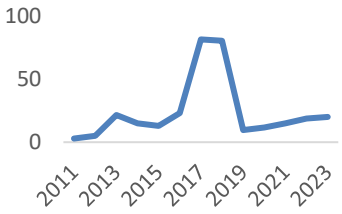
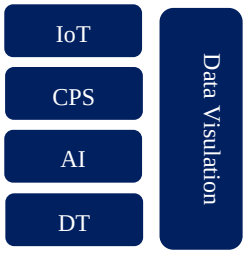
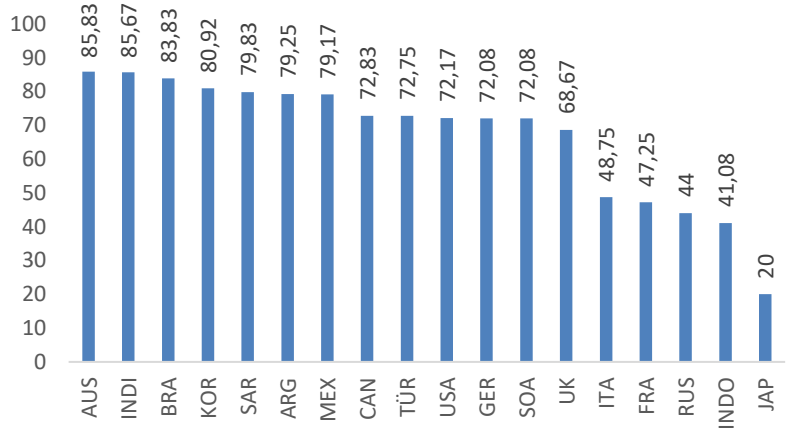
Awareness Analysis of CPS Technology According to Search Data Density

<table>
<tr><th>CPS</th><th colspan="2">13-Year Average of Highest and Lowest Awareness Levels</th></tr>
<tr><td>Definition</td><td>Highest Awareness: USA</td><td>Lowest Awareness: Saudi Arabia</td></tr>
<tr><td>CPS enable the integration of the cyber and physical worlds. This integration connects the cyber world to physical systems through sensors and actuators. In this way, data obtained from operational systems and business processes are combined to establish a digital ecosystem (Akanmu et al., 2021; Apilioğulları, 2018; Duo et al., 2022; Nandhini & Lakshmanan, 2022).</td><td> 
</td><td> 
</td></tr>
<tr><td>Related Technologies</td><td colspan="2">Awareness Ranking According to Search Data in 2023</td></tr>
<tr><td>IoT
AI
Cobot
DT</td><td colspan="2"> 
</td></tr>
</table>

According to the search intensity data of CPS technology across G20 countries, the lowest average awareness was in Saudi Arabia, and the highest was in the USA. It is worth noting that in Germany, the starting point of the Industry 4.0 process, the search intensity awareness in 2023 fell below 30. It can be said that CPS technology forms a kind of theoretical infrastructure of DT technology (Tao et al., 2019). For this reason, it is believed that the awareness in CPS is shifting towards DT.

Table 5

Awareness Analysis of Addictive Manufacturing Technology According to Search Data Density

Addictive Manufacturing	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness: India	Lowest Awareness: Japan
Unlike traditional manufacturing technologies, production is achieved by adding raw materials rather than subtracting them. The benefits include reducing the time between product development and production, eliminating raw material waste, and reducing distribution costs and delivery times. 3D printing is also known as additive manufacturing. 3D printing includes width, length and height (Floyd et al., 2017; Julia et al., 2021; Koch et al., 2021).		
Related Technologies	Awareness Ranking According to Search Data in 2023	
		

According to the search intensity data for additive manufacturing (3D printing) technology across G20 countries, the lowest average awareness was in Japan, and the highest was in India. The 2023 search intensity data shows that India's high awareness continues. According to the 2023 search intensity data, awareness is above 40 in all countries except Japan. Awareness might be expected to be higher in Japan because it is the second country with the highest number of patents in this field (Epo, 2023) and the investments made (Sher, 2020).

Table 6

Awareness Analysis of 4-D Printing Technology According to Search Data Density

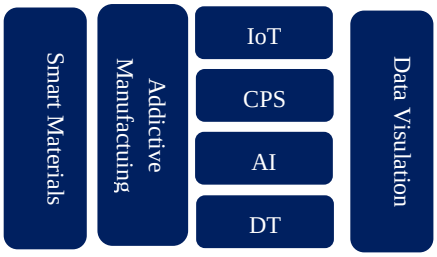
4-D Printing	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness:	Lowest Awareness:
4D printing technology enables an object to change shape in response to a stimulus. In 4D printing technology, the time dimension in which the stimulus is applied is added as a fourth dimension to the dimensions of width, length and height. The stimuli in 4D printing technology can be air, water, heat or specially designed alloys (smart materials) (Becher, 2023; Julia et al., 2021; Koch et al., 2021).	Search intensity data is not available.	Search intensity data is not available.
Related Technologies	Awareness Ranking According to Search Data in 2023	
	Search intensity data is not available. As 4D printing technology is not as widely used as additive manufacturing, it is assumed that there is no data.	

Table 7

Awareness Analysis of Wifi v6 Technology According to Search Data Density

Wifi v6	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness:	Lowest Awareness:
Wi-Fi v6, wireless access technology, allows more devices to be connected to the wireless access point and provides a faster communications infrastructure. Compatibility between Wi-Fi v6 and 5G allows users of these two technologies to ensure uninterrupted communications when transitioning from one to the other (Cisco Products and Services, 2021; Goss, 2022).	Search intensity data is not available.	Search intensity data is not available.
Related Technologies	Awareness Ranking According to Search Data in 2023	
	Search intensity data is not available.	

Table 8

Awareness Analysis of 5G Technology According to Search Data Density

5G	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness:	Lowest Awareness:
5G describes the next generation of mobile networks with high speed, superior reliability and negligible latency. 1G introduced analogue voice, 2G introduced digital voice, 3G introduced mobile data, and 4G introduced high-speed mobile data (Goss, 2022; Mertes et al., 2022; Vargas & Tien, 2023).	Search intensity data is not available.	Search intensity data is not available.
Related Technologies	Awareness Ranking According to Search Data in 2023	
IoT Wifi v6.	Search intensity data is not available.	

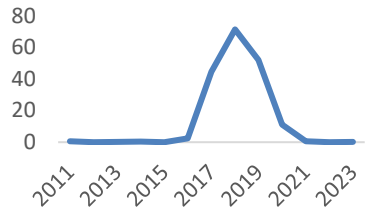
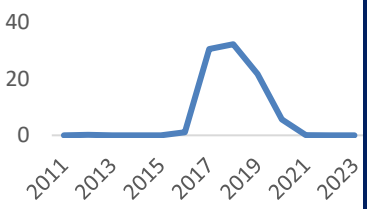
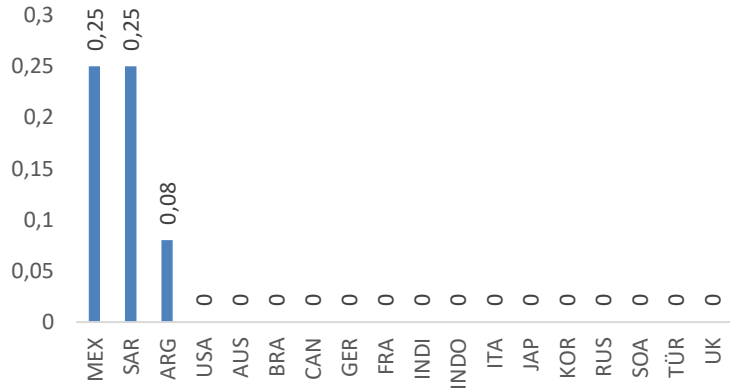
Table 9

Awareness Analysis of LoRa Networks Technology According to Search Data Density

LoRa Networks	13-year average of highest and lowest awareness levels	
Definition	Highest Awareness:	Lowest Awareness:
LoRa networks are being used to address the need for reliable, low-power transmission of data collected by IoT devices over long distances as Internet of Things (IoT) applications proliferate (LoRa Alliance, 2022).	Search intensity data is not available.	Search intensity data is not available.
Related Technologies	Awareness Ranking According to Search Data in 2023	
IoT	Search intensity data is not available.	

Table 10

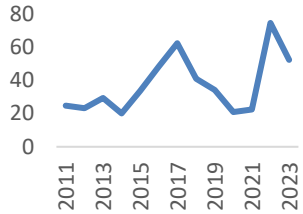
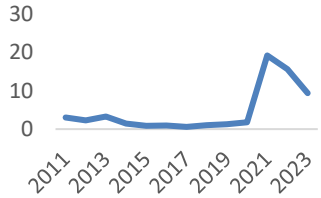
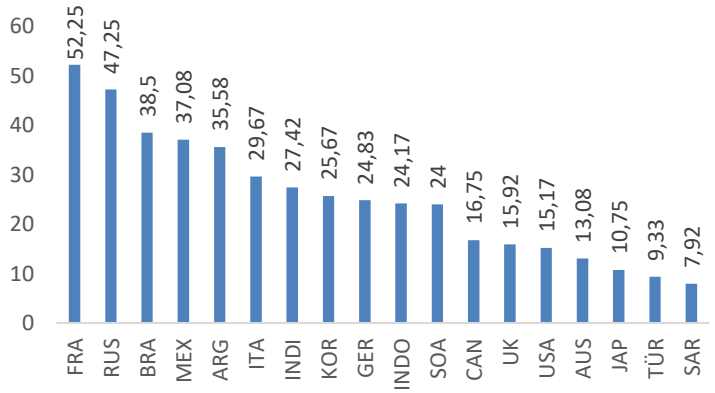
Awareness Analysis of Blockchain Technology According to Search Data Density

<table>
<tr><td>Blockchain</td><td colspan="2">13-Year Average of Highest and Lowest Awareness Levels</td></tr>
<tr><td>Definition</td><td>Highest Awareness: Mexican</td><td>Lowest Awareness: Türkiye</td></tr>
<tr><td>Blockchain is defined as a shared, immutable digital ledger that facilitates the process of recording transactions and tracking assets in a business network. Those who own the ledger can view the data but cannot change it. If a record is incorrect, the incorrect record is not deleted, but the correct record is added. The data recorded in the ledger are called blocks (Altaf et al., 2022; Pal & Yasar, 2020).</td><td> 
</td><td> 
</td></tr>
<tr><td>Related Technologies</td><td colspan="2">Awareness Ranking According to Search Data in 2023</td></tr>
<tr><td>MV
NFT
IoT
Web 3.0</td><td colspan="2"> 
</td></tr>
</table>

According to search intensity data across G20 countries provided by Google Trends, there is almost no awareness of blockchain technologies as of 2021. The lowest average awareness is in Türkiye, and the highest is in Mexican. However, blockchain awareness is almost nonexistent in the 2023 search intensity data except in Mexican, Saudi Arabia and Argentina. It is less than 1 in these three countries. There may be conceptual complexity in society regarding Blockchain technology and the concept of the cryptocurrency bitcoin, which was developed using Blockchain technology as its foundation.

Table 11

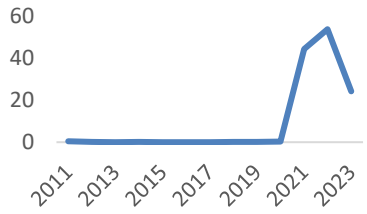
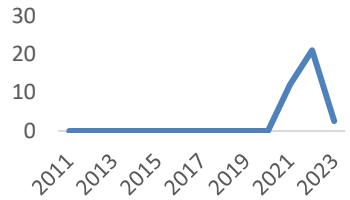
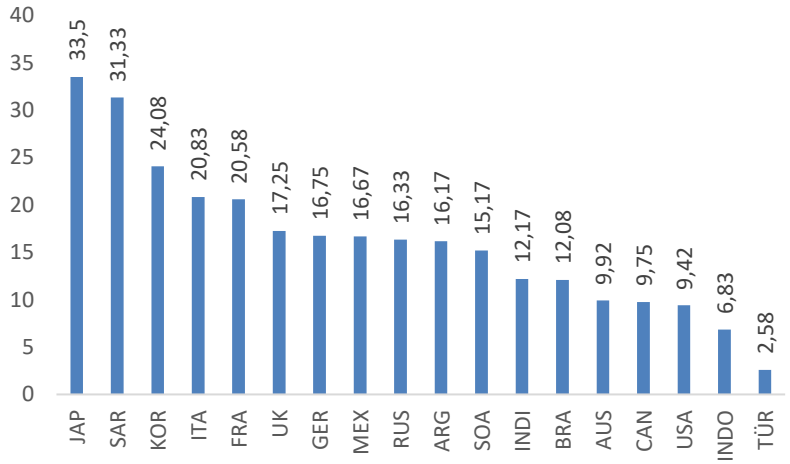
Awareness Analysis of Web 3.0 Technology According to Search Data Density

<table>
<tr><td>Web 3.0</td><td colspan="2">13-Year Average of Highest and Lowest Awareness Levels</td></tr>
<tr><td>Definition</td><td>Highest Awareness: France</td><td>Lowest Awareness: Türkiye</td></tr>
<tr><td>Web 3.0 technology differs from the previous WWW (World Wide Web) technologies. Web 3.0 is based not on sharing content by storing it in centralised resources but on sharing it using blockchain technologies in a distributed architecture. In Web 1.0, content was shared unidirectionally from the server to the user. In Web 2.0, two-way sharing between users and content producers emerged. In other words, interaction between users and content producers was born. In Web 3.0, content is not stored on central servers but between those with blockchain infrastructure and Web 3.0 applications (Kapan & Üncel, 2020).</td><td> 
</td><td> 
</td></tr>
<tr><td>Related Technologies</td><td colspan="2">Awareness Ranking According to Search Data in 2023</td></tr>
<tr><td>MV
NFT
BC
WWW</td><td colspan="2"> 
</td></tr>
</table>

According to the search intensity data for Web 3.0 technology across G20 countries, Türkiye has the lowest average awareness, and France has the highest average. According to the 2023 search intensity data, the highest average awareness is in France. It is evident that France is actively pursuing studies on Web 3.0 technologies, particularly through startup entrepreneurs. Notably, at Station F, a campus dedicated to startups, more than 1500 startups are active simultaneously. (Station F, 2023).

Table 12

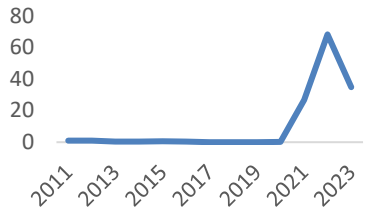
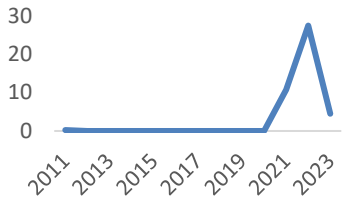
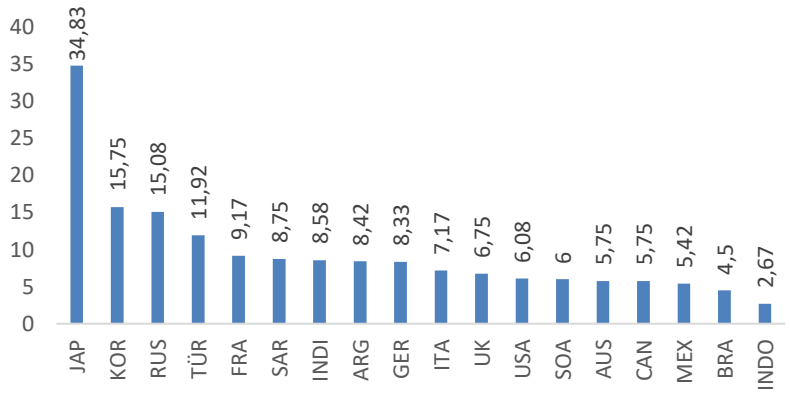
Awareness Analysis of Metaverse Technology According to Search Data Density

<table>
<tr><td>Metaverse</td><td colspan="2">13-Year Average of Highest and Lowest Awareness Levels</td></tr>
<tr><td>Definition</td><td>Highest Awareness: Republic of Korea</td><td>Lowest Awareness: Türkiye</td></tr>
<tr><td>Metaverse is used to express the structure in which a copy of objects in the physical world is represented in a virtual environment. Objects in this definition can include all kinds of objects such as people, cars, animals, houses, works of art, etc. (Abbasi, 2022; Lee et al.) Metaverse uses virtual reality and augmented reality technologies (Abbasi, 2022; Lee et al., 2021).</td><td> 
</td><td> 
</td></tr>
<tr><td>Related Technologies</td><td colspan="2">Awareness Ranking According to Search Data in 2023</td></tr>
<tr><td> 
</td><td colspan="2"> 
</td></tr>
</table>

According to the search intensity data of Metaverse technology across G20 countries, the lowest average awareness was in Türkiye, and the highest average awareness was in the Republic of Korea. It is thought that the reason for the high awareness in the Republic of Korea is that the Republic of Korea announced in 2021 that the studies on the Metaverse should be supported by state policies and carried out studies in this field (Koçak, 2016; Kurtuluş & Tekin, 2023). It is thought that necessary state policies should be produced to increase the awareness of new technologies among businesses and society.

Table 13

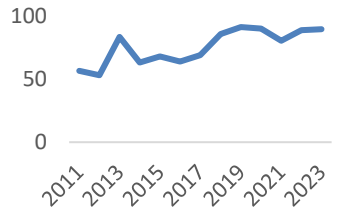
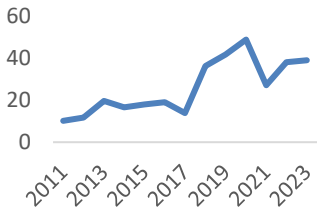
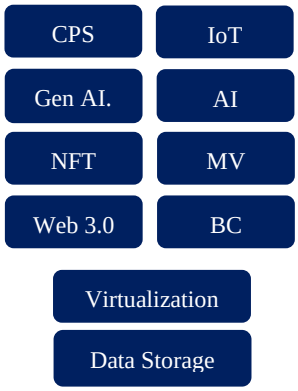
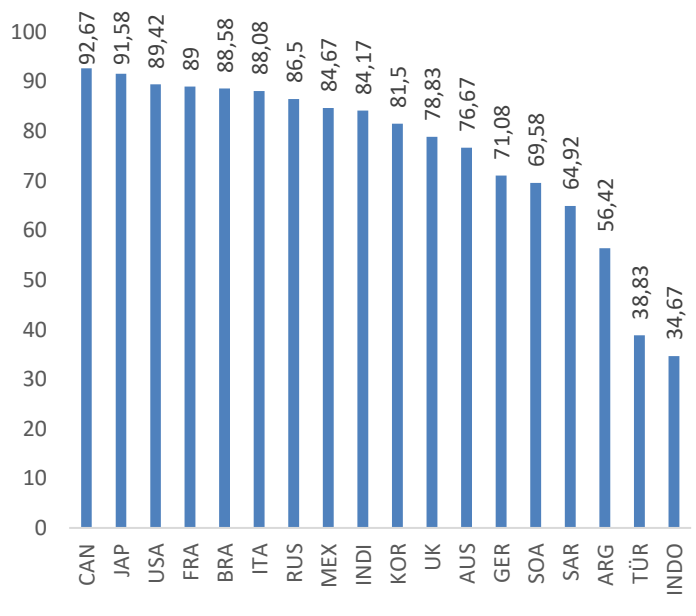
Awareness Analysis of NFT Technology According to Search Data Density

<table>
<tr><td>NFT</td><td colspan="2">13-Year Average of Highest and Lowest Awareness Levels</td></tr>
<tr><td>Definition</td><td>Highest Awareness: Japan</td><td>Lowest Awareness: Brazil</td></tr>
<tr><td>NFTs can be defined as the technology that enables the price regulation of objects in the virtual world with proof of ownership. The main link between the metaverse and NFTs is digital assets and how they are valued. While the metaverse allows digital forms of art and property to be displayed, NFTs allow this content to be priced with proof of ownership (Abbasi, 2022).</td><td> 
</td><td> 
</td></tr>
<tr><td>Related Technologies</td><td colspan="2">13-Year Average Of Highest And Lowest Awareness Levels</td></tr>
<tr><td>BC
MV
Web 3.0</td><td colspan="2"> 
</td></tr>
</table>

According to the data on the search intensity of NFT technology in the G20 countries, the lowest average awareness occurred in Brazil, and the highest average awareness occurred in Japan. Web 3.0 is associated with Metaverse and NFT. Web 3.0 is the technological infrastructure of Metaverse and NFT. Awareness of Metaverse and NFT is parallel. The high awareness of both Metaverse and NFT technologies in the Republic of Korea and Japan is believed to be largely due to awareness campaigns facilitated by government policies (Koçak, 2016).

Table 14

Awareness Analysis of Cloud Computing Technology According to Search Data Density

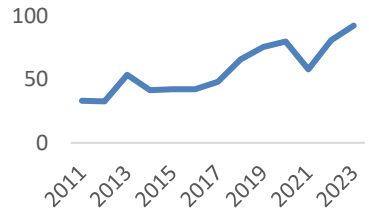
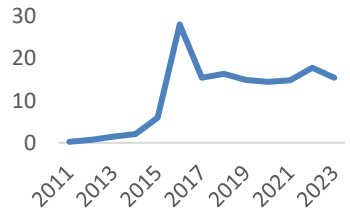
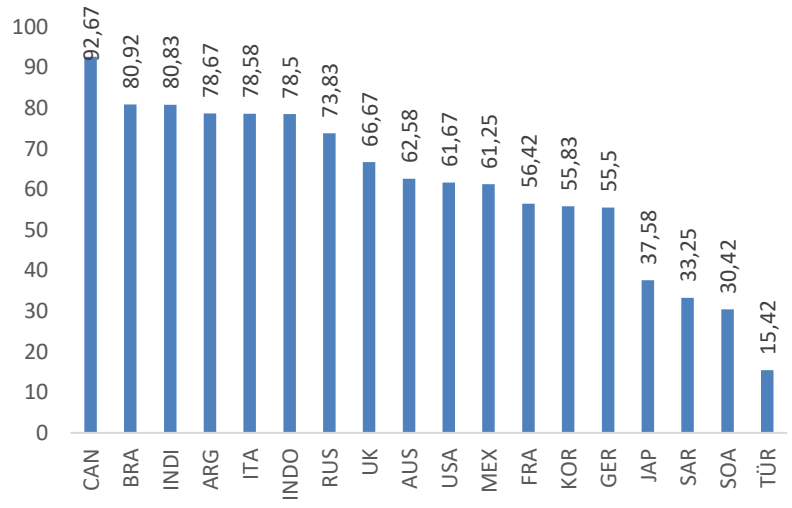
Cloud Computing	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness: USA	Lowest Awareness: Türkiye
Cloud computing is the virtualisation of information technology resources such as processors, RAM, disk capacity and bandwidth that businesses need and can use from anywhere. The focus is on using the resources, not managing them. Businesses can establish a cloud computing infrastructure using their local facilities or procure necessary resources by purchasing services from cloud computing service providers. In general, there are three different types of cloud computing services: SaaS (Service as a Software), PaaS (Platform as a Service) and IaaS (Infrastructure as a Service) (Almurisi & Tadisetty, 2022; Golightly et al., 2022; IBM, 2016; Taleb & Mohamed, 2020).		
Related Technologies	Awareness Ranking According to Search Data in 2023	
		

According to the search intensity data for cloud computing technology across G20 countries, Türkiye has the lowest average awareness, and the USA has the highest average. It is noteworthy that Türkiye has the lowest average density data. This is because Türkiye is one of the leading countries in cloud computing, especially in the public sector. It is one of the world's leading countries in e-government. In this context, it can be seen that there is a contradiction between Türkiye's awareness rate in the research and the studies conducted in the field of cloud computing in Türkiye (T.C. Cumhurbaşkanlığı Dijital

Dönüşüm Ofisi, 2022). However, more than 51% of the more than 10,000 businesses established in Technoparks under the auspices of the Ministry of Industry and Technology of the Republic of Türkiye work in the field of software. The software developed in the Technoparks is generally operated with cloud computing architecture (T.C. Sanayi ve Teknoloji Bakanlığı Ar-Ge Teşvikleri Genel Müdürlüğü, 2023). Evaluated in this context, it is believed that the digital transformation-oriented corporate culture that businesses need in digital transformation can be more easily achieved if efforts are made to increase the awareness of cloud computing technologies among society and employees in Türkiye.

Table 15

Awareness Analysis of IoT Technology According to Search Data Density

IoT	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness: Canada	Lowest Awareness: Türkiye
IoT is about all kinds of objects, such as computers, phones, machines, sensors, people, animals, etc., sending data to the network. Analysis of this data provides knowledge that many systems can use. IoT is one of the most fundamental building blocks for obtaining data through digital systems (Abdulkareem et al., 2021; Albert, 2015; Duo et al., 2022; Villamil et al., 2020).		
Related Technologies	Awareness Ranking According to Search Data in 2023	
CPS, DT, Gen AI., AI, AM, Cobot		

According to data on the search intensity of IoT technologies in G20 countries, Türkiye has the lowest average awareness, and Canada has the highest average awareness. Anadolu Agency, the official news agency of the Republic of Türkiye, reported that 81% of Turkish businesses use IoT technology, based on a survey conducted by cybersecurity business Kaspersky on the cybersecurity of IoT systems (Yanık, 2020). In addition, IoT in Türkiye is making its way into households, especially in the white goods sector (Arçelik, 2022; Vestel, 2022). These data and the research results are contradictory with regard

to Turkish data. In this context, it can be said that the society in Türkiye uses IOT technologies but has a low awareness of the technology they use.

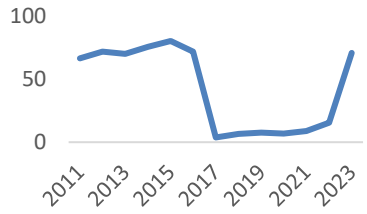
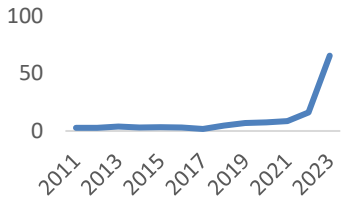
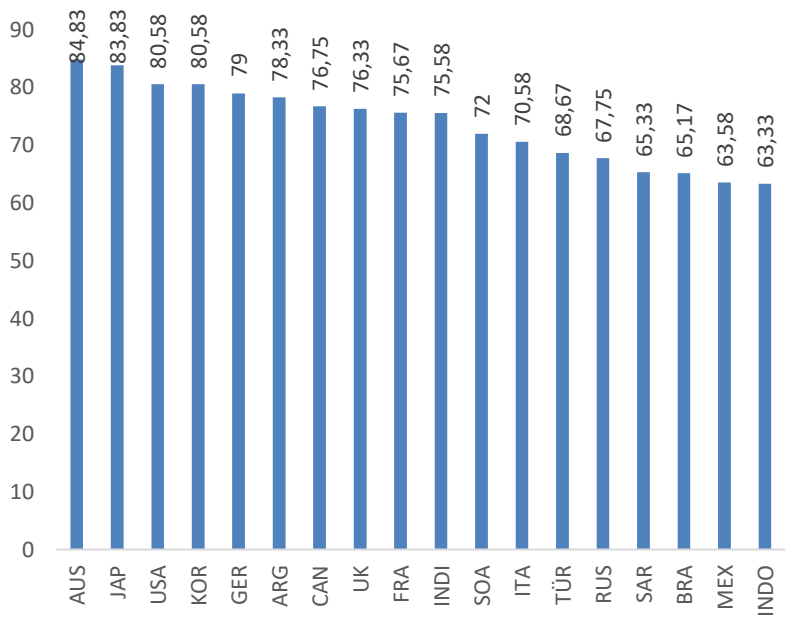
Table 16

Awareness Analysis of IoB Technology According to Search Data Density

IoB	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness:	Lowest Awareness:
It is about capturing human behaviour as data and transferring that data to information systems. By analysing these data, decisions can be made more efficiently about the psychological state of employees in the work environment and processes related to the way they do business (Duo et al., 2022; Gills, 2022; Sun et al., 2023). Within the scope of the Industry 5.0 process, the Internet of Behaviour is considered to be an essential focal point in this period, as it attempts to explain the cooperation between employees and technology (European Commission, 2022; Grabowska et al., 2022; Xu et al., 2021).	Search intensity data is not available.	Search intensity data is not available.
Related Technologies	Awareness Ranking According to Search Data in 2023	
CPS DT Gen AI. AI IoT Cobot Wearable Technologies	Search intensity data is not available.	

Table 17

Awareness Analysis of Artificial Intelligence Technology According to Search Data Density

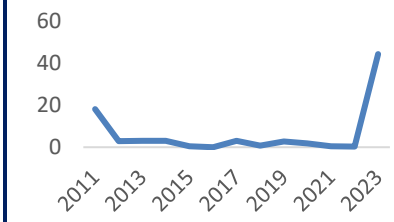
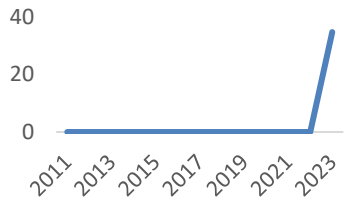
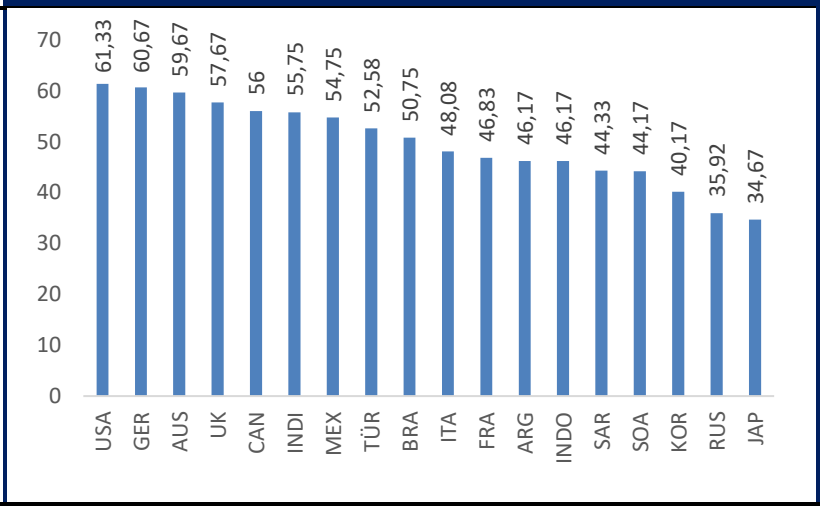
Artificial Intelligence	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness: Italy	Lowest Awareness: Saudi Arabia
The literature defines intelligence as a force encompassing personal activities such as learning, reasoning and understanding. Artificial intelligence is defined as a metaphor because machine learning, reasoning, and decision-making processes are similar to human intelligence. There are three types of artificial intelligence (Anyoha, 2017; Cannataro et al., 2022; Enholm et al., 2022; Korteling et al., 2021). Today, it is possible to see artificial intelligence-based software in many areas, such as autonomous vehicles, personal assistants, content generation software, decision support systems, financial tools and health applications.		
Related Technologies	Awareness Ranking According to Search Data in 2023	
IoT, IoB, CPS, DT, RPA, CC, CO		

According to the data on search intensity for artificial intelligence technology in the G20 countries, the lowest average awareness was in Saudi Arabia, and the highest was in Italy. However, when the year 2023 is evaluated, it is seen that the awareness of all G20 countries within the scope of the study is

above 60. It can be said that technologies related to artificial intelligence have a high level of awareness throughout society. This awareness is valuable considering that studies on artificial intelligence have affected many areas in the public and private sectors (Azadi Moghadam et al., 2024; Colbran & Toker, 2023; T.C. Cumhurbaşkanlığı Dijital Dönüşüm Ofisi, 2021; Currie, 2023; Lv, 2023; Ratten & Jones, 2023; Saenkhum & Kim, 2023; Sikka et al., 2022).

Table 18

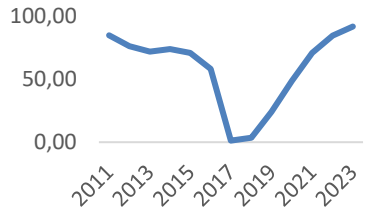
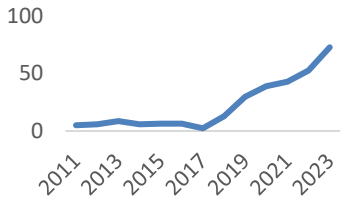
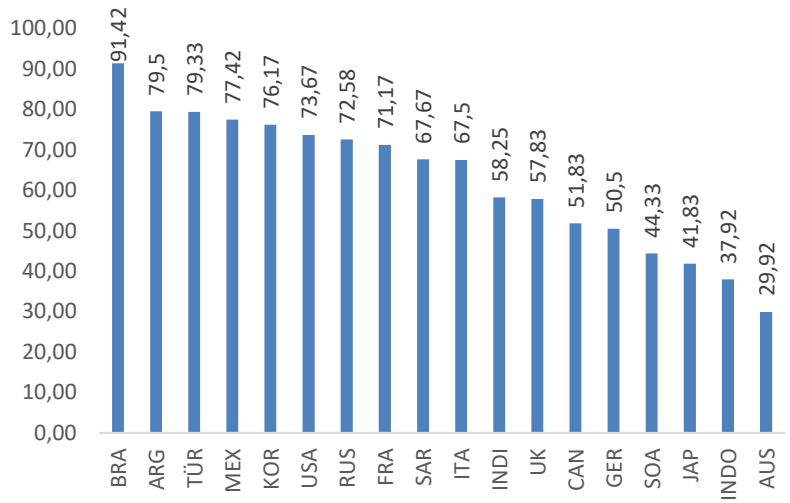
Awareness Analysis of Generative Artificial Intelligence Technology According to Search Data Density

Generative Artificial Intelligence	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness: South Africa	Lowest Awareness: Japan
Generative artificial intelligence refers to a type of AI capable of independently producing new content, including text, images, audio, and video (Lv, 2023).		
Related Technologies	Awareness Ranking According to Search Data in 2023	
CC AI		

According to the data on search intensity of generative artificial intelligence technology across G20 countries, Japan has the lowest average awareness, and South Africa has the highest average awareness. However, while South Africa's awareness will not change by 2023, the awareness of other countries will increase significantly. It can be said that the free use of generative artificial intelligence applications such as Chat-GPT for the use of society has increased the interest in generative artificial intelligence. The continuous expansion of the applications of generative artificial intelligence is in line with the findings of this study. (Eke, 2023; McKinsey, 2023; Moorhouse et al., 2023).

Table 19

Awareness Analysis of Robotic Process Automation Technology According to Search Data Density

Robotic Process Automation	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness: Brazil	Lowest Awareness: Russia
It is a technology that automates routine business processes that humans perform, such as queries, calculations, record creation, and updating (Tucci, 2021). Traditional robotic process automation technologies can work with structured data (Lawton, 2021b). The business processes taken over by robotic process automation have attempted to be described by the concept of hyper-automation, according to Gartner in 2019. Hyperautomation can also be defined as the digital twin of business processes.		
Related Technologies	Awareness Ranking According to Search Data in 2023	
Gen AI. AI		

According to the search intensity data for robotic process automation technology across the G20 countries, Russia has the lowest average awareness, and Brazil has the highest average. While Brazil's awareness is noteworthy, awareness is above 40 in all G20 countries except Indonesia and Japan. This result is valuable. This is because robotic process automation technologies are now being used in businesses to automate business processes (Lawton, 2021a, 2021b; Rogers & Zvarikova, 2021; Tucci, 2021).

Table 20

Awareness Analysis of Cognitive Automation Technology According to Search Data Density

Cognitive Automation	13-Year Average of Highest and Lowest Awareness Levels	
Definition	Highest Awareness:	Lowest Awareness:
Cognitive automation is described as a technology that combines artificial intelligence and process automation capabilities to make the results of a job more efficient. While traditional robotic process automation only works with structured data, cognitive automation can also analyse unstructured data from emails, phone calls and videos. Cognitive automation systems are more challenging to manage than robotic process automation (Lawton, 2021b).	Search intensity datais not available.	Search intensity datais not available.
Related Technologies	Awareness Ranking According to Search Data in 2023	
RPA AI Gen AI.	Search intensity datais not available.	

Conclusion and Evaluation

Digital transformation has affected many institutions, from the private to the public. In a world that is globalised in many ways, distances between people have virtually disappeared. In other words, the virtual world has generated a digital twin of various objects, including people, goods, food, and more. These digital twins have led to many innovations in trade and human relations. A trade item sold at one end of the world can be examined in great detail from the other end of the world. These items can be tried virtually in some sectors, such as clothing. Such changes are called disruptive innovation (Güleç, 2020). Businesses must be aware of this issue during disruptive innovation (Bilge, 2017). For all business stakeholders to adopt a digital transformation-oriented corporate culture, barriers to digital transformation within the business must be removed. One of these is the corporate culture barrier unrelated to digital transformation (Güvener, 2019). The corporate culture barrier consists of the resistance of employees within the business to change. This resistance consists of a corporate culture that does not refer to digital transformation. In order to remove this barrier, the corporate culture must be transformed into a corporate culture that refers to digital transformation. One of the components that influence corporate culture is national culture. National culture is also related to public awareness (Adel, 2022; Capgemini Digital Transformation Institute, 2018; Cherian et al., 2021; Didonato & Gill, 2015; Khan & Smith Law, 2015; Mandal, 2022; Moraes & Lepikson, 2017; Özutku, 2019). Although it is challenging to determine society's awareness fully, Google Trends data is an important database where search intensity data is stored to shed light on awareness in this context (Bredenoord, 2016).

As part of the study, the Google Trends database was analysed concerning 2011 - 2023 (01.05.2023 - 20.12.2023) to contribute to creating a corporate culture in the digital transformation process in businesses in 18 G20 countries. The research looked at trend technologies in four categories: manufacturing, communications, internet and information technologies and data collection, analysis and automation technologies. There is insufficient search intensity data in the Google Trends database for 5G, Wifi v6 and LoRa networks among the selected trend technologies in the communications category.

When analysing the search intensity data in the field of manufacturing, it can be seen that the USA, Germany and India have a high level of social awareness.

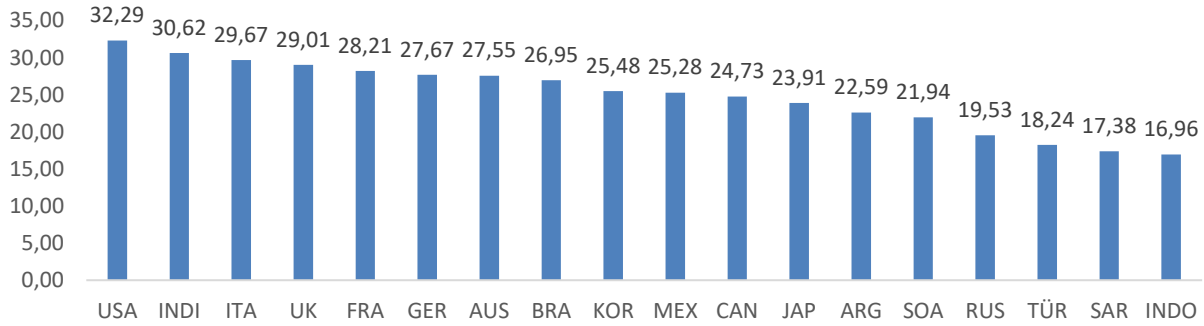
When analysing the search intensity data in the field of Internet and technologies, it can be seen that the social awareness of the USA, Japan, the Republic of Korea and France is high. In the search intensity data in the field of Internet and technologies, the awareness of blockchain technology in 2021 is below 1 for all countries. This result shows that awareness has not increased at all. Blockchain technology forms the infrastructure of digital currencies (such as Bitcoin, Ethereum, and digital Turkish lira), also used in the metaverse (Altaf et al., 2022). It is assumed that the reason for the negligible social awareness of this topic is that societies are more interested in technologies such as the metaverse and digital money, which are brought about by technological infrastructure, than in the technological infrastructure related to this topic.

An analysis of the search intensity data for data collection, analysis and automation technologies shows that Canada, Italy, South Africa and Brazil have a high level of awareness. The Internet of Behaviours and cognitive automation technologies could not be collected as no topic exists in the Google Trends infrastructure. In particular, the concept of the Internet of Behaviours is important in terms of collaboration between employees and technology in the Industry 5.0 process. It is important for businesses to get instant data from employees, as in IoT technology, to analyse their attitudes and reveal their tacit knowledge instantly.

Analysing the average search intensity data for the years 2011-2023, the ranking of awareness of trending technologies for the G20 countries is shown in Figure 1. Analysing this ranking, we see that the USA has the highest awareness and Indonesia has the lowest. When analysing the values in the awareness ranking, it can be seen that there is a difference of about two times between the highest awareness and the lowest awareness. It is natural for the USA, the world's largest economy, to have the highest average awareness, especially with its technological development.

Figure 1

Average Search Intensity Graph of Trending Technologies Across G20 Countries for the Period 2011-2023

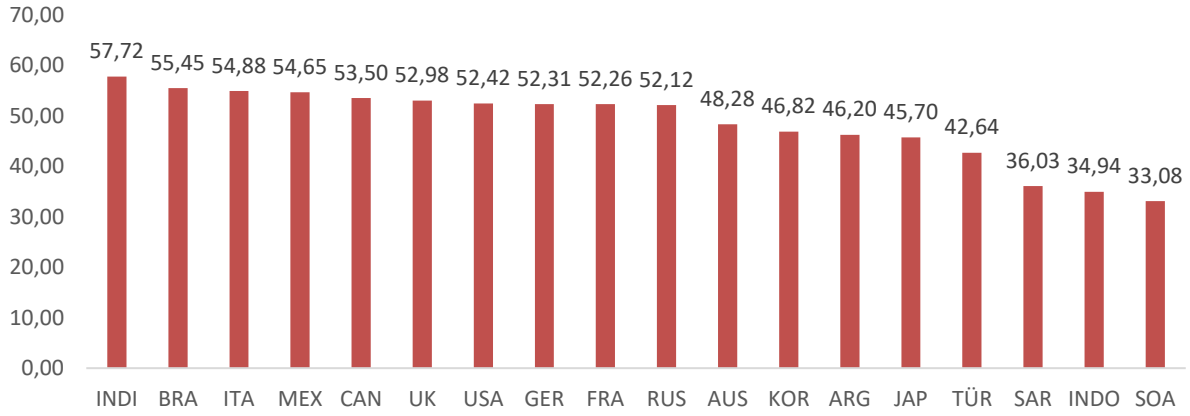


Note. The X-axis shows the G20 countries, and the Y-axis shows the awareness data with values between 1-100 taken from the Google Trends database

The awareness ranking of the trending technologies in the study according to the average search intensity data for 2023 is also shown in Figure 2. This chart shows that India has the highest awareness with 57.72, and South Africa has the lowest awareness with 33.08. According to the average of the 13-year data in Figure 1, the USA, which is ranked first, has dropped to seventh place for 2023. According to the data in Figure 2, the awareness of all countries is above 30. According to the same chart, India, Brazil, Italy, Canada, the United Kingdom, the United States, Germany and France will be among the ten largest economies in the world (IMF, 2023).

Figure 2

Average Search Intensity Graph of Trending Technologies Across G20 Countries for 2023



Note. The X-axis shows the G20 countries, and the Y-axis shows the awareness data with values between 1-100 taken from the Google Trends database

In order to increase social awareness of the technologies used in digital transformation processes, policies should first be developed at the state level. When developing policies, it may be more appropriate to listen to the advice of expert committees in the field.

Starting with primary education, curricula at all levels should be structured to cover new technologies.

Activities can be conducted to foster technological awareness in society. One such initiative is the Teknofest event organized in Türkiye. This event aims to engage young people in the domestic development of global technologies (Altuğ & Akkoyun, 2023).

As a result, this study attempted to identify the social awareness of trending technologies in order to develop a corporate culture that supports digital transformation in businesses' digital transformation processes. This awareness is essential in shaping the national culture and the corporate culture concerning digital transformation (Levin & Mamlok, 2021). Every individual in society who is fit for work is a potential employee for businesses. Raising awareness of trend technologies among potential employees is believed to significantly contribute to creating a corporate culture that is needed by businesses, and that takes digital transformation as a reference. However, studies on awareness of trend technologies should be evaluated country-by-country. The cultural structure of each country is different. Studies conducted in different countries can also be adapted to the cultural structure.

Compliance with Ethical Standards

Ethical Approval

It was declared by the author that the tools and methods used in the study do not require the permission of the Ethics Committee. It was declared by the author that scientific and ethical principles have been followed in this study and all the sources used have been properly cited.

Author Contributions

The author confirms the sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

References

Abbasi, A. (2022). (25.10.2023) *The metaverse and NFTs: What agencies and brand leaders should know*. https://www.forbes.com/sites/forbesagencycouncil/2022/01/06/the-metaverse-and-nfts-what-agencies-and-brand-leaders-should-know/?sh=2edfec54200b

Abdulkareem, N. M., Zeebaree, S. R. M., Sadeeq, M. A. M., Ahmed, D. M., Sami, A. S., & Zebari, R. R. (2021). IoT and cloud computing issues, challenges and opportunities: A review. *Qubahan Academic Journal*, *1*(2), 1-7. https://doi.org/10.48161/qaj.v1n2a36

Adel, A. (2022). Future of industry 5.0 in society: human-centric solutions, challenges and prospective research areas. *Adel Journal of Cloud Computing*, *11*, 40. https://doi.org/10.1186/s13677-022-00314-5

Ahmad, S., Miskon, S., Alabdan, R., & Tlili, I. (2020). Towards sustainable textile and apparel industry: Exploring the role of business intelligence systems in the era of industry 4.0. *Sustainability (Switzerland)*, *12*(7), 2632. https://doi.org/10.3390/su12072632

Akanmu, A. A., Anumba, C. J., & Ogunseiju, O. O. (2021). Towards next generation cyber-physical systems and digital twins for construction. *Journal of Information Technology in Construction*, *26*, 505-525. https://doi.org/10.36680/j.itcon.2021.027

Albert, M. (2015). Seven things to know about the internet of things. *Modern Machine Shop*, *88*(4), 74–81.

Almurisi, N., & Tadisetty, S. (2022). Cloud-based virtualization environment for IoT-based WSN: solutions, approaches and challenges. *Journal of Ambient Intelligence and Humanized Computing*, 13, 4681-4703. https://doi.org/10.1007/s12652-021-03515-z

Altaf, A., Iqbal, F., Latif, R., Yakubu, B. M., Latif, S., & Samiullah, H. (2022). A survey of blockchain technology: Architecture, applied domains, platforms, and security threats. *Social Science Computer Review*, *41*(5), 1941-1962. https://doi.org/10.1177/08944393221110148

Altair. (2022). (25.10.2023) *2022 digital twin global survey report*. https://altair.com/docs/default-source/pdfs/altair_dt-global-survey-report_web.pdf

Altuğ, F., & Akkoyun, K. (2023). Geçici kümelerin inovasyon süreçlerinin gelişmesine etkisi: Teknofest örneği. *International Journal of Geography and Geography Education*, *50*, 267-284. https://doi.org/10.32003/igge.1264500

Amazon Web Services. (2023). (25.10.2023) *What is an API? - Application programming interface explained - AWS*. https://aws.amazon.com/what-is/api/

Anyoha, R. (2017). (15.09.2023) *The history of artificial intelligence - Can machines think?* Harvard University. https://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/

Apilioğulları, L. (2018). *Dijital dönüşümün yol haritası endüstri 4.0: Değişimin değiştirdikleri* (1st ed.). Agora Kitaplığı.

Arçelik. (2022). (25.08.2023) *Arçelik 2022 faaliyet raporu*. https://www.arcelikglobal.com/media/7260/arcelik_fr_22_tr.pdf

Attaran, M., & Celik, B. G. (2023). Digital twin: Benefits, use cases, challenges, and opportunities. *Decision Analytics Journal*, *6*, 100165. https://doi.org/10.1016/j.dajour.2023.100165

Azadi Moghadam, P., Bashashati, A., & Goldenberg, S. L. (2024). Artificial intelligence and pathomics: Prostate cancer. *Urologic Clinics of North America*, *51*(1), 15–26. https://doi.org/https://doi.org/10.1016/j.ucl.2023.06.001

Balderas, D., Ortiz, A., Méndez, E., Ponce, P., & Molina, A. (2021). Empowering digital twin for industry 4.0 using metaheuristic optimization algorithms: Case study PCB drilling optimization. *International Journal of Advanced Manufacturing Technology*, *113*(5–6), 1295–1306. https://doi.org/10.1007/s00170-021-06649-8

Baraković, S., & Baraković Husić, J. (2022). *Digital transformation challenges: The cyber security threats of cryptocurrency technology use*. In proceedings of First International Conference on Advances in Traffic and Communication Technologies (ATCT 2022), (pp. 77-83). https://doi.org/10.59478/atct.2022.11

Bartodziej, C. J. (2017). The concept Industry 4.0. In *The Concept Industry 4.0* (pp. 27–50). https://doi.org/10.1007/978-3-658-16502-4_3

Becher, B. (2023). *What Is 4D printing? | Built In*. https://builtin.com/3d-printing/4d-printing

Benotsmane, R., Kovács, G., & Dudás, L. (2019). Economic, social impacts and operation of smart factories in Industry 4.0 focusing on simulation and artificial intelligence of collaborating robots. *Social Sciences*, *8*(5), 143. https://doi.org/10.3390/socsci8050143

Bilge, B. (2017). Yıkıcı teknolojilerin belirlenmesi. *Savunma Bilimleri Dergisi*, *16*(1), 57–83.

Biswas, R. (2023). (25.10.2023) *India's manufacturing output surges while inflation pressures ease | S&P Global*. https://www.spglobal.com/marketintelligence/en/mi/research-analysis/indias-manufacturing-output-surges-while-inflation-pressures-ease-oct23.html

Bourlakis, M., Papagiannidis, S., & Li, F. (2009). Retail spatial evolution: Paving the way from traditional to metaverse retailing. *Electronic Commerce Research*, *9*(1–2), 135–148. https://doi.org/10.1007/s10660-009-9030-8

Bredenoord, B. J. B. (2016). (19.10.2023) *Culture and queries: Google search data as a reflection of national culture*. http://essay.utwente.nl/70141/

Cannataro, M., Guzzi, P. H., Agapito, G., Zucco, C., & Milano, M. (2022). Artificial intelligence. *Artificial Intelligence in Bioinformatics*, 29–33. https://doi.org/10.1016/B978-0-12-822952-1.00012-7

Capgemini Digital Transformation Institute. (2018). *The digital culture challenge: Closing the employee-leadership gap*.

Cherian, J., Gaikar, V., Paul, R., & Pech, R. (2021). Corporate culture and its impact on employees' attitude, performance, productivity, and behavior: An investigative analysis from selected organizations of the United Arab Emirates (UAE). *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), 45. https://doi.org/10.3390/JOITMC7010045

Cisco Products and Services. (2021). (19.10.2023) *What is WiFi 6? (802.11ax) - Cisco*. https://www.cisco.com/c/en/us/products/wireless/what-is-wi-fi-6.html

Cobb, A. N., Benjamin, A. J., Huang, E. S., & Kuo, P. C. (2018). Big data: More than big data sets. *Surgery (United States)*, *164*(4), 640–642.

Colbran, R. J., & Toker, A. (2023). Regenerative artificial intelligence in Journal of Biological Chemistry. *Journal of Biological Chemistry*, *299*(8), 105008. https://doi.org/10.1016/j.jbc.2023.105008

Cumhurbaşkanlığı Dijital Dönüşüm Ofisi. (2022). (05.07.2023) *Kamu bulut bilişim stratejisi ülke incelemeleri*. https://cbddo.gov.tr/SharedFolderServer/Genel/File/UIR_Raporu.pdf.

Cumhurbaşkanlığı Dijital Dönüşüm Ofisi. (2021). (07.08.2023) *Ulusal yapay zekâ stratejisi (UYZS) 2021-2025*. https://cbddo.gov.tr/SharedFolderServer/Genel/File/TR-UlusalYZStratejisi2021-2025.pdf

Currie, G. M. (2023). Academic integrity and artificial intelligence: Is ChatGPT hype, hero or heresy? *Seminars in Nuclear Medicine*, *53*(5), 719–730. https://doi.org/https://doi.org/10.1053/j.semnuclmed.2023.04.008

Daecher, A., Sniderman, B., Holdowsky, J., Cotteleer, M., Matho, M., Hanley, T. P., Murphy, T., & Rutgers, V. (2018). (15.06.2023) *The Industry 4.0 paradox Overcoming disconnects on the path to digital transformation*. Deloitte Insights. https://www.deloitte.com/middle-east/en/Industries/energy/research/the-industry-4-0-paradox.html

Davies, R. (2015). (09.08.2023) Industry 4.0. Digitalisation for productivity and growth. *European Parliamentary Research Service*. https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568337/EPRS_BRI(2015)568337_EN.pdf

Deloitte. (2015). (09.06.2023) Industry 4.0 Challenges and solutions for the digital transformation and use of exponential technologies. https://www.deloitte.com/content/dam/Deloitte/ch/Documents/manufacturing/ch-en-manufacturing-industry-4-0-24102014.pdf

Deloitte. (2018). (01.09.2023) Industry 4.0: Are you ready? *Deloitte Review*, *22*. https://www2.deloitte.com/content/dam/insights/us/collections/issue-22/DI_Deloitte-Review-22.pdf

Didonato, T., & Gill, N. (2015). (01.09.2023) *Changing an organization's culture, without resistance or blame*. Harvard Business Review. https://hbr.org/2015/07/changing-an-organizations-culture-without-resistance-or-blame

Duo, W., Zhou, M. C., & Abusorrah, A. (2022). A survey of cyber attacks on cyber-physical systems: Recent advances and challenges. *IEEE/CAA Journal of Automatica Sinica*, *9*(5), 784–800. https://doi.org/10.1109/JAS.2022.105548

Eke, D. O. (2023). ChatGPT and the rise of generative AI: Threat to academic integrity? *Journal of Responsible Technology*, *13*, 100060. https://doi.org/10.1016/J.JRT.2023.100060

Ellström, D., Holtström, J., Berg, E., & Josefsson, C. (2022). Dynamic capabilities for digital transformation. *Journal of Strategy and Management*, *15*(2), 272-286. https://doi.org/10.1108/JSMA-04-2021-0089

Enholm, I. M., Papagiannidis, E., Mikalef, P., & Krogstie, J. (2022). Artificial Intelligence and Business Value: A literature review. *Information Systems Frontiers*, *24*(5), 1709–1734. https://doi.org/10.1007/s10796-021-10186-w

Epo. (2023). *Patent filings in 3D printing grew eight times faster than average of all technologies in last decade | Epo.org*. European Patent Office. https://www.epo.org/en/news-events/news/patent-filings-3d-printing-grew-eight-times-faster-average-all-technologies-last

Ertürk, M. (2022). Google trendlere göre uzaktan çalışmaya yönelik halk ilgisi: Covid-19 pandemisi öncesi ve pandemi dönemi. *Süleyman Demirel University Journal of Human Resources Management*, *1*(2), 1–14. https://orcid.org/0000-0002-6622-0204

European Commission. (2022). (01.10.2023) *Industry 5.0*. European Commission. https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/industry-50_en

Ferber, S. (2013). (07.07.2023) Industry 4.0-Technology for the Fourth Industrial Revolution. https://www.scribd.com/document/762394211/Industry-4-0-Technology-for-the-Fourth-Industrial-Revolution-PDFDrive

Filipov, V., & Vasilev, P. (2016). Manufacturing operations management - The smart backbone of industry 4 . 0. *International Scientific Conference 'Industry 4.0'*, *27/213*, 8–13. http://stumejournals.com/ni/2016/27-213.pdf

Floyd, E. L., Wang, J., & Regens, J. L. (2017). Fume emissions from a low-cost 3-D printer with various filaments. *Journal of Occupational and Environmental Hygiene*, *14*(7), 523-533. https://doi.org/10.1080/15459624.2017.1302587

Ford, M. (2015). (01.08.2023) Industry 4.0: Who benefits? https://iconnect007.com/article/91327/industry-40-who-benefits/91330/pcb

Gabriel, M., & Pessl, E. (2016). Industry 4.0 and sustainability impacts : Critical discussion of sustainability aspects with a special focus. *International Journal of Engineering*, *14*(2), 131–137.

Garcia, J. M. V., & Pinzon, B. H. D. (2017). Key success factors to business intelligence solution implementation. *Journal of Intelligence Studies in Business*, *7*(1), 48–69.

Garcia-Perez, A., Cegarra-Navarro, J. G., Sallos, M. P., Martinez-Caro, E., & Chinnaswamy, A. (2023). Resilience in healthcare systems: Cyber security and digital transformation. *Technovation*, *121*, 102583. https://doi.org/10.1016/j.technovation.2022.102583

Gaub, H. (2016). Customization of mass-produced parts by combining injection molding and additive manufacturing with Industry 4.0 technologies. *Reinforced Plastics*, *60*(6), 401–404. https://doi.org/10.1016/j.repl.2015.09.004

Gilchrist, A. (2016). Industry 4.0 the industrial internet of things. In *Library of Congress Control Number*. Apress Media Springer Science + Business Media Finance Inc. https://doi.org/10.1007/978-1-4842-2047-4

Gills, A. S. (2022). (25.06.2023) *What is IoT (internet of things) and how does it work? - Definition from techtarget.com*. TechTarget. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT

Golightly, L., Chang, V., Xu, Q. A., Gao, X., & Liu, B. S. C. (2022). Adoption of cloud computing as innovation in the organization. *International Journal of Engineering Business Management*, *14*. https://doi.org/10.1177/18479790221093992

Google Trends. (2023) (01.09.2023). *Basics of Google trends - Google news initiative*. https://newsinitiative.withgoogle.com/resources/trainings/basics-of-google-trends/

Goss, M. (2022). (01.09.2023) *Wi-Fi 6 vs. 5G: How are they different and why we need both*. TechTarget. https://www.techtarget.com/searchnetworking/feature/A-deep-dive-into-the-differences-between-5G-and-Wi-Fi-6

Grabowska, S., Saniuk, S., & Gajdzik, B. (2022). Industry 5.0: Improving humanization and sustainability of Industry 4.0. *Scientometrics*, *127*(6), 3117–3144. https://doi.org/10.1007/s11192-022-04370-1

Güleç, T. C. (2020). Merkezi olmayan kriptopara birimlerinin yıkıcı yenilik potansiyeli. *Yönetim ve Ekonomi Dergisi*, *27*(2), 369–379. https://doi.org/10.18657/yonveek.605395

Güvener, A. (2019). *Dijital dönüşüm sürecinde çalışanların teknolojik hazıroluş seviyelerinin belirlenmesi* [PhD Thesis]. Bahçeşir University.

Hautala-Kankaanpää, T. (2022). The impact of digitalization on firm performance: examining the role of digital culture and the effect of supply chain capability. *Business Process Management Journal*, *28*(8), 90-109. https://doi.org/10.1108/BPMJ-03-2022-0122

Heynitz, H., Bremicker, M., Amadori, D. M., & Reshke, K. (2016). (05.09.2023) The Factory of the Future: Industry 4.0- The challenges of tomorrow. *Kpmg*, 1–68. https://www.kpmg.com/ID/en/IssuesAndInsights/ArticlesPublications/Documents/factory-future-industry-4.0.pdf

Holroyd, C. (2022). Technological innovation and building a 'super smart' society: Japan's vision of society 5.0. *Journal of Asian Public Policy*, *15*(1), 18-31. https://doi.org/10.1080/17516234.2020.1749340

Hoske, M. T. (2015). Industry 4.0 and internet of things tools help streamline factory automation-communication and networking for the industrial internet of things. *Control Engineering*, *62*(2), M7–M10. https://doi.org/10.1007/978-3-319-42559-7

IBM. (2016). (01.09.2023) Industry (Industrie) 4.0 and IoT. InterConnect 2016: The Premier Cloud & Mobile Conference. https://www.controleng.com/download-the-2016-iiot-industrie-4-0-report/

IMF. (2023). *(30.11.2023) World economic outlook - GDP, current prices*. https://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEOWORLD

Inamdar, A. (2022). (01.06.2023) *Digital transformation and its impact on organizational culture*. Forbes. https://www.forbes.com/sites/forbeshumanresourcescouncil/2022/07/22/digital-transformation-and-its-impact-on-organizational-culture/?sh=695a669829a2

Joppen, R., Kühn, A., Förster, M., & Dumitrescu, R. (2022). Evaluation of industry 4.0 applications in production. *Journal of the Knowledge Economy*, *14*, 2479–2514. https://doi.org/10.1007/s13132-022-00959-2

Julia, A., Forno, D., Vieira Bataglini, W., Steffens, F., & Ulson De Souza, A. A. (2021). Industry 4.0 in textile and apparel sector: a systematic literature review Systematic literature review. *Research Journal of Textile and Apparel*, *27*(1), 95-117. https://doi.org/10.1108/RJTA-08-2021-0106

Kapan, K., & Üncel, R. (2020). Gelişen web teknolojilerinin (Web 1.0-Web 2.0-Web 3.0) Türkiye turizmine etkisi. *Safran Kültür ve Turizm Araştırmaları Dergisi*, *3*(3), 276–289.

Khan, M. A., & Smith Law, L. (2015). The role of national cultures in shaping the corporate management cultures: A three country theoretical analysis. *Proceedings of the 25th International Business Information Management Association Conference - Innovation Vision 2020: From Regional Development Sustainability to Global Economic Growth, IBIMA 2015*, 2426–2443. https://doi.org/10.5772/intechopen.78051

Koçak, D. (2016). Web 1.0'dan Web 3.0'a Metaverse'ün gelişimi ve sunduğu fırsatlar. *Electronic Journal of New Media*, *7*(2), 97–113. https://doi.org/10.17932/iau.ejnm.25480200.2023/ejnm_v7i2002

Koch, H. C., Schmelzeisen, D., & Gries, T. (2021). 4D textiles textiles—an made by additive overview manufacturing on pre-stressed textiles—an overview. *Actuators*, *10*(2), 31. https://doi.org/10.3390/act10020031

Koch, V., Kuge, S., Geissbauer, R., & Schrauf, S. (2014). (29.06.2023) Opportunities and challenges of the industrial internet. *PWC and Strategy*. https://www.strategyand.pwc.com/gx/en/insights/2015/industry-4-opportunities-and-challenges/industry-4-0.pdf

Korteling, J. E. (Hans), van de Boer-Visschedijk, G. C., Blankendaal, R. A. M., Boonekamp, R. C., & Eikelboom, A. R. (2021). Human- versus Artificial Intelligence. *Frontiers in Artificial Intelligence*, *4 :622364*. https://doi.org/10.3389/frai.2021.622364

Kovacova, M., & Lewis, E. (2021). Smart factory performance, cognitive automation, and industrial big data analytics in sustainable manufacturing internet of things. *Journal of Self-Governance and Management Economics*, *9*(3), 9-21. https://doi.org/10.22381/jsme9320211

Kurtuluş, M., & Tekin, Ç. (2023). *Metaverse Kronolojisi ve Ulusal Mimarlık Ortamında Metaverse*. *3*(2), 110 - 134.

Küsters, D., Praß, N., & Gloy, Y. S. (2017). Textile learning factory 4.0 – Preparing Germany's textile industry for the digital future. *Procedia Manufacturing*, *9*, 214–221. https://doi.org/10.1016/j.promfg.2017.04.035

Kuznaz, T., Pfohl, H.-C., & Yahsi, B. (2015). The impact of industry 4.0 on the supply chain. *Innovations and Strategies for Logistics and Supply Chains*, *August*, 32–58.

Langlois, A., & Benjanmin, C. (2017). The impact of supply chain management on business intelligence. *Journal of Intelligence Studies in Business*, *7*(2), 51–61.

Lawton, G. (2021a). (30.07.2023) *RPA vs. cognitive automation: What are the key differences? | TechTarget*. TechTarget. https://www.techtarget.com/searchcio/feature/RPA-vs-cognitive-automation-What-are-the-key-differences

Lawton, G. (2021b). (30.07.2023) *What is cognitive automation?* https://www.techtarget.com/searchcio/definition/cognitive-automation

Leal-Rodríguez, A. L., Sanchís-Pedregosa, C., Moreno-Moreno, A. M., & Leal-Millán, A. G. (2023). Digitalization beyond technology: Proposing an explanatory and predictive model for digital culture in organizations. *Journal of Innovation and Knowledge*, *8*(3), 100409. https://doi.org/10.1016/j.jik.2023.100409

Lee, S., Rho, S. H., Lee, S., Lee, J., Lee, S. W., Lim, D., & Jeong, W. (2021). Implementation of an automated manufacturing process for smart clothing: The case study of a smart sports bra. *Processes*, *9(2)*, 289. https://doi.org/10.3390/pr9020289

Levin, I., & Mamlok, D. (2021). Culture and society in the digital age. *Information (Switzerland)*, *12*(2), 68. https://doi.org/10.3390/info12020068

Liao, Y., Deschamps, F., Rocha Loures, E., & Ramos, L. F. (2017). Past, present and future of Industry 4.0 - a systematic literature review and research agenda proposal. *International Journal of Production Research*, 55(12), 3609-3629.

Lichtenthaler, U. (2021). Profiting from digital transformation? Combining data management and artificial intelligence. *International Journal of Service Science, Management, Engineering, and Technology*, *12*(5), 12. https://doi.org/10.4018/IJSSMET.2021090105

Lora Alliance. (2022). (30.11.2023) *What is LoRaWAN® Specification - LoRa Alliance®*. https://lora-alliance.org/about-lorawan/

Lv, Z. (2023). Generative artificial intelligence in the metaverse era. *Cognitive Robotics*, *3*, 208–217. https://doi.org/10.1016/j.cogr.2023.06.001

Malavasi, M., & Gabriele, S. (2017). *Lean manufacturing and Industry 4.0 : An empirical analysis between sustaining and disruptive change*. [Master's Dissertation] Politecnico Di Milano.

Mancı, A. R. (2019). Üniversite öğrencilerinin kültürel miras farkındalığı ve deneyimleri: Harran Üniversitesi örneği-Şanlıurfa. *Turk Turizm Arastirmalari Dergisi*, *3*(4), 1164–1177. https://doi.org/10.26677/tr1010.2019.234

Mandal, A. (2022). (30.06.2023) *How organisational culture and national culture impact your organisation*. https://hofstede-insights.in/how-organisational-culture-and-national-culture-impact-your-organisation/

McKinsey. (2023). (30.11.2023) *What is ChatGPT, DALL-E, and generative AI? | McKinsey*. https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-generative-ai#/

Mendhurwar, S., & Mishra, R. (2021). Integration of social and IoT technologies: architectural framework for digital transformation and cyber security challenges. *Enterprise Information Systems*, *15*(4), 565-584. https://doi.org/10.1080/17517575.2019.1600041

Mertes, J., Lindenschmitt, D., Amirrezai, M., Tashakor, N., Glatt, M., Schellenberger, C., Shah, S. M., Karnoub, A., Hobelsberger, C., Yi, L., Götz, S., Aurich, J. C., & Schotten, H. D. (2022). Evaluation of 5G-capable framework for

highly mobile, scalable human-machine interfaces in cyber-physical production systems. *Journal of Manufacturing Systems*, *64*, 578–593. https://doi.org/10.1016/j.jmsy.2022.08.009

Minelli, M., Chambers, M., & Dhiraj, A. (2013). *Big data, big analytics: Emerging business intelligence and analytic trends for today's businesses, Wiley*. https://doi.org/10.1002/9781118562260

Montanus, M. (2016). Business models for industry 4.0 developing a framework to determine and assess impacts on business models in the dutch oil and gas industry, [Master Thesis], Faculty of Technology, Delft University.

Moorhouse, B. L., Yeo, M. A., & Wan, Y. (2023). Generative AI tools and assessment: Guidelines of the world's top-ranking universities. *Computers and Education Open*, *5*, 100151. https://doi.org/10.1016/J.CAEO.2023.100151

Moraes, E. C., & Lepikson, H. A. (2017). Industry 4.0 and its impacts on society. In *Proceedings of the International Conference on Industrial Engineering and Operations Management*, *2017*, 729–735.

Murugesan, U., Subramanian, P., Srivastava, S., & Dwivedi, A. (2023). A study of artificial intelligence impacts on human resource digitalization in industry 4.0. *Decision Analytics Journal*, *7:* 100249. https://doi.org/10.1016/j.dajour.2023.100249

Nandhini, R. S., & Lakshmanan, R. (2022). A review of the integration of cyber-physical system and internet of things a cyber-physical systems perception of internet of things. *International Journal of Advanced Computer Science and Applications*, *13*(4). https://doi.org/10.14569/IJACSA.2022.0130453

Narvaez Rojas, C., Alomia Peñafiel, G. A., Loaiza Buitrago, D. F., & Tavera Romero, C. A. (2021). Society 5.0: A Japanese concept for a superintelligent society. In *Sustainability (Switzerland)* 13(12). https://doi.org/10.3390/su13126567

Nyberg, E., & Nilsen, S. (2016). The adoption of Industry 4.0 technologies in manufacturing – a multiple case study. [Master Thesis]. KTH Industrial Engineering and Management.

Özutku, H. (2019). Kültürel boyutlar bağlamında örgütsel değerlerde ayrışma ve benzeşme: Fortune 500 global ve fortune 500 Türkiye listesindeki en beğenilen firmalar üzerine bir araştırma. *International Review of Economics and Management*, *7*(1), 1–27. http://dictionary.cambridge.org/tr

Pal, K., & Yasar, A. U. H. (2020). Internet of things and blockchain technology in apparel manufacturing supply chain data management. *The 11th International Conference on Ambient Systems, Networks and Technologies (ANT), 170*, 450–457. https://doi.org/10.1016/j.procs.2020.03.088

Papanagnou, C., Seiler, A., Spanaki, K., Papadopoulos, T., & Bourlakis, M. (2022). Data-driven digital transformation for emergency situations: The case of the UK retail sector. *International Journal of Production Economics*, *250*. https://doi.org/10.1016/j.ijpe.2022.108628

Passi, L. F. (2015). Italian finance industry sustains the digitalisation of the public administration-business-citizen relationship: Electronic invoicing and the CBILL Service. *Journal of Payments Strategy & Systems*, *9*(2), 132–147. http://search.ebscohost.com/login.aspx?direct=true&db=plh&AN=103611215&site=eds-live

Pavlova, E. (2020). Enhancing the organisational culture related to cyber security during the university's digital transformation. *Information & Security: An International Journal*, *46*(3), 239-249. https://doi.org/10.11610/isij.4617

Pecorari, D. (2023). Generative AI: Same same but different? *Journal of Second Language Writing*, *62*, 101067. https://doi.org/10.1016/J.JSLW.2023.101067

Pfeiffer, S. (2016). Robots, industry 4.0 and humans, or why assembly work is more than routine work. *Societies*, *6*(2), 16. https://doi.org/10.3390/soc6020016

Piccarozzi, M., Silvestri, C., Aquilani, B., & Cagnetti, C. (2021). Industry 4.0 tools in innovative European firms: Exploring their adoption and communication features through content analysis. *Procedia Computer Science*, *180*, 414–423. https://doi.org/10.1016/j.procs.2021.01.257

Planing, P., Pfoertsch, W., & G., D. A. (2016). The digital business transformation paths from manufacturer to digital ecosystem provider - analyzing the strategic options of large corporations towards digitalization. *Allied Academies Summer Internet Conference*, *18*(2), 66–70.

Prasad Agrawal, K. (2023). Towards adoption of generative AI in organizational settings. *Journal of Computer Information Systems*, 64(5), 636-651. https://doi.org/10.1080/08874417.2023.2240744

Ratten, V., & Jones, P. (2023). Generative artificial intelligence (ChatGPT): Implications for management educators. *International Journal of Management Education*, *21*(3), 100857. https://doi.org/10.1016/j.ijme.2023.100857

Rifkin, J. (2014). *The zero marginal cost society the internet of things, the collaborative commons, and the eclipse of capitalism*. Palgrave Macmillan.

Rogers, S., & Zvarikova, K. (2021). Big data-driven algorithmic governance in sustainable smart manufacturing: Robotic process and cognitive automation technologies. *Analysis and Metaphysics, 20,* 130-144. https://doi.org/10.22381/am2020219

Ryalat, M., ElMoaqet, H., & AlFaouri, M. (2023). Design of a smart factory based on cyber-physical systems and internet of things towards industry 4.0. *Applied Sciences, 13*(4), 2156. https://doi.org/10.3390/APP13042156

Saenkhum, T., & Kim, S. H. (2023). Generative artificial intelligence and second language writing. *Journal of Second Language Writing*, *62*, 101066. https://doi.org/10.1016/j.jslw.2023.101066

Sætra, H. S. (2023). Generative AI: Here to stay, but for good? *Technology in Society*, *75*. https://doi.org/10.1016/j.techsoc.2023.102372

Schrauf, S., Vedsø, J., & Geissbauer, R. (2016). (30.08.2023) A strategist's guide to industry 4.0. *Strategy + Business*, *83*. https://www.strategy-business.com/article/A-Strategists-Guide-to-Industry-4.0

Schwab, K. (2016). *Dördüncü sanayi devrimi*. Optimist Yayım Dağıtım San. ve Tic. Ltd. Şti.

Sedliaková, I. (2013). Corporate culture. *Analecta Technica Szegedinensia*, *7*(1–2), 50–58. https://doi.org/10.14232/ANALECTA.2013.1-2.50-58

Sheehan, M. (2018). (10.08.2023) *How Google took on China—and lost | MIT Technology Review*. MIT Technology Review. https://www.technologyreview.com/2018/12/19/138307/how-google-took-on-china-and-lost/

Sher, D. (2020). (10.08.2023) *Japanese additive manufacturing is rising | 3dpbm*. https://www.voxelmatters.com/japanese-additive-manufacturing-is-rising/

Shi, Z., Xie, Y., Xue, W., Chen, Y., Fu, L., & Xu, X. (2020). Smart factory in Industry 4.0. *Systems Research and Behavioral Science*, *37*(4), 607–617. https://doi.org/10.1002/sres.2704

Shin, J., Mollah, M. A., & Choi, J. (2023). Sustainability and organizational performance in South Korea: The effect of digital leadership on digital culture and employees' digital capabilities. *Sustainability (Switzerland)*, *15*(3), 2027. https://doi.org/10.3390/su15032027

Sikka, M. P., Sarkar, A., & Garg, S. (2022). Artificial intelligence (AI) in textile industry operational modernization. *Research Journal of Textile and Apparel*, *28*(1), 67-83. https://doi.org/10.1108/RJTA-04-2021-0046

Sima, V., Gheorghe, I. G., Subić, J., & Nancu, D. (2020). Influences of the industry 4.0 revolution on the human capital development and consumer behavior: A systematic review. In *Sustainability (Switzerland)* 12(10), 4035.

Station F. (2023). (10.08.2023) *Station F*. https://stationf.co/services

Stojanov, Z., Dobrilovic, D., Jotanovic, G., Perakovic, D., Jausevac, G., & Brtka, V. (2021). *Software architectures in smart manufacturing: Review and experiences*. In Proceedings of the 1st International Workshop on Advanced Information and Computation Technologies and Systems, 160-168.

Sun, J., Gan, W., Chao, H. C., Yu, P. S., & Ding, W. (2023). Internet of behaviors: A survey. *IEEE Internet of Things Journal*, *10*(13), 11117-11134. https://doi.org/10.1109/JIOT.2023.3247594

Tagarev, T. (2019). DIGILIENCE - A platform for digital transformation, cyber security and resilience. *Information & Security: An International Journal*, *43*(1), 7-10. https://doi.org/10.11610/isij.4300

Taleb, N., & Mohamed, E. A. (2020). Cloud computing trends: A literature review. *Academic Journal of Interdisciplinary Studies, 9*(1), 91-104. https://doi.org/10.36941/ajis-2020-0008

Tao, F., Qi, Q., Wang, L., & Nee, A. Y. C. (2019). Digital Twins and Cyber–Physical Systems toward Smart Manufacturing and Industry 4.0: Correlation and Comparison. *Engineering*, *5*(4), 653–661. https://doi.org/10.1016/J.ENG.2019.01.014

T.C. Sanayi ve Teknoloji Bakanlığı Ar-Ge Teşvikleri Genel Müdürlüğü. (2023). (10.08.2023) *İstatistikler | T.C. Sanayi ve Teknoloji Bakanlığı*. https://www.sanayi.gov.tr/istatistikler/istatistiki-bilgiler/mi0203011501

Thomas, D. S. (2023). (01.11.2023). *Annual report on the U.S. manufacturing economy: 2023*. https://doi.org/10.6028/NIST.AMS.600-13-UPD1

Toorajipour, R., Sohrabpour, V., Nazarpour, A., Oghazi, P., & Fischl, M. (2021). Artificial intelligence in supply chain management: A systematic literature review. *Journal of Business Research*, *122*, 502-517. https://doi.org/10.1016/j.jbusres.2020.09.009

Tucci, L. (2021). (01.11.2023) *Ultimate guide to RPA (Robotic Process Automation)*. https://www.techtarget.com/searchcio/Ultimate-guide-to-RPA-robotic-process-automation

Ültay, E., Akyurt Hakan, & Ültay, N. (2021). Sosyal bilimlerde betimsel içerik analizi. *IBAD Sosyal Bilimler Dergisi*, *10*, 188–201. https://doi.org/10.21733/ibad.871703

Vargas, P., & Tien, I. (2023). Impacts of 5G on cyber-physical risks for interdependent connected smart critical infrastructure systems. *International Journal of Critical Infrastructure Protection*, *42*, 100617. https://doi.org/10.1016/j.ijcip.2023.100617

Vercellis, C. (2009). *Business intelligence: data mining and optimization for decision making*. Wiley. https://doi.org/10.1002/9780470753866

Vestel. (2022). (01.11.2023) *Vestel 2022 faaliyet raporu*. https://www.vestelyatirimciiliskileri.com/_assets/pdf/faliyet/2022/VESTL_Entegre_Faaliyet_Raporu_2022_new.pdf

Villamil, S., Hernández, C., & Tarazona, G. (2020). An overview of internet of things. *Telkomnika (Telecommunication Computing Electronics and Control)*, *18*(5), 2320-2327. https://doi.org/10.12928/TELKOMNIKA.v18i5.15911

Wang, S., Feng, J., & Li, F. (2021). Factory operating system (FOS): Vertical integration framework for smart factories. *Proceedings of 2021 IEEE 2nd International Conference on Information Technology, Big Data and Artificial Intelligence, ICIBA 2021*, 323–331. https://doi.org/10.1109/ICIBA52610.2021.9687978

Wang, S., Wan, J., Zhang, D., Li, D., & Zhang, C. (2016). Towards smart factory for industry 4.0: A self-organized multi-agent system with big data based feedback and coordination. *Computer Networks*, *101*, 158–168. https://doi.org/10.1016/j.comnet.2015.12.017

World Economic Forum. (2016). (30.11.2023) Digital Transformation of Industries : Digital Enterprise. *World Economic Forum*, *January*, 45. http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/digital-enterprise-narrative-final-january-2016.pdf%0Ahttp://reports.weforum.org/digital-transformation-of-industries/wp-content/blogs.dir/94/mp/files/pages/fil

Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and industry 5.0—Inception, conception and perception. *Journal of Manufacturing Systems*, *61*, 530-535. https://doi.org/10.1016/j.jmsy.2021.10.006

Yanık, T. (2020). (10.11.2023) Türkiye'deki şirketlerin yüzde 81'i nesnelerin internetini kullanıyor. *Anadolu Haber Ajansı*. https://www.aa.com.tr/tr/isdunyasi/bilisim/turkiyedeki-sirketlerin-yuzde-81i-nesnelerin-internetini-kullaniyor/656068

Yao, X., Zhou, J., Zhang, J., & Boër, C. R. (2017). (15.06.2023) From intelligent manufacturing to smart manufacturing for industry 4.0 driven by next generation artificial intelligence and further on. *5th International Conference on Enterprise Systems* (pp. 311-318). https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8119409

Yavaşgel, E., & Turdubaeva, E. (2021). Digital culture and power. In *Digital Siege*. Istanbul University Press 1–31 https://doi.org/10.26650/b/ss07.2021.002.01

Young Lee, J. (2021). A study on metaverse hype for sustainable growth. *International Journal of Advanced Smart Convergence*, *10*(3), 72–80. https://doi.org/10.7236/IJASC.2021.10.3.72

Zhang, N. (2021). A cloud-based platform for big data-driven cps modeling of robots. *IEEE Access*, *9*, 34667-34680. https://doi.org/10.1109/ACCESS.2021.3061477

Appendix

Table A1

Arithmetic Mean of Awareness of Trending Technologies in G20 Countries Over the Period 01 May 2011 – 20 Dec 2023

Techs	SAR	GER	USA	ARG	AUS	BRA	INDO	FRA	INDI	UK	ITA	JAP	CAN	KOR	MEX	RUS	SOA	TÜR
DT	14,69	29,41	25,19	13,15	20,35	20,57	22,75	19,47	26,72	22,21	19,12	23,87	19,54	24,06	19,57	18,13	16,15	16,57
CB	0,00	36,84	38,27	16,97	25,02	30,85	4,60	38,73	35,05	34,94	29,43	24,96	29,53	15,67	23,90	21,61	9,05	21,26
CPS	3,29	37,50	58,46	9,63	19,87	16,49	6,99	23,36	37,81	29,07	29,19	29,70	20,91	27,00	20,87	16,07	6,60	17,89
AM	46,09	41,22	43,04	37,91	52,90	53,92	35,85	34,07	71,39	45,20	37,64	24,34	42,94	63,89	41,66	28,97	53,07	38,40
BC	10,80	10,36	8,51	11,93	7,50	11,76	13,77	12,62	11,63	10,46	10,76	11,62	8,06	9,93	14,11	10,21	11,26	7,05
Web 3.0	10,08	17,70	11,21	29,58	12,26	26,70	16,93	36,70	15,61	10,04	27,71	7,79	12,13	9,71	33,27	18,65	16,58	4,64
MV	8,08	6,56	5,65	6,54	5,00	5,94	3,95	7,91	4,73	6,82	7,12	8,57	5,29	9,46	6,74	5,02	7,23	2,74
NFT	5,34	4,43	4,81	5,37	4,65	3,30	1,98	5,30	4,59	4,92	4,21	10,27	4,39	6,78	3,69	6,94	4,39	6,86
CC	37,20	50,18	75,44	30,08	66,13	47,66	28,47	59,47	66,38	67,71	40,30	50,69	57,51	37,72	47,88	45,17	56,94	26,05
IOT	14,83	47,11	51,77	52,43	49,44	51,65	30,34	51,12	47,40	55,58	67,71	43,16	43,62	45,85	34,88	33,50	24,37	11,37
BD	45,19	54,62	62,21	32,76	54,32	27,98	27,31	36,29	48,10	58,54	51,67	42,35	59,40	58,11	46,94	26,34	48,22	51,74
AI	9,96	14,44	13,34	11,80	14,58	17,96	12,54	14,20	13,85	13,01	42,65	25,55	12,57	20,37	11,29	16,46	12,30	12,54
Gen. AI	5,80	4,96	4,73	5,46	5,05	4,21	4,23	3,84	4,36	4,58	4,09	2,67	4,60	3,43	5,09	4,13	6,21	5,44
RPA	31,98	31,99	49,45	52,67	48,66	58,26	27,69	51,81	41,04	43,12	43,85	29,14	25,79	24,80	44,06	22,24	34,79	32,74
Average	**17,38**	**27,67**	**32,29**	**22,59**	**27,55**	**26,95**	**16,96**	**28,21**	**30,62**	**29,01**	**29,67**	**23,91**	**24,73**	**25,48**	**25,28**	**19,53**	**21,94**	**18,24**

Table A2

01.05.2011 – 20.12.2023 Average Awareness of DT Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	0,88	9,75	0,00	1,63	1,88	0,25	14,13	2,13	7,88	20,13	1,63	0,00	0,75	19,63	4,13	8,25	0,00	2,25	2,25
2012	1,00	13,75	2,08	3,58	0,50	0,25	7,67	0,33	7,33	11,92	3,08	0,25	1,25	0,00	2,92	22,08	0,00	3,67	1,17
2013	1,38	12,25	2,63	4,75	1,75	0,38	4,63	0,63	4,50	5,38	1,75	1,13	0,00	14,00	0,50	9,75	4,50	3,75	2,00
2014	0,58	0,00	1,67	3,00	0,50	2,75	2,08	0,25	3,67	6,00	3,25	0,17	1,83	1,17	0,83	6,25	0,00	2,92	1,83
2015	1,92	7,00	0,00	1,33	0,33	16,58	2,50	2,08	1,67	1,75	2,75	1,75	0,67	6,42	1,08	12,25	0,00	2,33	1,42
2016	3,75	4,25	2,08	4,67	1,25	4,50	5,58	1,25	5,08	3,58	1,08	2,67	1,50	4,17	0,67	4,92	5,17	2,42	1,92
2017	10,58	11,25	5,17	6,58	3,42	2,50	9,92	6,42	15,67	8,67	2,17	6,83	5,67	6,83	3,08	7,83	6,00	6,08	7,25
2018	16,42	5,08	11,00	12,58	12,83	6,50	27,25	13,00	22,58	17,25	9,42	16,42	17,92	11,33	3,17	9,67	5,25	7,08	15,17
2019	27,00	14,58	26,33	20,17	19,00	13,75	42,58	21,25	30,67	19,67	16,92	25,75	28,83	24,25	19,00	22,42	17,33	18,08	27,17
2020	34,83	9,33	32,58	35,58	24,83	19,58	41,33	28,58	41,33	43,92	22,58	41,50	35,83	27,67	29,83	16,50	18,00	23,42	33,17
2021	50,42	15,42	40,50	27,50	37,50	43,67	60,00	39,42	46,75	47,67	34,75	51,42	54,75	30,50	39,42	19,58	19,83	25,83	42,25
2022	86,92	27,00	72,33	67,75	70,67	38,75	78,92	60,58	77,58	52,58	65,50	80,50	82,42	45,75	61,67	36,00	47,75	47,25	70,17
2023	91,75	41,25	68,17	78,33	79,58	64,58	85,75	77,42	82,67	57,25	83,67	81,92	81,42	62,67	69,42	34,50	67,17	70,33	82,92

Table A3

01.05.2011 – 20.12.2023 Average Awareness of Cobot Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	17,38	15,25	13,12	12,62	12,25	0,00	1,62	12,12	19,37	4,00	21,87	7,75	11,75	3,12	17,25	7,875	0,00	25,5	9,25
2012	14,83	4,58	14,33	26,17	5,58	0,00	5,92	15,33	7,58	4,08	7,17	9,92	17,00	11,00	15,92	0,00	0,00	5,58	10,58
2013	16,92	10,17	15,67	27,33	15,75	0,25	12,63	9,25	17,58	4,42	7,33	9,50	18,17	9,92	11,08	8,83	0,00	12,75	11,67
2014	20,83	12,00	14,67	28,75	22,83	3,92	19,17	10,58	11,50	3,50	11,08	7,58	0,00	15,92	5,75	6,58	0,00	10,33	18,92
2015	30,33	7,58	13,33	18,08	22,33	8,33	39,50	21,83	21,00	2,25	9,08	8,25	2,33	15,25	5,25	0,00	0,00	6,75	23,83
2016	29,75	15,58	23,58	33,75	18,83	4,33	61,17	37,08	20,25	2,00	13,42	9,50	7,42	6,75	1,33	10,08	0,00	13,58	23,50
2017	31,17	24,17	25,58	22,92	19,00	6,58	83,83	59,08	23,58	1,58	18,00	3,25	0,00	7,33	3,92	3,08	0,00	14,00	36,50
2018	41,08	10,33	13,00	39,75	27,58	0,58	83,42	66,75	35,08	2,00	27,67	15,58	21,75	20,00	13,50	13,25	0,00	25,92	38,83
2019	47,25	8,42	28,67	24,92	36,42	5,17	76,75	53,58	43,50	2,25	40,00	30,83	24,42	25,33	29,58	16,00	0,00	23,25	49,83
2020	47,58	23,58	32,58	28,33	42,75	2,08	59,83	40,00	61,75	4,42	40,58	41,50	12,42	38,17	32,17	17,33	0,00	23,08	63,25
2021	51,42	26,25	28,00	43,92	39,58	1,83	53,25	45,08	52,17	19,75	55,00	50,75	16,33	43,58	32,17	14,50	0,00	33,17	44,00
2022	66,08	29,67	49,25	42,75	51,83	7,00	56,17	60,00	64,33	6,25	59,58	57,92	21,00	53,50	51,33	9,33	0,00	39,83	54,08
2023	82,92	33,00	53,42	51,75	69,17	3,83	55,50	72,75	78,00	3,25	71,83	72,17	51,17	60,83	61,67	10,75	0,00	42,67	70,00

Table A4

01.05.2011 – 20.12.2023 Average Awareness of CPS Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	47,88	24,75	9,13	4,50	6,88	0,50	9,63	11,25	12,25	5,25	17,00	11,38	9,25	23,75	7,63	19,88	16,75	3,88	5,75
2012	38,33	5,67	5,75	2,92	7,67	0,50	11,17	16,08	16,00	15,17	5,67	4,33	3,00	10,92	2,42	16,58	0,67	18,42	7,00
2013	63,13	18,50	24,13	6,75	7,88	1,13	27,13	14,88	33,13	8,50	30,63	5,50	18,88	9,25	0,00	4,25	2,00	14,75	11,50
2014	55,00	2,92	15,50	4,58	6,08	3,00	24,75	17,58	29,75	0,00	22,58	3,08	6,42	9,42	6,58	2,75	0,00	5,42	11,25
2015	56,25	0,00	9,42	5,58	19,50	18,58	33,75	10,83	21,75	1,50	14,75	7,75	8,33	11,17	4,17	7,08	3,75	3,50	26,92
2016	64,25	8,42	14,75	6,25	15,00	6,67	37,83	26,67	27,50	0,50	16,67	14,75	12,58	10,92	8,25	3,08	2,08	19,92	31,33
2017	70,17	2,50	9,92	14,25	16,17	8,58	47,08	26,33	43,92	2,33	38,17	57,67	30,67	9,67	12,08	3,67	2,17	7,25	41,75
2018	61,58	4,33	27,67	20,08	23,25	5,58	48,83	17,00	40,17	5,00	48,67	63,42	55,83	16,58	10,42	1,17	1,75	18,83	34,00
2019	64,50	13,25	30,58	18,92	33,50	5,50	58,42	25,25	40,58	10,00	36,00	56,00	42,42	21,50	17,83	8,67	1,83	14,75	37,58
2020	52,83	9,17	26,08	32,92	18,58	5,67	58,42	35,58	42,00	8,67	26,58	41,25	49,25	26,67	19,08	6,67	1,50	32,17	34,42
2021	45,83	13,50	10,67	23,33	32,58	4,83	66,75	34,83	47,50	7,00	34,25	55,00	54,42	26,25	34,00	3,83	3,00	29,83	28,92
2022	70,92	12,67	32,83	35,08	44,25	4,25	36,50	30,67	73,75	14,00	48,75	37,75	51,92	49,75	38,42	2,75	3,50	35,33	60,17
2023	69,25	9,50	41,83	39,25	40,50	4,00	28,58	36,75	63,25	13,00	39,75	28,25	8,08	45,50	48,00	5,42	16,75	28,50	47,33

Table A5

01.05.2011 – 20.12.2023 Average Awareness of AM Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	7,50	2,13	9,63	9,25	8,13	1,25	4,88	2,38	18,13	8,25	4,13	2,88	5,38	4,38	4,38	13,25	8,25	3,75	8,00
2012	12,00	4,50	17,50	13,17	12,50	7,33	8,67	6,00	20,17	9,50	8,67	5,00	7,58	7,50	4,08	19,33	6,83	5,75	16,67
2013	52,50	18,25	63,63	74,00	49,13	45,00	45,88	38,75	87,50	42,75	36,75	21,50	78,25	31,00	17,38	72,75	27,63	24,00	58,38
2014	37,17	16,92	43,58	45,25	35,92	32,67	29,17	33,25	77,25	27,75	51,75	14,92	76,58	28,92	11,25	54,50	29,83	22,58	38,83
2015	40,58	23,75	54,08	45,83	39,33	59,25	32,17	31,83	88,83	36,08	40,92	13,00	84,58	35,42	11,25	52,75	42,83	28,67	47,00
2016	34,58	22,08	48,17	42,00	34,58	52,08	33,50	34,08	77,42	25,67	36,17	22,92	71,50	33,67	19,08	40,42	42,92	28,67	37,67
2017	40,42	32,00	52,58	51,25	40,17	47,42	40,83	36,42	72,42	26,17	39,67	81,25	75,58	41,75	73,75	45,33	46,25	35,92	41,50
2018	45,42	38,08	57,92	61,92	46,75	50,42	45,83	41,00	77,17	37,67	41,33	80,25	80,33	45,75	74,75	57,50	54,58	51,17	45,50
2019	44,50	48,33	54,33	61,75	46,58	45,67	51,33	41,08	71,92	58,67	38,83	9,58	59,00	54,92	22,58	59,33	58,92	47,67	45,67
2020	53,00	55,33	64,00	67,75	56,33	51,92	61,92	53,33	84,58	54,42	49,50	11,50	75,50	55,17	21,67	68,25	64,42	68,17	61,08
2021	55,33	67,67	59,58	64,92	51,83	61,17	52,92	44,83	84,42	55,25	45,25	15,00	68,83	51,92	29,83	59,17	62,08	54,50	53,92
2022	64,33	84,58	76,83	80,08	64,17	59,25	57,42	45,58	82,58	42,83	47,67	18,67	66,50	72,08	42,58	75,25	74,83	55,58	64,67
2023	72,17	79,25	85,83	83,83	72,83	59,92	72,08	47,25	85,67	41,08	48,75	20,00	80,92	79,17	44,00	72,08	79,83	72,75	68,67

Table A6

01.05.2011 – 20.12.2023 Average Awareness of BC Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	0,00	0,38	0,38	0,00	0,00	0,00	0,00	0,00	0,13	4,00	0,13	0,00	0,38	0,63	0,00	0,25	1,38	0,00	0,13
2012	0,00	0,92	0,08	0,00	0,00	0,00	0,00	0,00	0,08	0,17	0,17	0,00	0,00	0,00	0,00	0,83	1,17	0,17	0,00
2013	0,00	0,38	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,25	0,13	0,00	0,13	0,25	0,00	1,00	0,00	0,00	0,00
2014	0,00	0,08	0,00	0,08	0,00	0,08	0,00	0,00	0,00	0,08	0,08	0,00	0,00	0,42	0,00	0,17	0,50	0,00	0,00
2015	0,00	0,17	0,00	0,00	0,00	0,92	0,00	0,00	0,00	0,17	0,00	0,00	0,00	0,08	0,00	0,50	1,42	0,00	0,00
2016	1,67	1,67	1,75	2,75	1,75	2,42	2,75	4,42	2,92	2,58	2,08	4,08	1,58	2,33	2,00	4,08	1,42	1,08	3,00
2017	32,42	38,42	32,25	45,33	32,75	22,83	43,67	47,67	44,50	39,17	34,75	39,83	24,58	44,58	48,50	43,67	34,50	30,67	41,58
2018	47,17	58,33	39,58	46,75	44,17	61,50	51,58	60,75	57,92	60,92	51,50	61,67	61,58	71,33	47,58	52,75	52,83	32,33	54,33
2019	24,67	43,33	19,58	50,17	21,58	28,75	30,33	41,83	37,08	59,33	43,08	38,08	35,50	52,00	29,42	35,50	37,25	21,75	30,42
2020	4,67	10,50	3,92	7,75	4,50	4,75	6,33	9,33	8,58	12,25	8,00	7,42	5,33	11,08	5,17	7,25	9,00	5,58	6,58
2021	0,00	0,67	0,00	0,00	0,00	0,25	0,00	0,00	0,00	0,08	0,00	0,00	0,00	0,50	0,00	0,33	0,42	0,08	0,00
2022	0,00	0,17	0,00	0,00	0,00	0,08	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,33	0,00	0,00
2023	0,00	0,08	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,25	0,00	0,00	0,25	0,00	0,00

Table A7

01.05.2011 – 20.12.2023 Average Awareness of Web 3.0 Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	14,13	44,00	18,88	41,63	16,63	2,25	28,38	24,75	30,88	37,25	29,88	5,63	5,25	24,88	25,75	17,75	12,63	3,00	10,13
2012	10,00	36,17	14,92	38,83	11,92	1,17	26,17	23,17	22,00	20,17	31,08	3,58	4,83	29,83	20,42	34,83	3,33	2,25	10,17
2013	13,25	41,50	13,38	42,63	15,50	1,88	31,13	29,38	24,63	37,13	48,75	2,25	8,63	47,88	26,50	24,50	14,63	3,25	11,13
2014	8,50	22,08	8,83	20,42	6,33	1,25	14,92	20,08	11,17	15,83	28,08	2,17	5,08	28,67	11,17	15,67	3,92	1,42	6,75
2015	7,08	21,33	7,00	16,83	7,67	8,42	14,17	33,67	8,50	10,33	26,75	1,75	3,33	29,33	5,50	10,33	6,83	0,83	5,42
2016	3,42	20,75	6,17	14,67	4,58	12,92	8,67	48,17	4,83	7,08	24,75	1,58	2,83	26,08	7,75	1,75	7,83	0,92	2,92
2017	1,50	38,92	1,67	23,50	2,42	1,42	3,67	62,33	1,17	2,33	40,92	1,17	1,58	47,92	3,50	1,00	1,50	0,58	1,08
2018	3,58	18,25	4,33	10,33	4,42	0,42	5,58	41,00	2,58	5,67	18,17	1,92	1,83	30,58	7,83	6,08	2,50	1,00	3,33
2019	3,50	14,42	5,83	8,08	5,42	0,00	7,58	34,17	2,75	6,17	11,25	1,67	2,08	26,25	8,08	14,75	6,08	1,25	3,67
2020	3,08	10,83	3,17	9,08	3,50	2,83	5,17	20,92	2,83	2,92	8,92	1,75	2,08	27,00	4,00	4,00	8,83	1,75	3,17
2021	23,67	21,08	21,75	21,75	22,83	8,75	16,75	22,50	13,42	10,58	13,17	6,92	18,25	24,00	11,58	20,75	16,58	19,17	18,17
2022	38,92	59,58	40,42	60,83	39,75	60,67	45,08	74,50	50,75	40,42	48,83	60,08	44,75	53,00	63,17	40,08	38,50	15,58	38,67
2023	15,17	35,58	13,08	38,50	16,75	16,58	24,83	52,25	27,42	24,17	29,67	10,75	25,67	37,08	47,25	24,00	7,92	9,33	15,92

Table A8

01.05.2011 – 20.12.2023 Average Awareness of MV Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	0,00	0,38	0,00	0,00	0,00	0,00	0,13	0,13	0,13	0,25	0,00	0,25	0,38	0,50	0,25	3,00	0,63	0,00	0,00
2012	0,00	0,42	0,17	0,00	0,00	0,00	0,08	0,00	0,00	0,17	0,00	0,00	0,08	0,33	0,17	1,92	0,17	0,00	0,17
2013	0,00	0,38	0,00	0,00	0,13	0,00	0,25	0,00	0,00	0,13	0,00	0,00	0,00	0,63	0,38	1,63	0,88	0,00	0,13
2014	0,00	0,50	0,08	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,17	0,25	0,25	0,42	0,17	0,00	0,00
2015	0,00	0,33	0,00	0,00	0,00	1,50	0,17	0,08	0,08	0,08	0,00	0,00	0,00	0,33	0,17	0,50	0,50	0,00	0,00
2016	0,00	0,42	0,08	0,00	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,08	0,00	0,17	0,00	0,42	0,50	0,00	0,08
2017	0,33	0,17	0,42	0,00	0,33	0,75	0,33	0,25	0,00	0,00	0,00	0,17	0,00	0,33	0,42	0,00	0,08	0,00	0,17
2018	0,17	0,25	0,58	0,00	0,67	0,42	0,25	0,08	0,00	0,00	0,00	0,08	0,08	0,58	0,67	0,42	0,17	0,00	0,33
2019	0,25	0,50	0,50	0,00	0,33	0,92	0,58	0,00	0,00	0,00	0,08	0,17	0,08	0,75	0,33	0,42	0,33	0,00	0,25
2020	0,50	0,42	0,67	0,00	0,17	0,00	0,75	0,17	0,00	0,00	0,08	0,50	0,33	1,00	0,08	0,33	0,33	0,00	0,33
2021	23,58	18,58	19,75	14,67	22,17	26,33	17,58	20,25	8,33	10,08	12,25	11,17	44,17	22,67	7,50	20,25	17,75	12,08	20,75
2022	39,25	46,58	32,83	50,50	35,25	42,92	48,42	61,25	40,75	33,83	59,25	65,50	53,58	43,42	38,75	49,50	52,17	21,00	49,25
2023	9,42	16,17	9,92	12,08	9,75	14,67	16,75	20,58	12,17	6,83	20,83	33,50	24,08	16,67	16,33	15,17	31,33	2,58	17,25

Table A9

01.05.2011 – 20.12.2023 Average Awareness of NFT Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	0,00	0,00	0,38	0,25	0,00	0,00	0,88	0,75	1,00	0,00	0,13	1,00	0,38	0,50	2,00	0,50	0,50	0,00	1,00
2012	0,00	0,25	0,67	0,00	0,00	0,00	0,58	0,50	0,92	0,00	0,08	0,92	0,17	0,50	2,50	0,33	0,33	0,08	1,00
2013	0,00	0,50	0,38	0,00	0,00	0,00	0,25	1,38	1,38	0,00	0,00	0,38	0,38	0,25	4,00	0,25	0,13	0,00	1,50
2014	0,00	0,17	0,08	0,00	0,00	0,25	0,17	0,42	1,00	0,00	0,00	0,42	0,00	0,17	2,25	0,17	0,33	0,00	1,00
2015	0,00	0,33	0,25	0,00	0,00	1,25	0,17	0,08	1,00	0,00	0,00	0,50	0,00	0,17	2,00	0,33	0,33	0,00	1,00
2016	0,00	0,17	0,00	0,00	0,00	0,08	0,08	0,08	0,83	0,00	0,00	0,42	0,08	0,08	1,83	0,00	0,33	0,00	0,83
2017	0,00	0,00	0,00	0,00	0,00	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,17	0,00	0,00
2018	0,00	0,00	0,00	0,00	0,00	0,33	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2019	0,00	0,00	0,00	0,00	0,00	0,33	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,08	0,00	0,00
2020	0,00	0,00	0,00	0,00	0,00	0,42	0,00	0,00	0,00	0,00	0,00	0,17	0,08	0,00	0,00	0,00	0,25	0,00	0,00
2021	25,75	23,92	21,92	10,75	22,50	27,92	15,58	18,50	13,50	4,67	13,58	26,75	22,92	12,58	14,67	16,92	19,25	29,50	20,17
2022	30,75	36,00	31,00	27,42	28,83	60,08	31,50	38,08	31,50	18,42	33,83	68,17	48,42	28,25	45,83	32,58	38,92	47,67	30,75
2023	6,08	8,42	5,75	4,50	5,75	17,00	8,33	9,17	8,58	2,67	7,17	34,83	15,75	5,42	15,08	6,00	8,75	11,92	6,75

Table A10

01.05.2011 – 20.12.2023 Average Awareness of CC Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	56,50	10,88	39,38	14,88	33,38	4,75	23,13	22,25	64,00	16,75	11,13	19,88	18,88	15,88	32,88	42,13	12,50	10,13	37,13
2012	52,92	10,75	40,75	17,67	32,75	3,67	27,92	29,58	60,00	18,92	12,58	15,50	13,25	17,83	29,33	47,33	14,17	11,67	44,58
2013	83,13	17,38	83,88	32,63	53,88	6,75	45,13	55,50	94,75	24,38	22,13	19,00	18,38	30,38	39,50	74,63	25,00	19,50	85,38
2014	63,00	14,33	64,50	26,08	41,67	7,58	32,08	44,42	60,33	15,75	18,25	14,75	13,00	25,83	25,00	43,75	24,50	16,58	64,83
2015	67,83	15,75	64,25	27,58	42,25	14,58	32,83	42,75	62,50	18,67	19,92	14,33	14,08	29,67	23,42	43,92	29,92	17,83	64,25
2016	63,83	17,83	60,92	30,83	42,25	20,75	36,33	47,42	55,17	19,50	22,00	22,67	17,33	32,25	23,75	37,17	30,92	18,92	60,92
2017	68,92	34,42	58,92	50,75	48,08	52,00	52,25	62,92	52,17	18,83	29,50	66,00	43,83	48,00	21,92	43,08	33,92	13,83	60,58
2018	85,58	39,75	79,00	59,75	65,83	72,17	63,25	72,25	55,00	35,00	38,25	73,42	49,50	61,17	45,42	62,92	40,75	36,17	78,00
2019	91,00	45,67	81,25	62,42	75,67	84,67	66,58	79,25	56,25	45,08	71,50	77,08	57,42	69,33	65,67	69,42	45,92	41,58	82,50
2020	89,83	47,50	78,08	71,17	80,00	67,42	70,08	80,75	71,08	57,83	77,75	83,42	60,08	72,67	66,25	72,83	57,75	48,67	87,08
2021	80,25	38,08	59,00	57,92	58,08	39,50	66,50	65,83	63,50	32,00	55,92	74,42	49,50	56,75	54,50	61,67	45,67	27,08	62,17
2022	88,50	42,33	73,08	79,33	81,08	19,17	67,00	81,25	84,08	32,75	56,92	86,92	53,67	78,00	73,08	71,83	57,67	37,92	73,92
2023	89,42	56,42	76,67	88,58	92,67	17,42	71,08	89,00	84,17	34,67	88,08	91,58	81,50	84,67	86,50	69,58	64,92	38,83	78,83

Table A11

01.05.2011 – 20.12.2023 Average Awareness of IoT Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	8,00	13,63	5,88	16,63	33,38	15,88	5,75	5,75	4,38	1,63	51,38	2,13	2,50	3,00	2,50	1,88	1,00	0,25	10,38
2012	6,83	14,33	5,00	17,58	32,75	11,25	5,92	5,75	4,00	1,25	46,08	2,25	3,75	1,67	4,00	3,00	0,58	0,75	9,50
2013	16,75	23,75	11,63	28,75	53,88	21,13	12,63	15,38	10,88	3,63	64,25	3,25	10,00	5,50	5,13	4,38	0,88	1,50	19,75
2014	29,67	24,42	19,08	27,00	41,67	20,50	19,17	39,00	16,92	4,08	48,83	12,83	47,42	8,17	8,00	11,00	1,83	2,08	28,08
2015	53,17	42,17	39,58	43,83	42,25	55,67	39,50	64,67	41,33	11,42	64,58	50,58	72,50	20,25	16,17	15,33	5,75	5,92	51,58
2016	72,08	55,17	65,75	51,50	42,25	48,92	61,17	83,67	58,08	19,83	77,42	77,75	73,33	29,33	26,42	16,75	8,92	28,08	69,17
2017	82,58	57,42	76,83	59,92	48,08	73,83	83,83	82,42	67,75	21,83	81,50	83,67	74,83	43,08	37,25	33,00	13,33	15,42	79,75
2018	70,58	69,25	82,08	65,83	65,83	85,33	83,42	68,83	66,08	32,83	80,33	81,92	65,17	59,67	46,00	44,00	21,42	16,33	77,33
2019	68,17	75,25	83,00	65,75	75,67	80,42	76,75	67,42	64,75	51,58	79,33	69,25	55,58	60,00	50,00	36,17	24,25	14,92	84,00
2020	69,08	73,50	68,33	68,83	80,00	74,33	59,83	59,92	58,58	47,83	67,83	54,17	49,67	53,83	48,25	28,58	22,00	14,42	87,08
2021	68,67	76,33	57,42	72,58	58,08	74,08	53,25	55,25	59,00	47,00	63,75	44,67	42,17	47,25	53,42	56,58	22,58	14,83	69,58
2022	65,75	77,75	65,50	72,33	81,08	65,33	56,17	60,08	83,58	73,00	76,33	41,00	43,25	60,50	64,50	35,75	37,00	17,83	69,67
2023	61,67	78,67	62,58	80,92	92,67	52,17	55,50	56,42	80,83	78,50	78,58	37,58	55,83	61,25	73,83	30,42	33,25	15,42	66,67

Table A12

01.05.2011 – 20.12.2023 Average Awareness of AI Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	4,38	7,50	6,75	18,00	4,25	3,88	5,00	7,75	6,88	15,00	66,25	14,38	6,38	6,63	18,63	6,75	2,88	6,88	4,38
2012	4,17	7,17	6,00	19,08	4,17	3,33	4,92	8,00	6,17	13,75	71,50	13,00	5,92	6,50	14,33	5,58	2,75	6,92	4,33
2013	6,00	8,00	8,00	27,13	5,88	4,88	6,50	10,75	8,13	16,00	69,92	18,75	9,63	8,00	16,13	7,13	3,88	7,00	6,13
2014	4,33	4,92	5,42	17,75	3,92	4,08	4,75	7,75	7,25	7,92	75,33	10,00	8,42	5,50	9,67	4,08	3,00	4,17	4,33
2015	5,08	5,17	5,92	23,08	4,33	7,00	5,08	8,42	7,92	6,83	80,00	13,08	8,42	5,92	8,67	4,08	3,25	4,92	5,33
2016	5,17	4,33	6,08	19,42	4,67	9,00	5,50	8,92	6,75	5,92	71,58	18,17	11,75	4,92	8,08	3,92	3,00	4,67	5,17
2017	5,58	3,75	5,75	1,58	5,50	13,33	5,25	4,17	4,42	1,17	3,75	18,83	9,83	4,42	5,50	5,25	1,75	5,17	5,00
2018	9,58	5,17	10,42	3,17	9,17	21,58	11,75	8,75	9,83	4,08	6,67	24,92	17,17	6,42	8,83	9,50	4,58	7,83	9,25
2019	10,42	5,50	10,75	6,08	9,33	22,08	13,25	9,08	11,25	7,75	7,67	27,67	19,58	7,17	11,50	9,17	6,92	10,17	10,42
2020	9,50	5,33	9,83	7,25	8,58	19,75	12,00	8,50	10,00	5,75	6,92	25,83	23,42	7,17	12,00	8,50	7,58	9,83	10,00
2021	9,50	6,42	9,75	8,75	8,17	23,17	13,42	9,67	11,33	6,25	8,75	26,33	25,17	7,67	14,58	8,17	8,50	9,92	9,42
2022	19,17	11,83	20,08	17,08	18,75	30,25	21,67	17,17	17,25	9,33	15,50	37,33	38,58	12,92	18,25	15,75	16,00	16,92	19,00
2023	80,58	78,33	84,83	65,17	76,75	78,92	79,00	75,67	75,58	63,33	70,58	83,83	80,58	63,58	67,75	72,00	65,33	68,67	76,33

Table A13

01.05.2011 – 20.12.2023 Average Awareness of Gen AI. Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	0,13	1,50	1,63	0,25	0,25	0,13	0,25	0,88	0,38	1,13	1,00	0,00	2,00	0,75	5,25	18,00	9,75	0,75	0,13
2012	0,00	4,92	1,00	0,58	0,33	0,08	0,42	0,42	0,17	0,00	0,58	0,00	0,00	0,50	2,67	2,92	0,00	2,25	0,25
2013	0,00	5,00	1,00	0,38	0,25	0,13	0,63	0,00	0,25	1,13	1,38	0,00	0,25	1,50	1,75	3,00	2,63	3,13	0,38
2014	0,00	0,92	0,00	0,92	0,42	2,67	0,58	0,00	0,00	1,00	0,00	0,00	0,17	0,67	1,00	3,00	0,92	3,00	0,17
2015	0,00	1,58	0,33	0,17	0,00	2,08	0,25	0,08	0,00	1,08	0,00	0,00	0,42	0,00	1,08	0,50	2,25	0,00	0,00
2016	0,00	3,17	0,17	0,50	0,58	2,00	0,50	0,33	0,08	0,00	0,42	0,00	0,08	0,00	0,58	0,00	3,25	0,00	0,25
2017	0,00	2,08	0,58	0,67	0,25	0,58	0,17	0,17	0,00	1,75	0,58	0,00	0,67	2,00	0,67	3,08	1,33	2,08	0,17
2018	0,00	1,08	0,42	0,00	0,58	0,58	0,33	0,33	0,00	0,83	0,08	0,00	0,25	1,08	1,58	0,83	2,08	1,50	0,17
2019	0,00	1,00	0,42	0,25	0,25	0,83	0,08	0,33	0,00	0,33	0,08	0,00	0,17	0,83	1,25	2,75	2,08	2,08	0,17
2020	0,00	0,58	0,25	0,33	0,33	0,67	0,33	0,25	0,00	0,25	0,42	0,00	0,08	0,25	1,17	1,83	1,75	2,25	0,08
2021	0,00	1,92	0,17	0,00	0,33	0,83	0,17	0,25	0,00	0,50	0,25	0,00	0,17	2,75	0,00	0,42	1,58	1,08	0,08
2022	0,00	1,08	0,08	0,00	0,17	0,75	0,25	0,08	0,00	0,83	0,25	0,00	0,17	1,08	0,83	0,25	3,42	0,00	0,08
2023	61,33	46,17	59,67	50,75	56,00	38,75	60,67	46,83	55,75	46,17	48,08	34,67	40,17	54,75	35,92	44,17	44,33	52,58	57,67

Table A14

01.05.2011 – 20.12.2023 Average Awareness of RPA Technology Across G20 Countries by Year

Years	USA	ARG	AUS	BRA	CAN	CHI	GER	FRA	INDI	INDO	ITA	JAP	KOR	MEX	RUS	SOA	SAR	TÜR	UK
2011	24,88	52,63	85,38	84,50	11,25	0,75	11,88	34,50	6,63	15,38	42,25	0,63	3,63	36,00	5,00	12,25	6,13	10,63	32,38
2012	24,33	52,17	71,75	75,92	12,92	1,33	13,67	36,00	5,58	17,33	28,25	0,67	1,25	32,58	5,67	18,83	10,67	21,67	35,25
2013	34,50	73,63	100,38	107,50	23,13	3,38	16,63	55,13	9,13	18,25	41,13	1,25	4,63	37,25	8,50	31,25	6,00	19,38	46,13
2014	23,42	55,42	67,33	73,50	18,00	3,08	14,83	40,50	7,25	13,00	25,25	0,83	2,50	26,25	5,92	21,75	4,00	12,25	31,92
2015	28,50	55,00	67,08	70,50	14,67	23,00	14,50	42,42	7,75	24,17	31,58	0,58	20,67	29,75	6,25	31,58	6,25	10,42	38,08
2016	24,75	43,67	56,75	57,83	10,42	5,75	13,50	37,83	16,67	13,83	23,67	1,83	25,17	24,75	6,42	19,58	7,25	6,75	33,50
2017	27,25	2,92	10,92	1,25	8,92	9,17	17,00	11,58	58,25	5,08	14,67	28,83	3,25	13,58	2,33	26,25	10,58	3,50	20,92
2018	53,67	17,33	19,58	3,42	17,75	21,33	37,42	45,58	67,50	13,17	41,50	79,42	15,75	27,75	12,75	37,00	20,08	17,00	31,33
2019	76,25	37,17	31,50	24,08	29,58	51,33	54,83	75,50	79,92	48,50	62,83	79,08	40,33	49,25	29,67	64,00	69,75	43,00	61,25
2020	84,92	59,00	39,00	48,50	48,42	57,67	60,08	66,83	70,00	55,33	58,00	54,92	45,08	67,25	38,92	49,00	63,75	53,50	80,75
2021	84,17	76,67	25,08	70,50	41,25	66,83	53,83	78,08	69,75	57,00	61,58	45,75	41,50	66,08	42,67	43,00	72,42	63,25	43,50
2022	82,50	79,67	27,92	84,33	47,08	78,83	58,42	78,42	76,83	41,00	71,83	43,17	42,50	84,92	52,42	53,42	71,17	85,00	47,67
2023	73,67	79,50	29,92	91,42	51,83	70,33	50,50	71,17	58,25	37,92	67,50	41,83	76,17	77,42	72,58	44,33	67,67	79,33	57,83