TÜBİSAD
BİLİŞİM SANAYİCİLERİ DERNEĞİ

Information and Communications Technologies (ICT)

2021 Market Data

June 2022

Deloitte.

Contents

1. Leading technologies in the sector

Leading technologies in the sector

Leading Technologies in the Sector

5G and fiber internet, cloud communications, artificial intelligence, the internet of things, blockchain, digital reality, cyber security and data privacy technologies continue to develop with new sub-technologies and diversify sectoral areas of use.

5G and fiber internet

When assessed according to the connectivity technology, the use of 5G is expected to reach 25% by 2025.

Leading sub-technologies:

- Network slicing
- 5G fixed wireless access (5G FWA)

Cloud computing

It is expected that the annual income increase in the cloud computing market will be more than 30% from 2021 to 2025.

Leading sub-technologies:

- Smart edge computing
- Multi-cloud

Artificial intelligence

It is estimated that the global artificial intelligence market will reach 391 billion USD by 2025.

Leading sub-technologies:

- Decision intelligence (DI)
- Deep learning (DL)

Digital Reality

It is estimated that the global virtual reality and augmented reality market will reach 73 billion USD by 2024.

Leading sub-technologies:

- Metaverse

Blockchain

According to the Global Blockchain Convention, 76% of the participants believe that digital assets will replace currencies in the 5 to 10 years to come.

Leading sub-technologies:

- Tokenization
- Non-fungible tokens (NFT)

Internet of things (IoT)

It is expected that the number of connected things will reach 16.4 billion by 2025.

Leading sub-technologies:

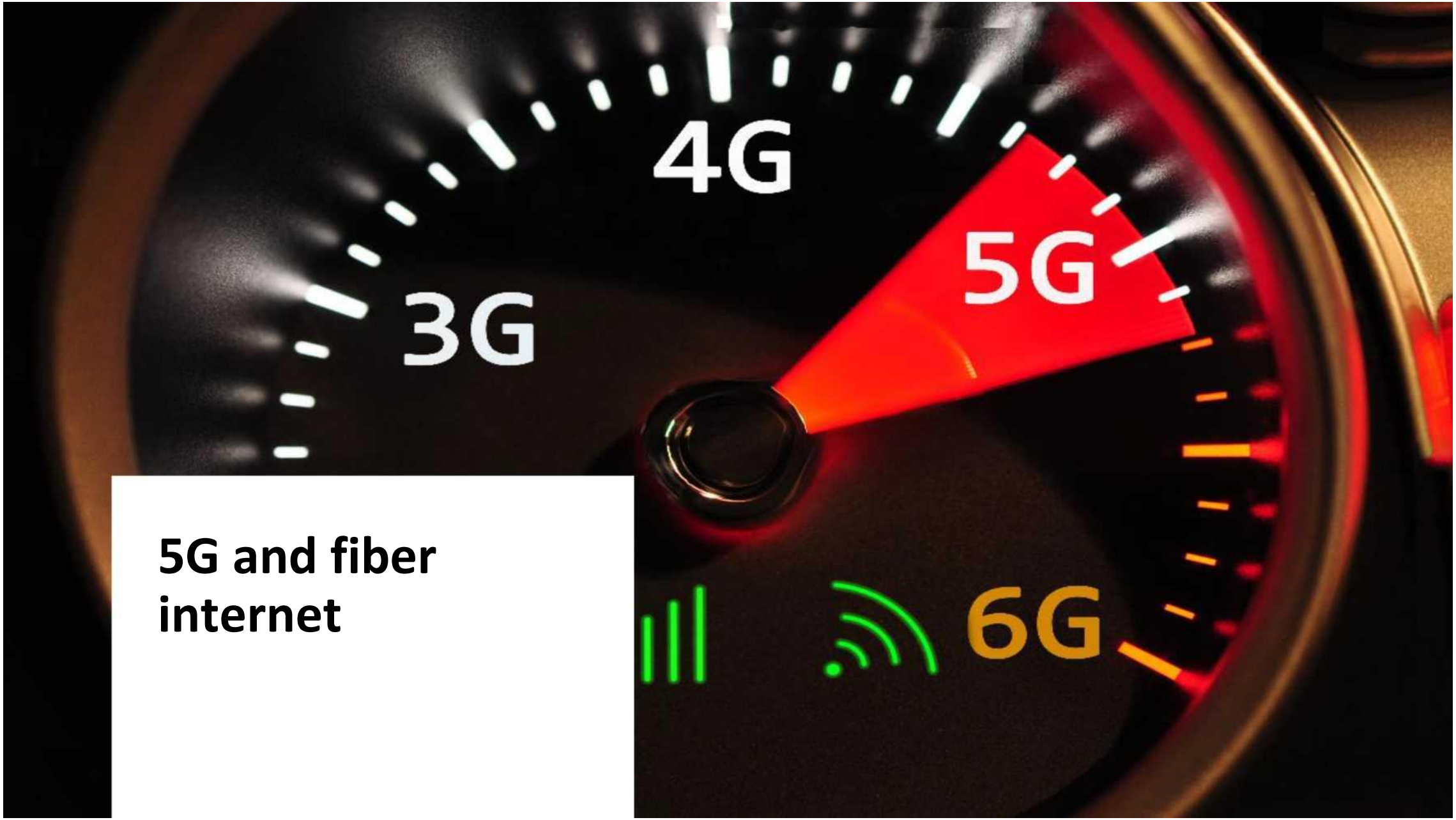
- Applications and software with IoT feature
- BT, OT and MT orchestration

Cyber security and data privacy

It is estimated that the global information security and risk management expenses will reach 221 billion USD by 2025.

Leading sub-technologies:

- Cyber physical systems (SFS)
- Application security requirements and threat management (ASRTM) tools



5G and fiber internet

Global Use of Mobile Network

The mobile data traffic managed on mobile networks in 2011 is now around 300 times more. Service providers have sped up investments in 5G to improve the quality of the increasing data flow.

Number of subscribers to mobile internet and penetration rate

2021 **4.2 billion**

Compound annual growth rate: **4.5%**

5.0 billion 2025

53%

60%

Use rates according to connectivity technology*

4G

2021 **58%**

55% 2025

5G

2021 **8%**

25% 2025

Operator income and investments

Total income

2021 **1.08 trillion USD**

1.16 trillion USD 2025

Operator investments

620 billion USD

2022 — 2025

85% of it is 5G investments

Source: Ericsson, GSMA

*Calculated excluding the licensed cellular internet of things.

5G: 5th Generation Mobile Network

Features of the 5G technology allow digital consumers, businesses and industry players to have new competencies, paving the way for new devices, business models and practices.

The 5G offers **low latency, a high number of processes in a unit time and a high use level** for its users.

This is very important for industries with a high digitalization rate(automotive, smart transportation, energy, etc.) **to meet their special connectivity requirements**.

Key Features

Enhanced broadband

eMBB (Enhanced Mobile Broadband) allows operators to offer mobile services with an experience similar to that of fiber networks, especially in terms of broadband width.

Low latency communication

uRLLC (Ultra Reliable and Low Latency Communications) allow to significantly reduce connection latency in cases where latency is of critical importance.

High density in device use

mMTC (Massive Machine Type Communications) keep costs low and use energy efficiently while allowing for broader coverage and increased penetration indoors.

Network slicing

In order to meet the diversified service requirements of operators, the 5G technology allows for independent network slicing over a single network infrastructure, which brings about a concept that has not been used before.

Source: Deloitte Analysis

Network Slicing

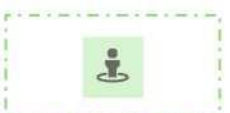
Network slicing offers logically separated network segments for services that have different speed, latency, and security requirements, while optimizing service types. Its service speed and flexibility trigger business model innovations.

Public Network

- **It has broad coverage**.
- The public network is **shared by different users.**
- Sharing the network **may lead to latencies and broadband problems** .

Private Network

- **A network exclusive to the user** is established.
- **It requires high investments, operation and maintenance/repair costs** .
- As there is a single user, **there are no connection or security issues**.



Network Slicing

- Multiple logical networks are created on a shared physical infrastructure .
- It offers the **broad coverage of public networks** and **the connection quality and security of private networks**.
- It offers **speed and flexibility** for its users.

%90 of the total addressable network slicing comprises of ***6 sectors that are expected to grow by 46% by 2030***

- Manufacture
- Public
- Energy and infrastructure
- Health services
- Media and entertainment
- Transportation

Source: Ericsson, Huawei

5G Fixed Wireless Access (5G FWA)

Fixed wireless access is a high speed connection service provided over a wireless network to fixed points of use. It was used before the 5G technology but it has been more preferred since the service performance increased thanks to 5G.

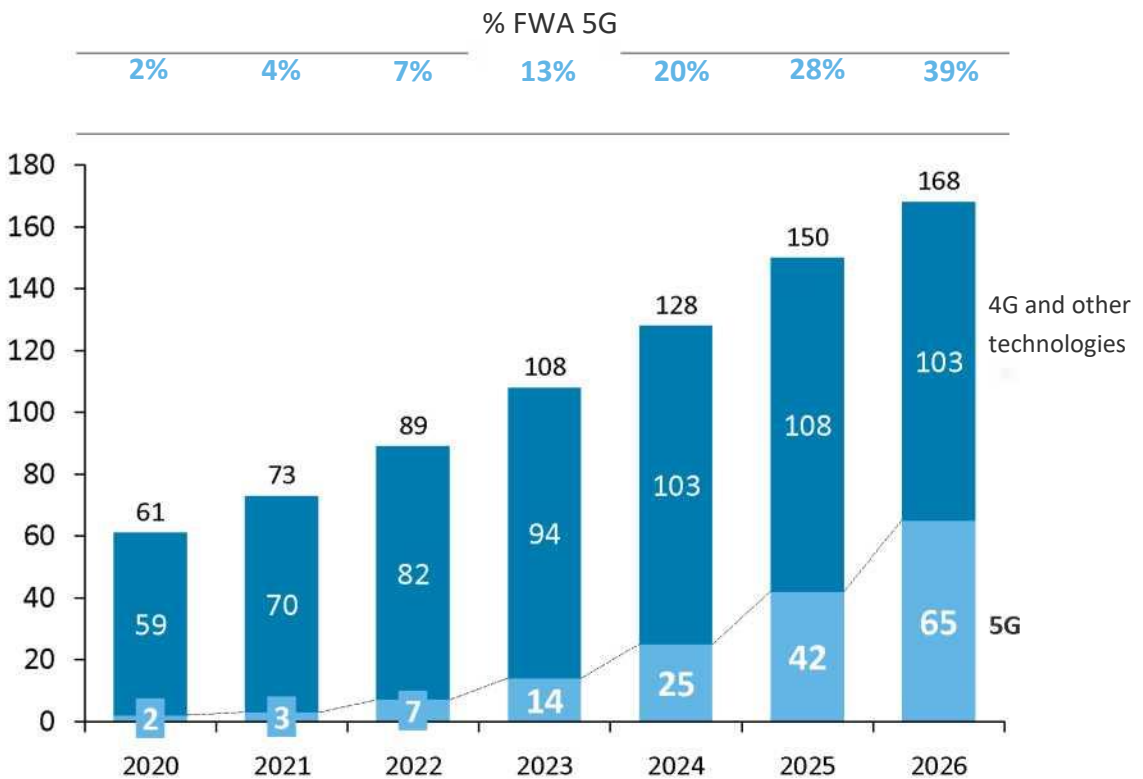
FWA is mostly used **in residential areas where wired internet service is not available or cannot be established** (mountains, woods, islands).

Having a wider spectrum and network infrastructure with the 5G, **the FWA has reached a connection performance** where it can compete with the wired fiber internet.

The 5G FWA technology significantly reduces **the investment costs for the internet infrastructure, as well as installation and operational costs, which** ultimately offers a faster and more economical solution.

It has a huge potential to be an alternative to wired internet **both due to its connection performance and** cost efficiency.

Number of FWA connections by years*, 2020-2026 (million units)



Source: Deloitte

*Created by Deloitte based on data from Ericsson, Statista and ABI Research.

5G and Fiber Internet in Turkey

While the number of mobile subscriptions and the average internet use of subscribers are increasing in Turkey, investments are continuing with the aim to spread the fiber infrastructure, which has critical importance to improve the broadband internet and 5G technologies.

Fiber

- In 2021, the operators that offer fiber internet in Turkey have an overall share of 26.7% in the total fixed broadband market, and the total number of fiber internet subscribers exceeded 4.8 **millions.**

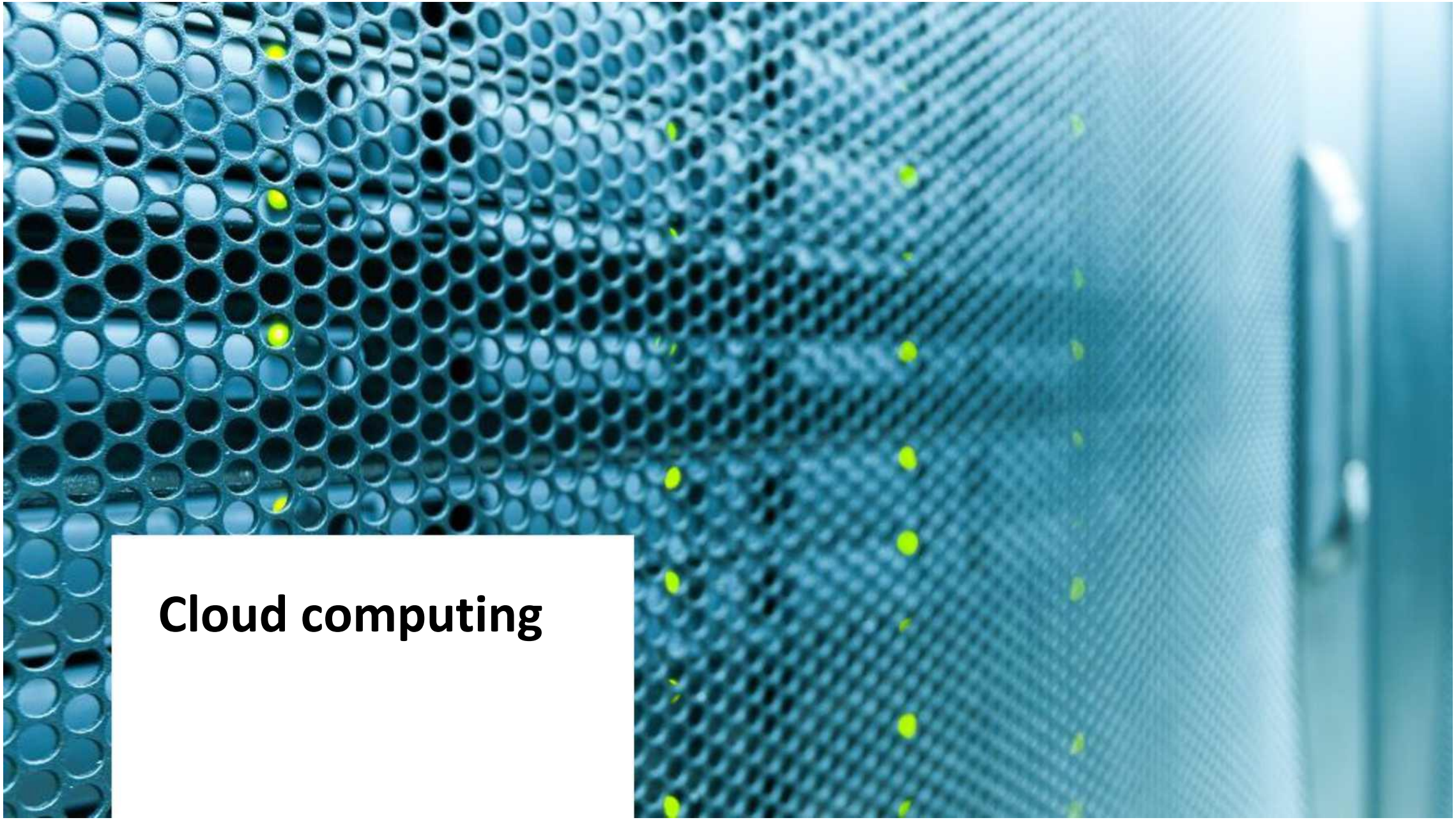
- **The length of fiber infrastructure exceeded** 471 thousand km in the fourth quarter of 2021, which is an 11% increase year over year, when the length was around 425 thousand km.

5G

- In 2021, the number of mobile subscribers **in Turkey reached approximately 86.2 million,** and the monthly average data use from mobile internet subscriptions was **11 GB.**

- In 2021, 80% of mobile subscribers benefited from the 4G technology, it is estimated that this number will reach 84% in 2025 as it will get a share from technologies older than the 4G, and that the 5G technology, for which studies are underway with domestic resources, will get a share of around 14%.

Source: BTK, GSMA


Cloud computing

Cloud Computing

Cloud computing comprises of systems that allow to use cloud computing sources (such as data storage, processing power, software, etc.) over the internet when and as long as they are required.

It is used in 3 common ways:

PUBLIC CLOUD

- All hardware, software and other supporting infrastructures **belong to the 3rd party cloud service provider and are managed by them.**
- Users of the public cloud can instantly access the cloud, faster than the users of internet can.
- It is suitable for small and medium enterprises in the sectors where legal restrictions are relatively low.

- For example, public cloud is recommended for low security requirements such as e-mails, as well as high-volume needs.

PRIVATE CLOUD

- **These are cloud computing sources exclusive to organizations.**
- Optionally, these can be stored at cloud service providers or the company's own data centers.
- It allows for more control **over resources and** prevents multi-user structure.
- It is suitable for sectors where legal restrictions are relatively high, such as the finance sector.

- It is recommended for requirements that contain private information and are business critical, such as financial reporting.

HYBRID CLOUD

- **It is a solution obtained by combining private cloud with public cloud.**
- Companies can share their data and applications in the hybrid environment.
- Companies can be **more flexible** with the hybrid cloud and use various spreading options to optimize their existing infrastructures, security and costs.

- Hybrid cloud is preferred for sectors that operate with extremely sensitive data, such as banking, finance, government and health services.

Source: Deloitte Analysis

Benefits of Cloud Computing

Cloud systems are preferred more as they offer benefits such as cost effectiveness, flexibility and reliability, and it is estimated that their increase of income in the market will be over 30%.

COST EFFECTIVENESS

It eliminates investment costs to purchase hardware and software, install and operate internal data centers, etc.

FLEXIBILITY

As it offers a flexible scaling option, it can offer services for the desired location when needed.

PERFORMANCE

It works on the network of the latest data centers, which means less latency and higher performance.

RELIABILITY

It backs up the data in multiple locations on the cloud provider's network and facilitates disaster recovery.

SECURITY

It offers various principles, technologies and controls with regards to security to protect the applications and the infrastructure against potential threats.

Smart Edge Computing

Edge computing is a group of connected systems and devices that ensures that data are processed and stored in a location close to where they were created, so that they can be collected and analyzed faster; almost in real time.

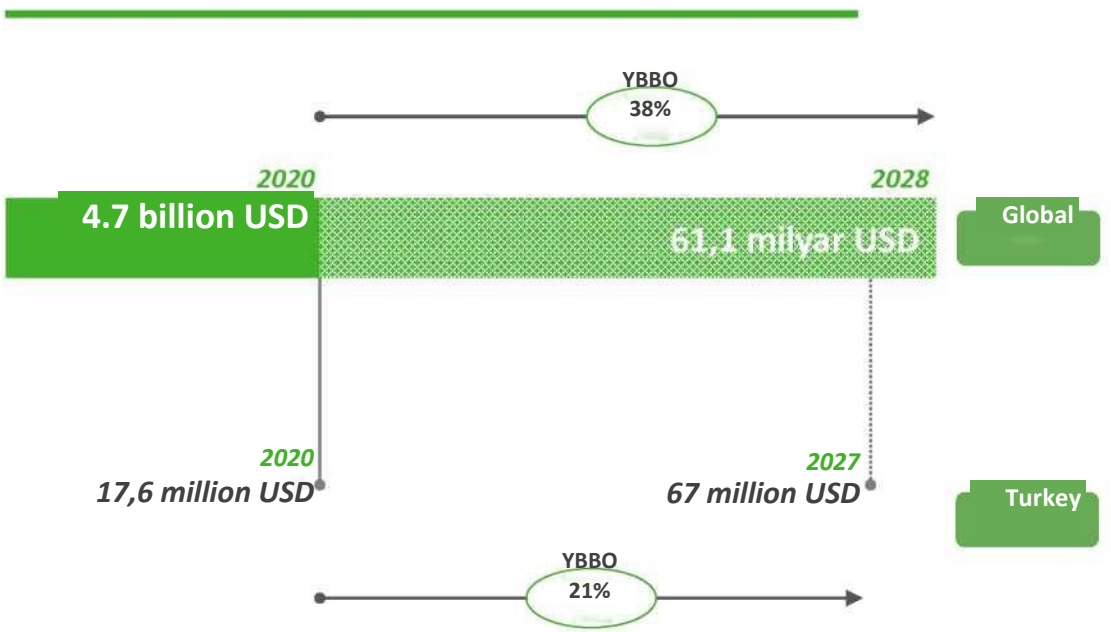
Sectors that benefit from the smart edge computing the most

- Energy and infrastructure
- Industrial manufacturing
- Transportation and logistics
- Smart cities, homes and buildings
- Health
- Agriculture

Fast developing areas of use

- It is expected that the **investments made in smart edge computing in the** telecommunications and health sectors **will** increase quickly by 2028.
- The digital transformation of manufacturing **still continues** with the industrial internet **of things and smart edge computing infrastructure.**

Size of the smart edge computing market in the world and in Turkey, 2020-2028



Source: Barnes Reports, Grand View Research

Multi-Cloud

Multi-cloud is a method where an organization that wants to optimize its cloud infrastructure and costs combines various cloud services and software offered by two or more cloud providers in collaboration, and easily accesses all clouds.

How does it affect sector players?

- Data are flexibly placed in the most suitable environment possible thanks to the various features and services
- Risk is dispersed and enhanced security is ensured thanks to the fact that services are purchased from various cloud providers
- Businesses can easily monitor the usage costs and benefit from competitive pricing
- Businesses are not dependent on a single provider for certain services
- A more innovative and agile environment is ensured thanks to the flexibility offered by different clouds

71% of businesses prefer cloud computing technologies for speed improvement, ***63%*** for more flexibility, and ***57%*** for improved customer support.

According to a survey by a cloud service provider, ***73%*** of clients use two or more clouds. It is expected that ***81%*** of organizations will be using multi cloud by 2024.

What are the areas of use?

- Data backup and archiving
- Adaptability
- Artificial intelligence and machine learning
- Software development
- Clustering to add access to the cloud where data are stored

It is expected that multiple clouds, which cover management, infrastructure, security and network creation and are combined in a single functionality, **will** become popular in the future to reduce complexity and risk.

Source: Forbes, IDG, Oracle

Cloud Computing in Turkey

In line with global trends, the interest in cloud computing is increasing in Turkey. The increasing use of the cloud brings about data security concerns and data localization.

In addition to the KVKK (Personal Data Protection Law), companies are also subject to data restrictions established by the **BTK, SPK,, BDDK and other organizations**.

According to the latest legislations and regulations, it is obligatory, for data security reasons, that personal data are stored in **data centers** in Turkey.

In particular, companies doing business in Turkey and abroad **need to transfer data overseas** for reasons such as use of shared systems and processes managed by central teams.

Furthermore, since many companies buy services from cloud computing service providers based in overseas countries**,** they can experience problems when adapting to operations and regulations.

In the "Personal Data Security Guide" prepared by the Personal Data Protection Board, it is highlighted that when storing and using personal data on the cloud system,

- Data must be encrypted **with cryptographic methods**
- **Personal data must be encrypted before being transferred to cloud environments**
- Whenever possible, different encryption keys must be used especially for

each cloud solution **used**.

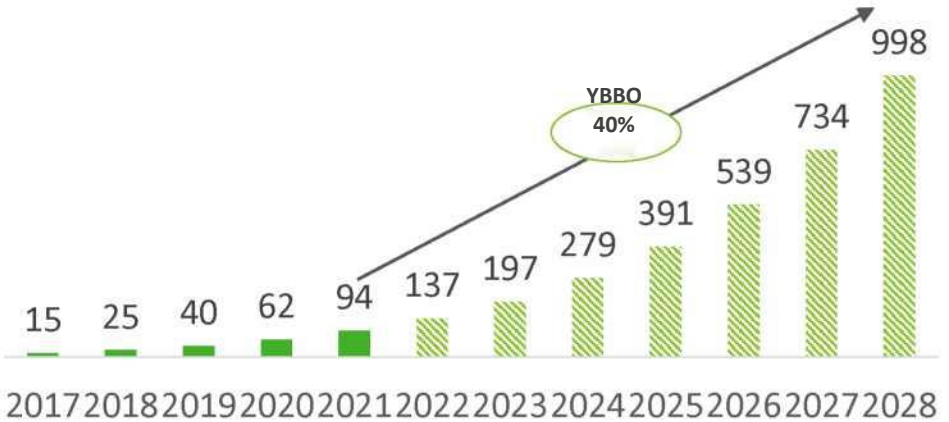
Source: Deloitte Analysis, IDC

Artificial intelligence

Global Artificial Intelligence (AI) Market

Artificial intelligence technologies are aimed at reducing the need for humans by improving the programming systems for tasks that need human direction, such as decision making, voice recognition and language translation.

Size of the global artificial intelligence market, 2017-2028 (billion USD)



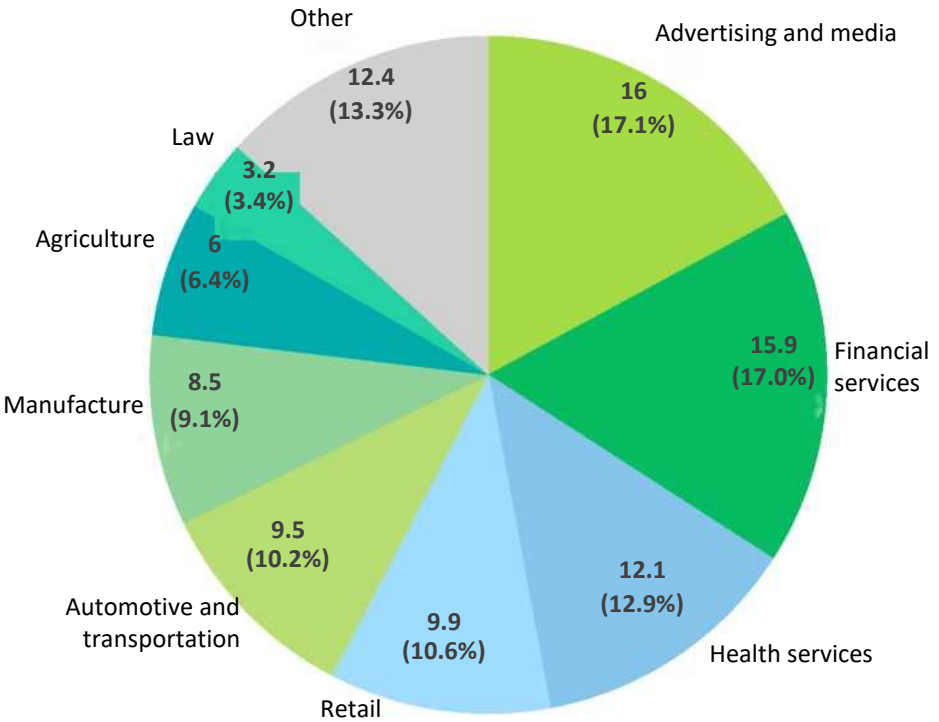
Estimated compound rates of growth of the global artificial intelligence market, 2021-2028

40% All solutions (hardware, software, services)

49% Artificial intelligence services

It is expected that the service category **will be the** artificial intelligence solution **with the highest growth rate.**

Sectoral shares and distribution of the global artificial intelligence market, 2021 (billion USD)

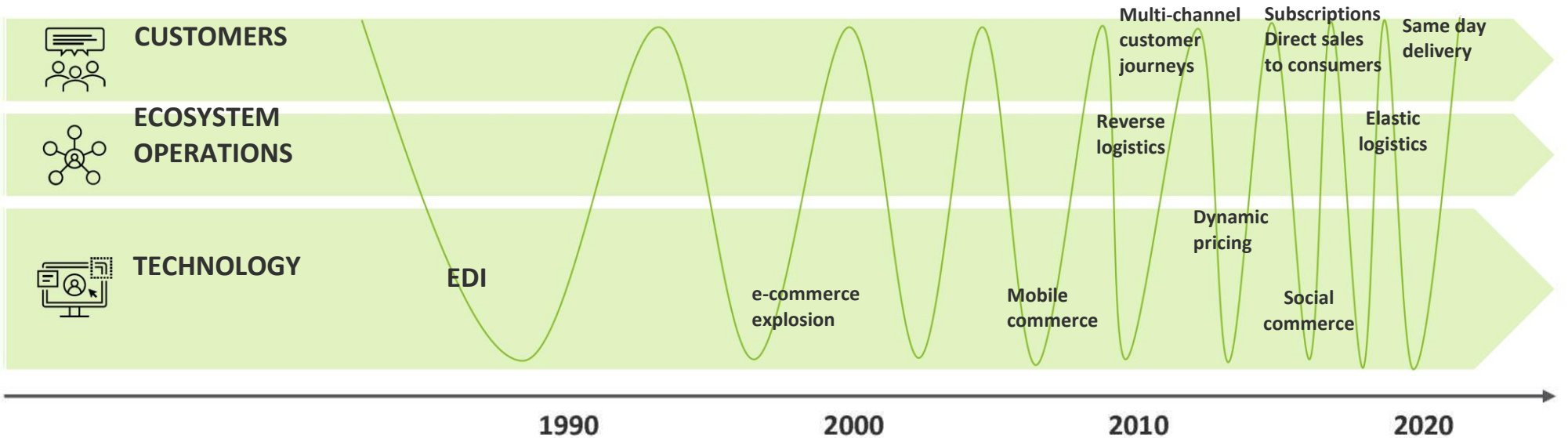


Source: Grand View Research

Decision Intelligence (DI)

Decision intelligence applications produce useable insights with the help of artificial intelligence from the ever-increasing data sources to meet the need to take quick and target-focused decisions in organizations' business processes, which are changing with speed and become more complicated.

While technological advances have brought new opportunities for companies to create value for their clients and for each other, **the ever-changing sector dynamics, customers with increasing expectations, agile competitors, increasing market variability and growing data silos** have introduced new challenges to face.



Source: IDC

Decision Intelligence (DI)

With humans and the artificial intelligence working together in decision-making processes, organizations are now taking their potential to reach target results one step further.

What are the types of decision models?

Artificial intelligence allow humans to make decisions through the insights it produces and the data visualization it offers.	***Human-based decisions***
The artificial intelligence makes decisions independently of humans. Autonomous systems pose a risk to develop new behaviors and break the limits of what was estimated.	***Machine-based decisions***
Artificial intelligence and humans collaborate to reach a conclusion. Hybrid models can make recommendations or take actions for humans. The ratio of responsibilities in the decision-making process may vary.	***Hybrid decisions***

What benefits does it offer to organizations

- Better decisions that lead to better results
- Faster decisions
- Elimination of mistakes such as prejudices
- Benefits of human judgement, such as intuitions
- Connection between decision support and decision management systems

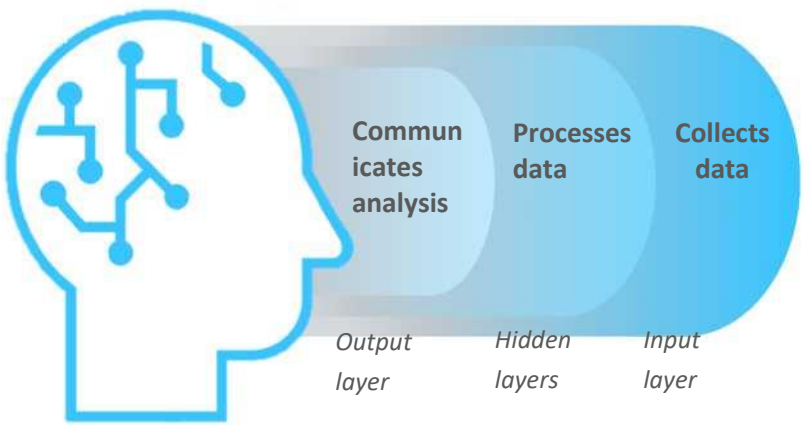
Source: AI Multiple

Deep Learning (DL)

Deep learning is based on a conceptual model of the human brain called the “neural networks” and it is a subsegment of machine learning. Deep neural networks aim to uncover the complex relations between the input data and the targeted outputs.

Neural networks are comprised of ***layers connected to one another. As the number of hidden layers increases, so does the depth of the system,*** which in turn ensures that more complicated information can be processed:

Deep Learning



Deep learning is used to ***process large datasets that have a complex structure, rich content and multiple dimensions,*** such as voice, visuals and videos.

How does it affect sector players?

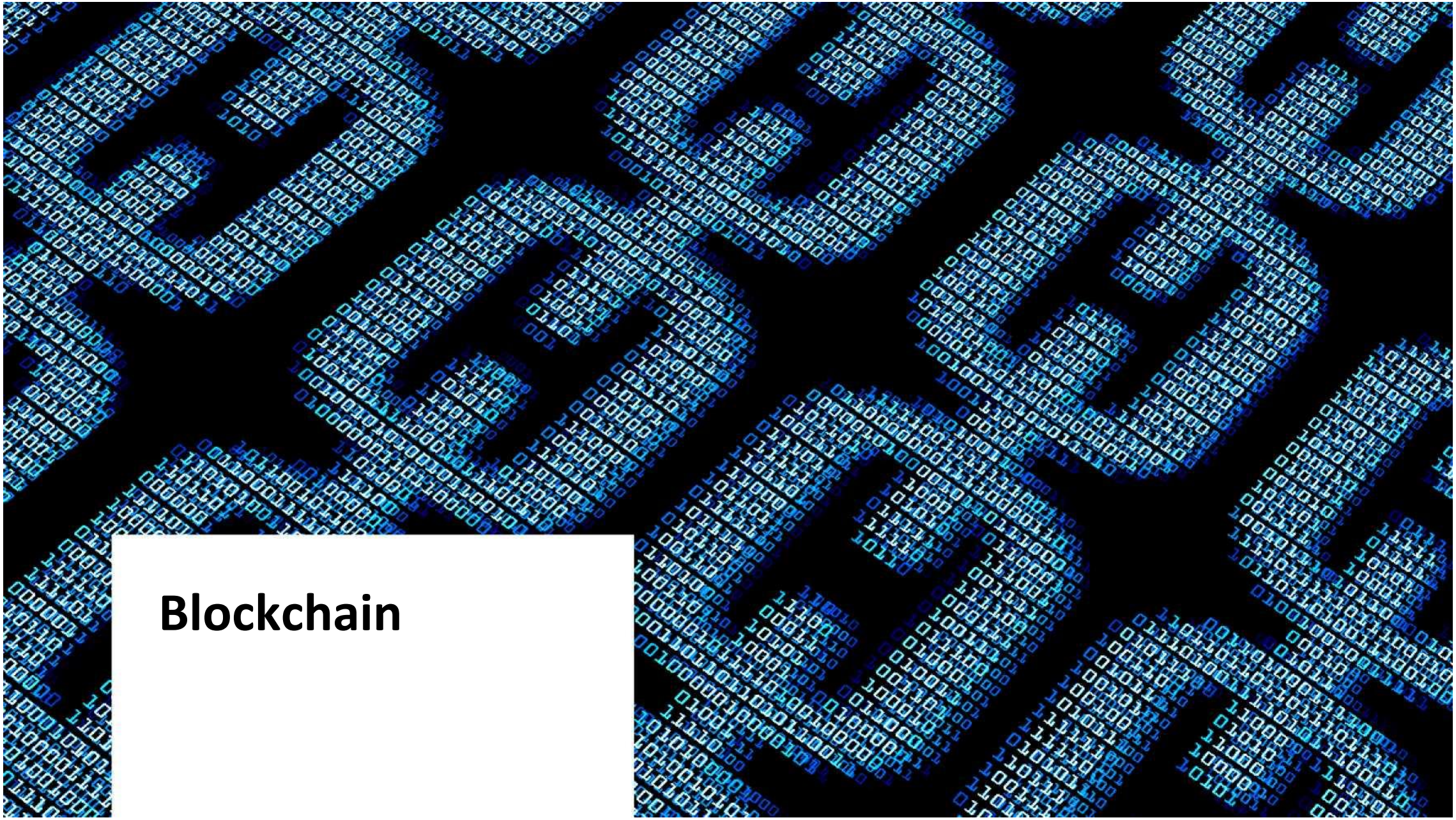
- It allows for differentiation and increases competitive power.
- It increases operational efficiency.
- It offers customer and employee retention.
- It paves the way for new business models and operation models.

What are the areas of use?

- Product search by image
- Creating screens that provide customer insight
- Detecting fraud
- Developing strategies for commerce and investment

Although there are a lot of data that can be used for decisions with a potential to create a transformative effect, it is estimated that most organizations use ***less than 1% of their data.***

Source: Deloitte, World Economic Forum

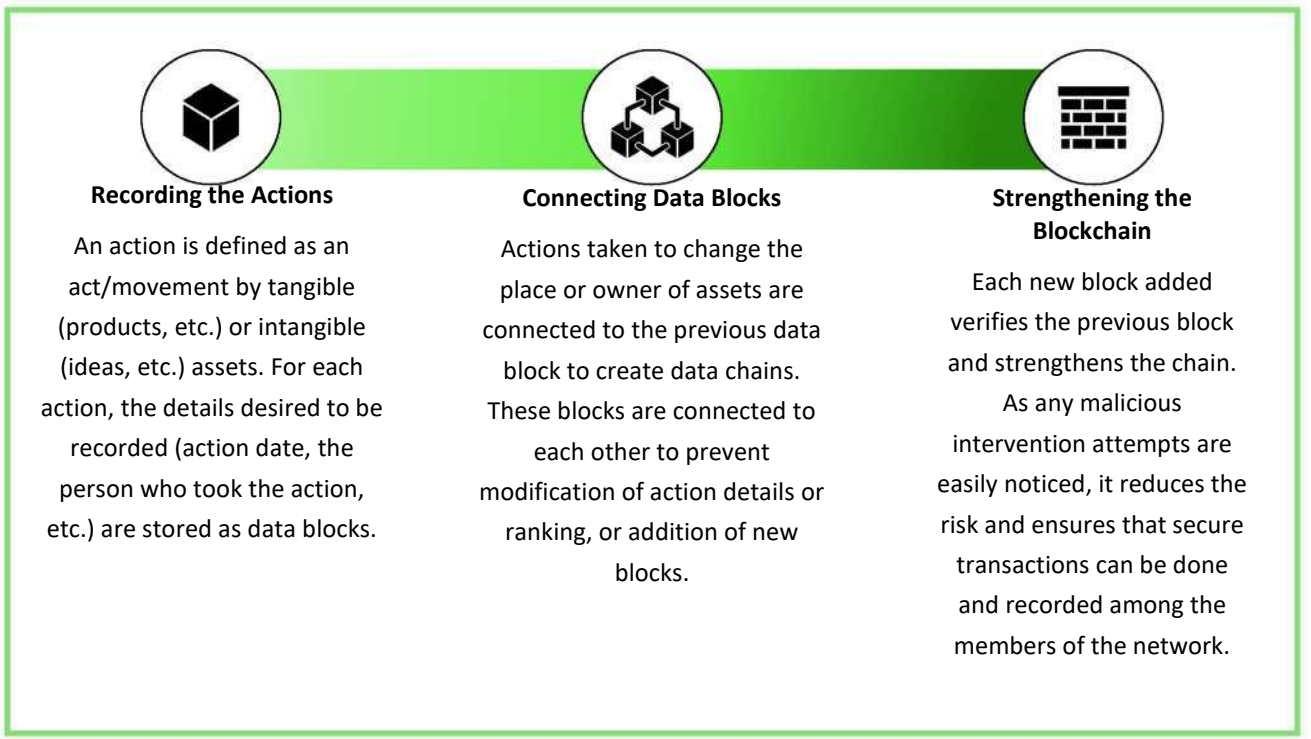


Blockchain

Blockchain Technology

With the blockchain technology, every action taken within the system is subject to approval from authorized shareholders in the ecosystem. The action details are recorded at every shareholder in a decentralized structure and is dependent on the previous action.

How does the blockchain work?



Recording the Actions

An action is defined as an act/movement by tangible (products, etc.) or intangible (ideas, etc.) assets. For each action, the details desired to be recorded (action date, the person who took the action, etc.) are stored as data blocks.

Connecting Data Blocks

Actions taken to change the place or owner of assets are connected to the previous data block to create data chains. These blocks are connected to each other to prevent modification of action details or ranking, or addition of new blocks.

Strengthening the Blockchain

Each new block added verifies the previous block and strengthens the chain. As any malicious intervention attempts are easily noticed, it reduces the risk and ensures that secure transactions can be done and recorded among the members of the network.

Blockchain technology with the use of cryptography...

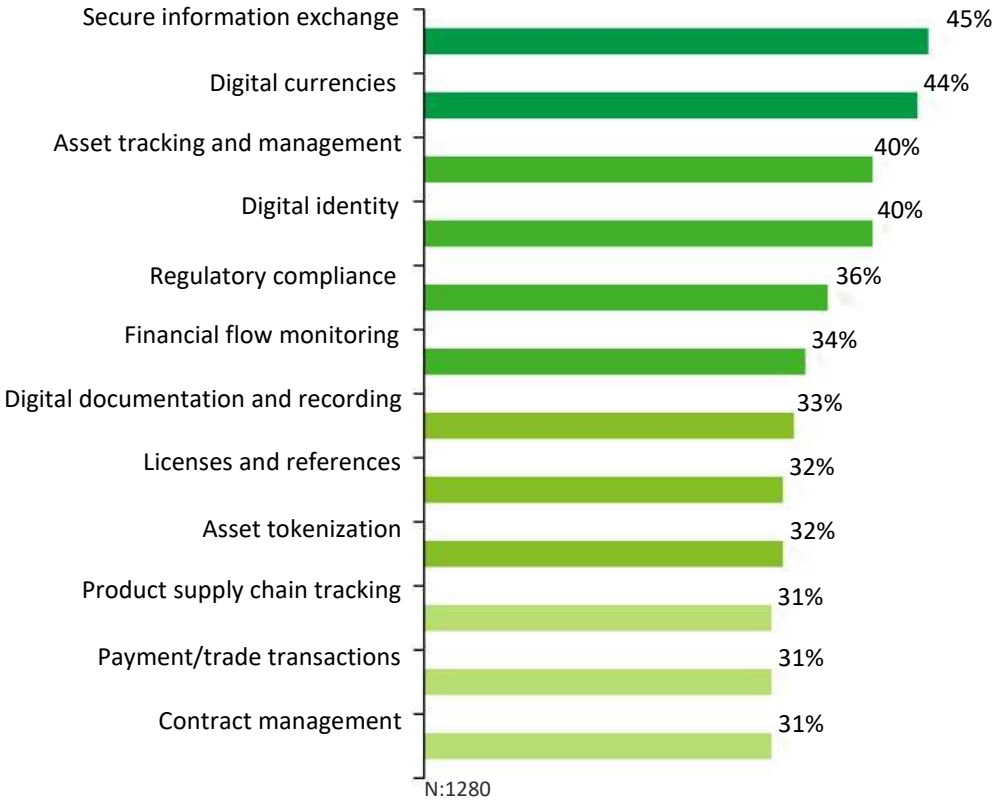
- **It** mostly **does not need a central structure.**
- **It can be** controlled **from multiple points simultaneously.**
- The set of rules is automatically run, **which** increases **operational efficiency.**
- **It** guarantees **to provide reliable consensus** on the existence/status **of facts.**
- Data are shared with the shareholders to the extent of authorization**, and consistency and accuracy of actions are ensured.**

Source: Deloitte, IBM

Blockchain Application Areas

Blockchain is used in many sectors such as financial services, retail, logistics, education, media and energy, because it ensures that the stored data cannot be modified and allows shareholders to control the data in real time.

Global areas of use for the blockchain technology, 2021



Source: Deloitte

Corporate blockchains

Corporate blockchains aim to solve problems related to multiple organization interactions and facilitate to create new business models through distributed ledger technology.

- **Record monitoring:** It allows information and asset transfer in a safe and cost effective manner in almost real time without any intermediaries.
- **Digital assets:** Programmable features allow to store assets in a secure environment that does not need a central structure.
- **Value transfer:** User-specific encryption allows to transfer information with high security and reduced costs.
- **Smart contracts:** Actions are verified in chunks in real time and the next action is triggered until the whole process is complete.

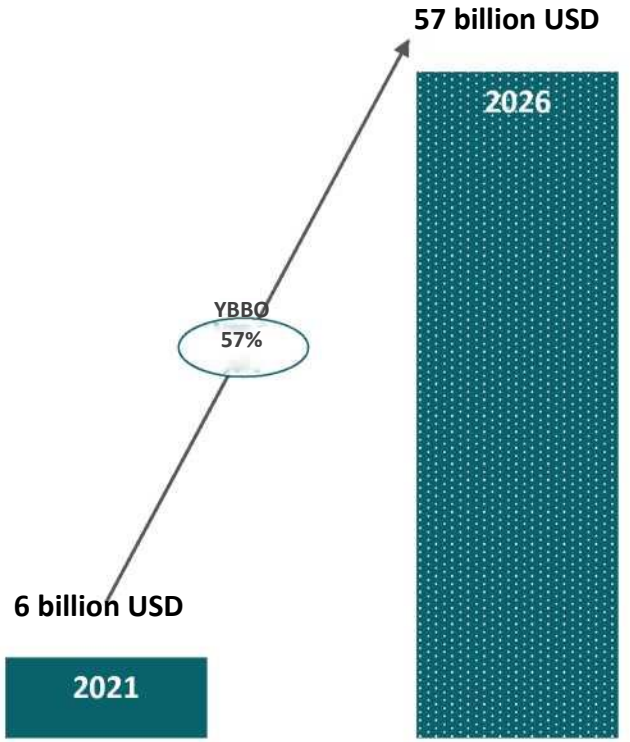
The transformative effect of blockchain

According to Deloitte 2021 Global Blockchain Survey, **73% of participants** believe that **it is vital for organizations to adapt to** blockchain **if they want to remain competitive in the future, and 76% believe that in the** 5 to 10 years to come**, digital assets will replace currencies and** the physical currency will come to an end.

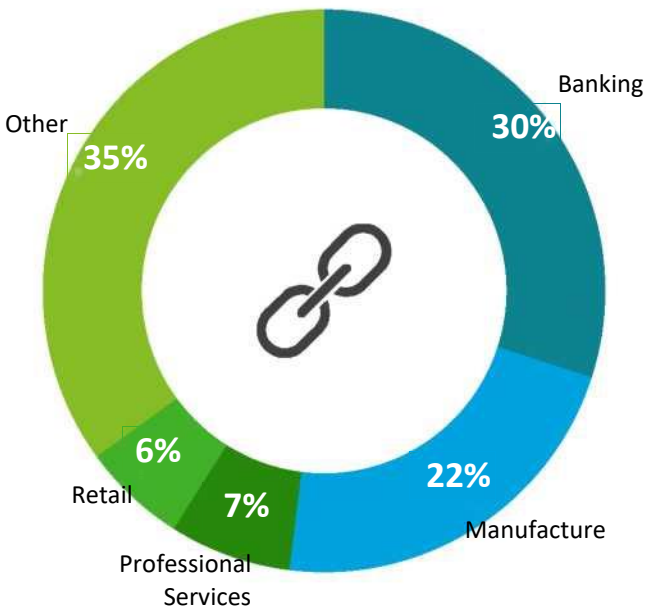
Size of the Blockchain Market

The diversity in the areas of use in blockchain and the increase in the technological expenses made by actors from different sectors have led to an expectation for a serious growth in the global market size.

Size of the global blockchain market, 2021-2026



Global blockchain expenses by sectors, 2020



Source: BCC Research, IDC

Tokenization

Representing physical assets, financial instruments or valuable data with an unimportant datum is possible through tokenization on blockchain. Tokens can be transferred on the blockchain to change to owner of the relevant asset.

Tokenization acts like a bridge between business processes/physical assets and the blockchain.

Operating principle

- While tokenizing assets in compliance with the law, the format of the data is preserved or new data are created to represent the relevant data to establish a connection to the tokens.
- The ownership of the tokenized asset can be monitored on blockchain.

Benefits

- It securely verifies asset ownership because it cannot be imitated or copied.
- It uses blockchain techniques to allow to partially share assets without needing complicated legal procedures.
- Sharing personal data that are kept private with the shareholders of the ecosystem paves the way for studies that will create value within the sector and between sectors.

Areas of use

- **Smart contracts**
- **Real estate**
- **E-commerce**
- **Finance (crypto-currency markets, etc.)**
- **Gaming**
- **Retail**

Source: Deloitte, Gartner

Non-Fungible Tokens (NFT)

Non-Fungible Tokens (NFT) are a type of token defined specifically for the relevant asset on the blockchain technology for unique assets that cannot be copied/duplicated.

Fungible Tokens	Non-Fungible Tokens
o These are tokens that are equivalent in terms of quality and quantity (e.g. amount of money).	o Since the properties of the asset are unique, these tokens are unique and cannot be duplicated.
o The type of token can be preserved and divided, and the amount can be changed.	o Their structure cannot be intervened, they cannot be divided or copied.
o It can be partially or wholly traded or replaced with equivalent assets.	o They cannot be replaced with any equivalent asset but the asset ownership can be changed.
o Crypto currencies and company shares are some of the examples.	o Artwork and intellectual property rights are some of the examples.

Non-Fungible Tokens (NFT) are used to **create verifiable digital ownership, originality, traceability** and **security records that can be easily implemented in various sectors and activities.**

- Crypto artwork
- Digital collections
- Online games
- Music
- Valuable stuffand equipment
- Patents and other intellectual property rights
- Real estate
- Licenses or use rights
- Financial documents

Source: EU Blockchain Observatory & Forum

Blockchain Applications in Turkey

In Turkey, blockchain technologies are increasingly used for investment in the cryptocurrency markets, and with the aim to reduce operational loads in various sectors, securely complete commercial transactions and increase brand recognition.

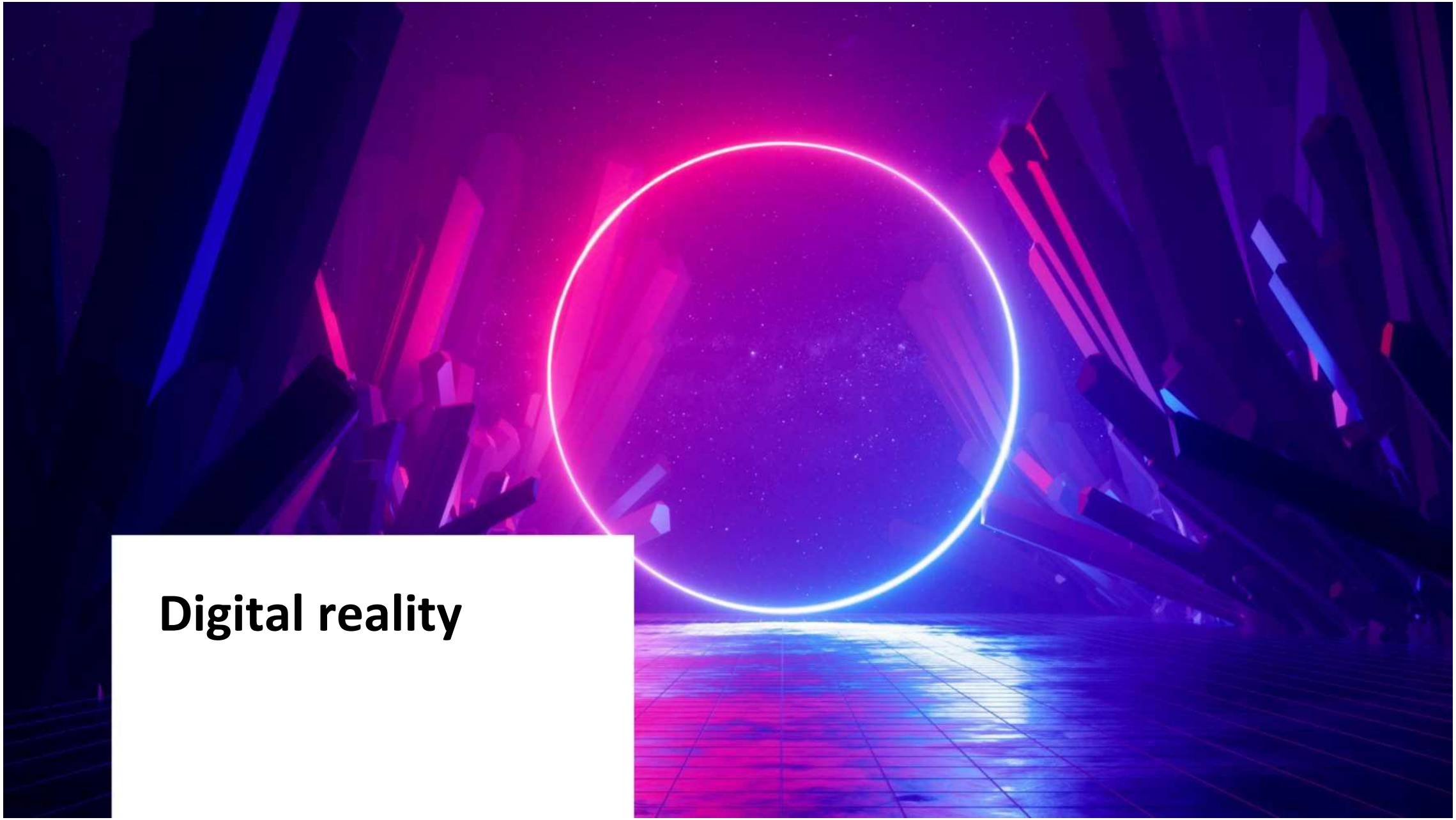
Blockchain in Foreign Trade Financing

- One of the leading banks in Turkey uses the blockchain technology and smart contracts **for its foreign trade financing** procedures and **guarantees payment**.
- This practice eliminates the paper transfer and the operational load in control **processes** in international trade, ensuring that transactions are **faster and transparent,** in addition to providing **financial privacy** so that processes can be carried out securely.

Non-Fungible Tokens in Textile

- A leading textile company in Turkey **is getting ready to introduce Non-Fungible Tokens (NFT) themed** products.
- The plan is to print the artwork from the digital collection of a famous artist on **textile products and market them.**
- The aim is to **increase** brand recognition **through marketing activities supported by themed products.**

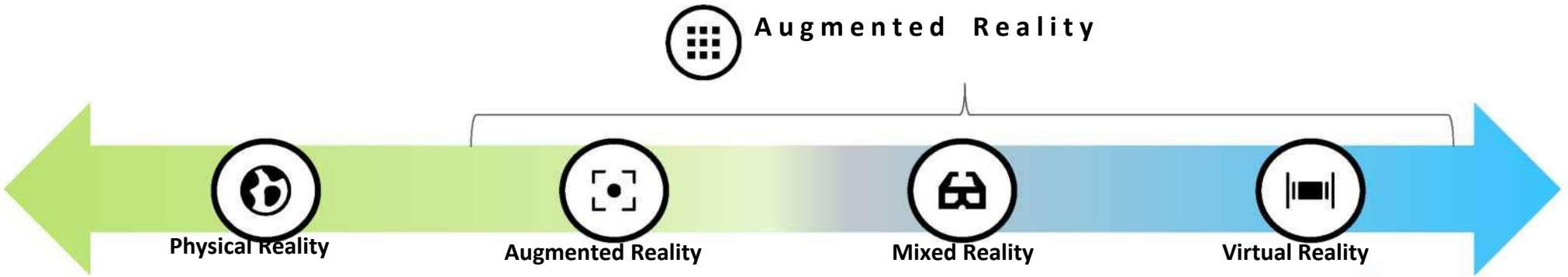
Source: Deloitte Analysis



Digital reality

Digital Reality

Digital reality transform its interaction with the technology by providing holistic experiences for uses through augmented, mixed and virtual reality technologies that focus on human in terms of design and are created based on intuitions and data.



Physical reality is when a person interacts with what/who they are surrounded with, without intervention from any digital factor.

Augmented reality reflects **digitally created content on the user's real life environment.**

The user **is aware of themselves and their real external environment**.

It continuously blends digital content with the real world to offer an experience **where both environments coexist and interact with each other**.

It uses advanced sensors for dimensional awareness and mimic recognition **.**

Virtual reality creates **closed digital environments that replace the real world.**

It follows the body and moves of users to ensure interaction in the digital environment.

Source: Deloitte

Areas of Use for Digital Reality

Digital reality combined the real world with the digital world, which in turn introduced innovative areas of use to allow product and service providers to transform various experiences from the way they do business to entertainment.

Connectivity

It allows users to communicate, interact and collaborate remotely without having to be at the same location.

Field services
Repair and Diagnosis
Equipment installation
Holo Asset

Information

It transforms existing ways of doing business by ensuring that professionals can use data and resources with more diversity and more efficiently.

Architecture
Maintenance and repair
Design
Medical sciences

Training

Training makes analytical processes and research experience more interesting, shortens the time, reduces risk and cost.

Immersive training
Security and compliance
Gamification
Behavioral analytics

Discovery

Regardless of time and place, it allows consumers to discover products and services.

Tourism and accommodation
In-store experience
Shopping with augmented reality

Entertainment

It combines digital world with the real world to create new content and offer it to users.

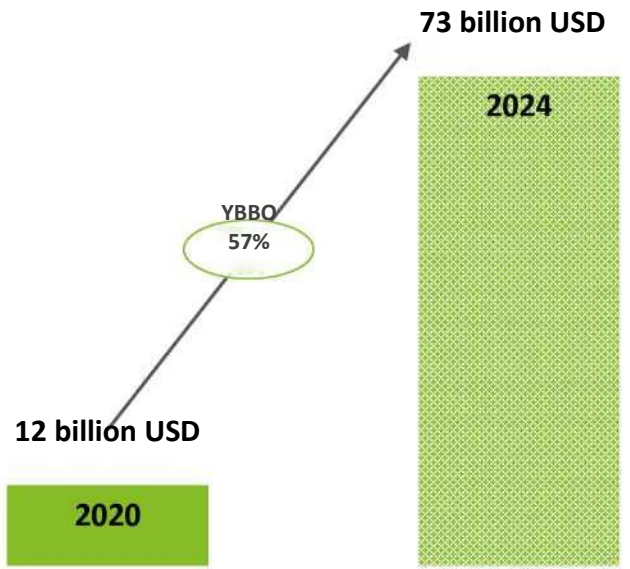
Live events
Story telling
Game
360° experience

Source: Deloitte

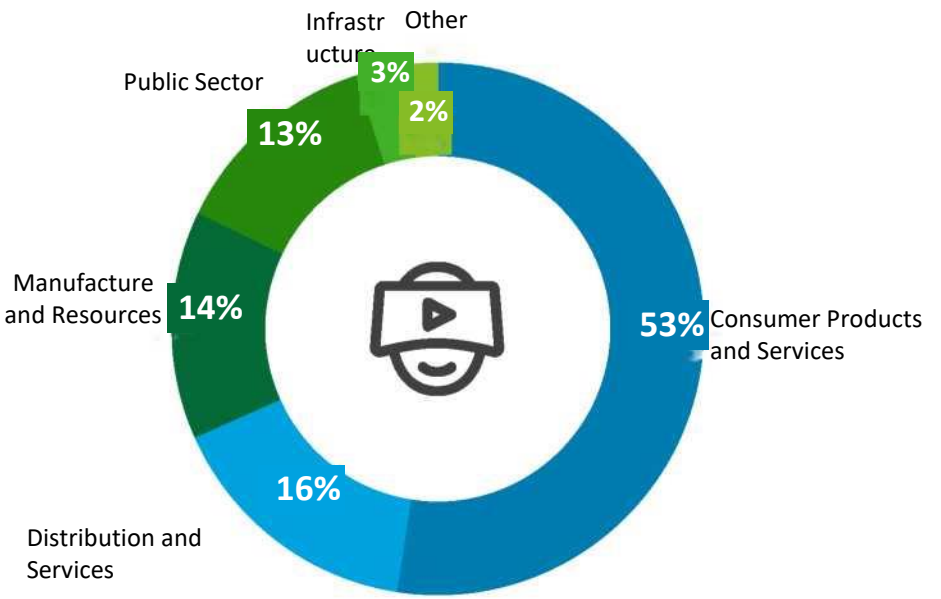
Market Size of Digital Reality

Since the pandemic has caused organizations and sectors to digitalize really fast, they now need augmented reality, mixed reality and virtual reality more, which introduces an expectation for increase in the market size.

Global market size of virtual reality and augmented reality, 2020-2024



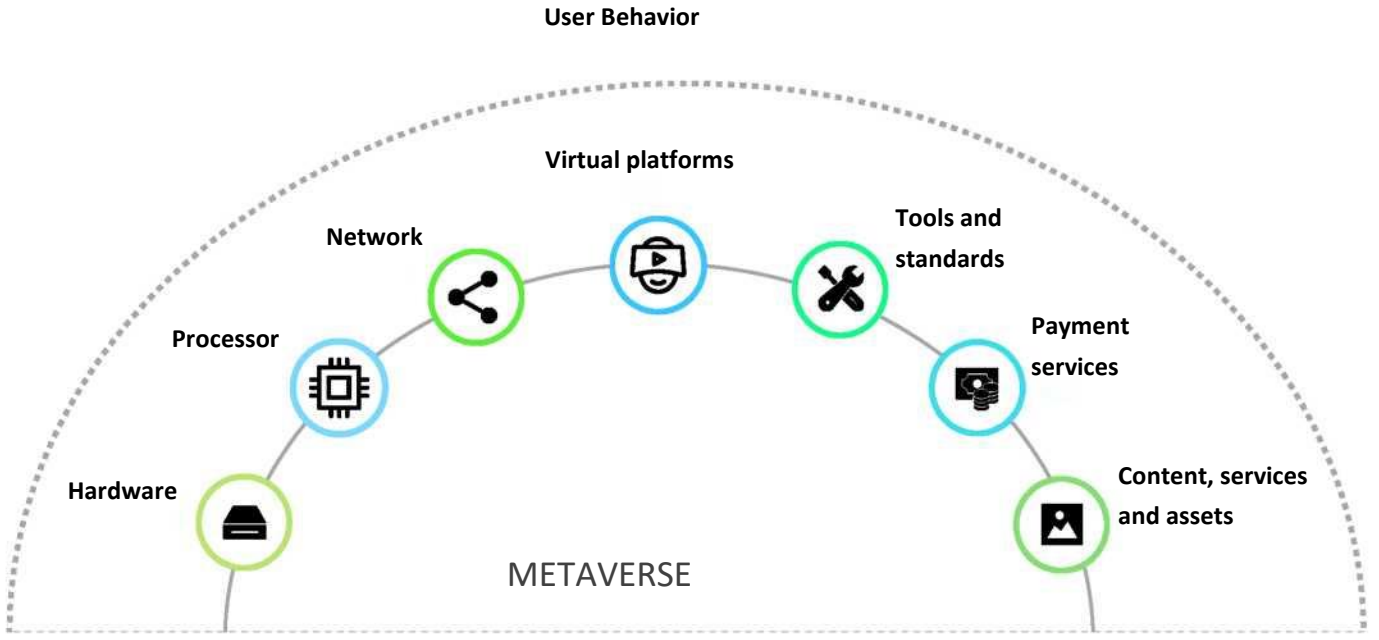
Sectoral distribution of the market shares of global virtual reality and augmented reality, 2021



Source: IDC

Metaverse

Metaverse (virtual universe) refers to the conceptual reality that emerged when a digital twin of the physical world was created on the internet. Metaverse is a type of digital interaction where connected virtual experiences simulate those of the physical world.



Leading sectors with a market opportunity

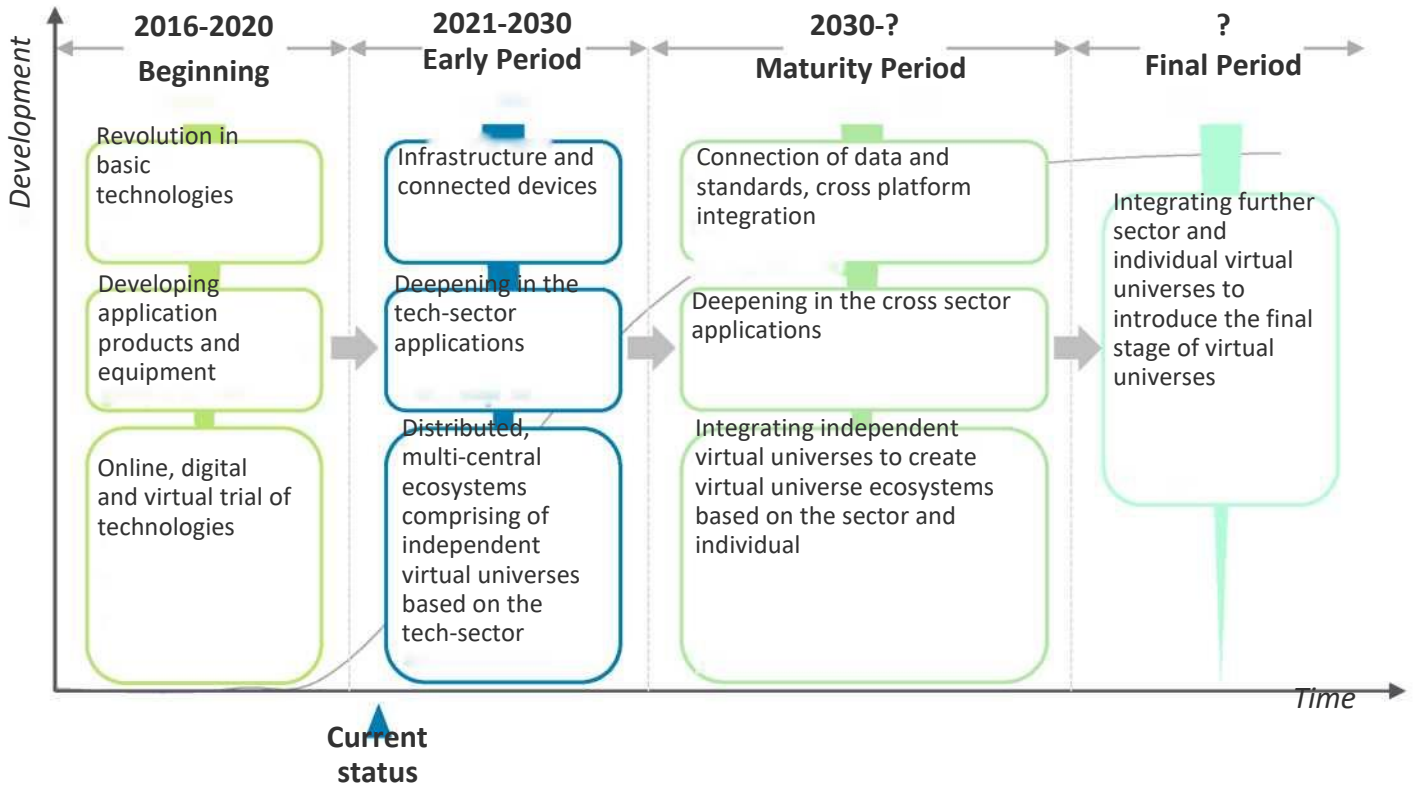
- Gaming
- Tourism
- Education/training
- E-commerce
- Real estate
- Entertainment, Art and Sports
- Media and Advertisement
- Software and Application Development

It is estimated that the potential global income opportunities from the Metaverse ***will reach 800 billion dollars by 2024***.

Source: Deloitte Analizi, Bloomberg

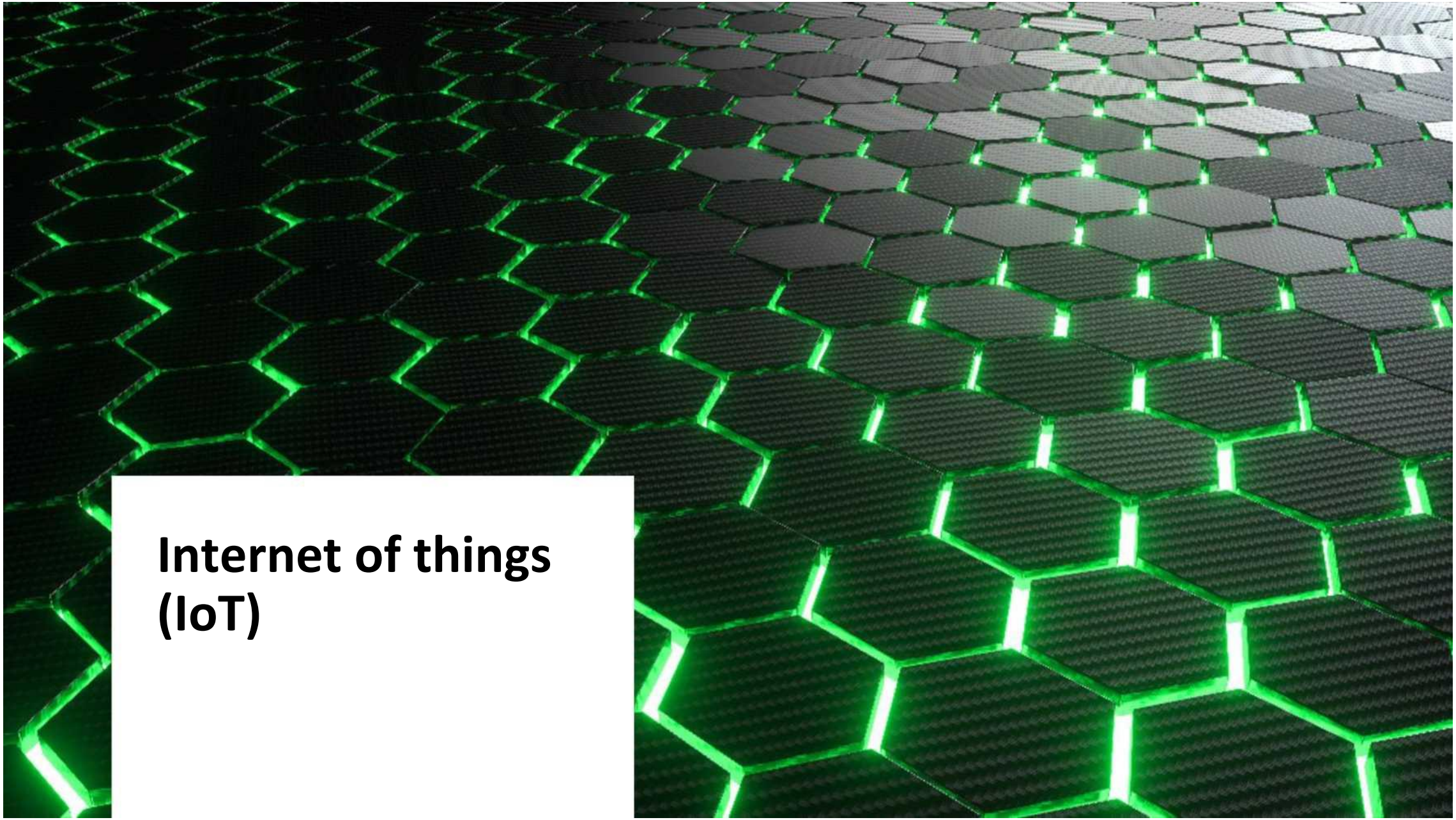
Metaverse Development Stages

Metaverse is currently in the beginning stages of its development and it has been improving as new technologies emerge. 5G, artificial intelligence, blockchain and Non-Fungible Tokens (NFT) are some of the most important technological components used today.



- Currently, **many virtual universes are actively used where users play games with their representative characters, participate in events and do shopping**.
- **Virtual universes that are independent of each other** are defined as the baby steps of the metaverse concept.
- Technological components must improve and be widely used **so that we can have experiences where the virtual world** can directly impact the physical world and the limits are not clear.

Source: Deloitte Analysis



Internet of things (IoT)

Transformative Effect of the Internet of Things

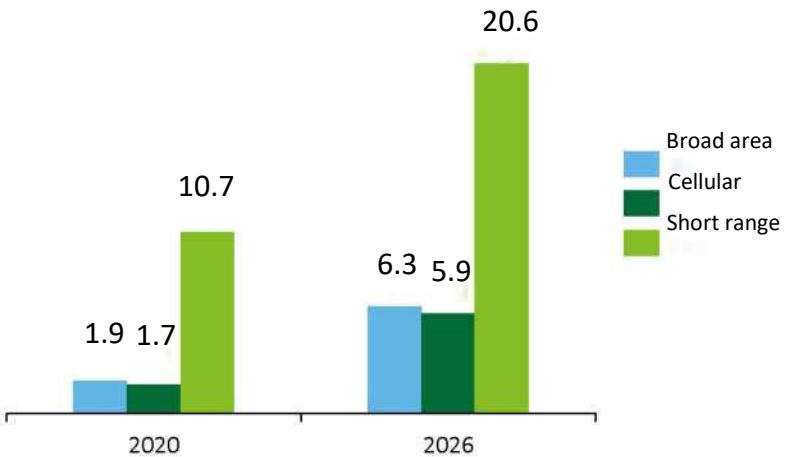
The internet of things creates a connection between the physical (human, asset, facilities, supply networks) and digital worlds, ensuring that insights are introduced that can have a transformative effect on businesses.

*It is expected that the number of connected things will **reach 16.4 billion by 2025.***

*It is expected that the **amount of data transferred over the internet of things connections will be 79.4 zettabytes by 2025.***

*It is estimated that the **global expenses for the internet of things technologies will be 1.1 trillion dollars in 2023.***

Number of the global internet of things connections by types, 2020-2026 (billion)



Source: Deloitte, Forrester, Statista

Applications and Software with IoT Feature

Applications and software with IoT feature are designed or developed in order to ensure data-based decision-making or automation by integrating products, assets, humans and processes that are connected with the internet of things, directly into organizational software and applications.

Applications and software with IoT feature

- The internet of things works in integration with edge devices and technologies and can be integrated with the internet of things platforms.
- It collects and analyzes data **to increase situational awareness in real time** and can create a response or device action **for the situation**.
- To complete the process determined, it can get into a two-way interaction with **digital twins**.
- It benefits from new applications and update to facilitate adaptation to the internet of things **technology**.
- *Asset Performance Management (APM), Enterprise Asset Management (EAM), Field Service Management (FSM), Product Lifecycle Management (PLM), analytics, modelling, simulation, etc. software* **are some of the examples**.

Benefits for organizations

When used to improve conventional applications (APM, CRM, EAM, etc.) and software (modelling, visualization, simulation), it offers benefits such as **asset and process optimization, improved customer services, design improvements** among others.

It provides savings on the powerful device integration skills required to integrate existing applications and software to the internet of things technology, and on the resources designated for the process to **develop business flows**.

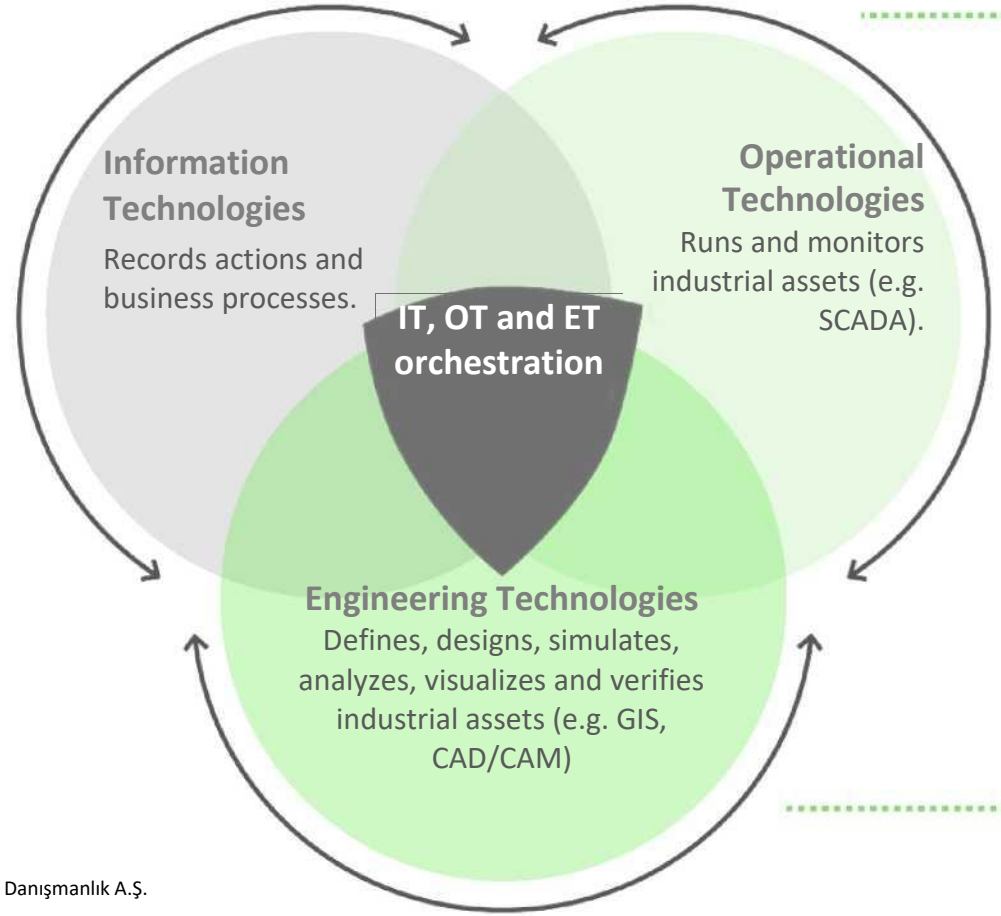
It offers a two-way interaction between the machine and the app/software, which is one of the increasing needs of organizations**, to ensure that the gaps of awareness against emergencies are closed and the level of control is** increased in the asset, process tracking, optimization and maintenance procedures.

Together with process improvements, enhancements in the output quality and effective resource management, **it reduces cost and ensures that the regular planning cycles at organizations** are done faster **under the light of relevant data**.

Source: Gartner

IT, OT and ET orchestration

IT, OT and ET Orchestration means information technologies (IT), operational technologies (OT) and engineering technologies work in harmony in line with common standards and management. Each technology is both complementary to and a strengthening factor for the remaining two.



Benefits of the IT, OT and ET Orchestration

- ✓ *Monopolization of license, maintenance and support costs for shared software components*
- ✓ *Consolidation of the provider and backend hardware at shared data centers*
- ✓ *Reduced risk in security, repair and update processes*
- ✓ *Easier access to ET and OT data for IT-supported data analyses*
- ✓ *Using ET systems to benefit from OT performance data in the product development stage*

Source: Gartner

Cyber security and data privacy

Global Status in Cyber Security and Data Privacy

Cyber security and data privacy has become an increasing concern for companies of every size because of the increasing and changing tactics of cyber attackers. Systems and information stored sometimes become vulnerable because of low awareness and inadequate protection practices of organizations.

~ 28.3%

Cyber security vulnerabilities had an average annual growth rate of 28.3% between 2016 and 2021.

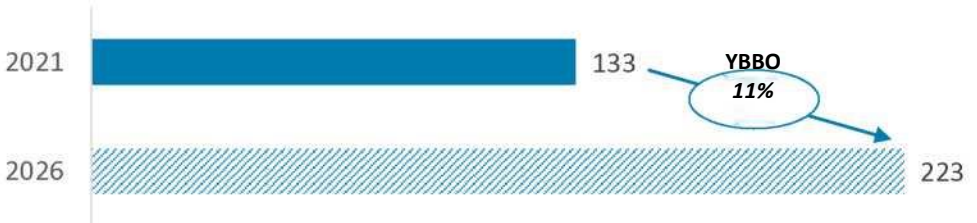
>40 billion

It is estimated that the number of global ***data breach cases*** in 2021 was over 40 billion.

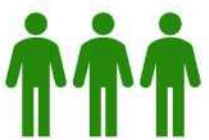
4.24 million $

The cost of data breaches went from *3.86* million to 4.24 million dollars, reaching the highest point reported in 17 years.

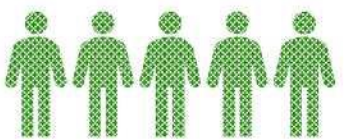
Global information security and risk management expenses, 2021-2026 (billion USD)



Global user privacy rights access, 2021-2023 (billion people)



In 2021, **~3 billion people** in 50 different countries have access.



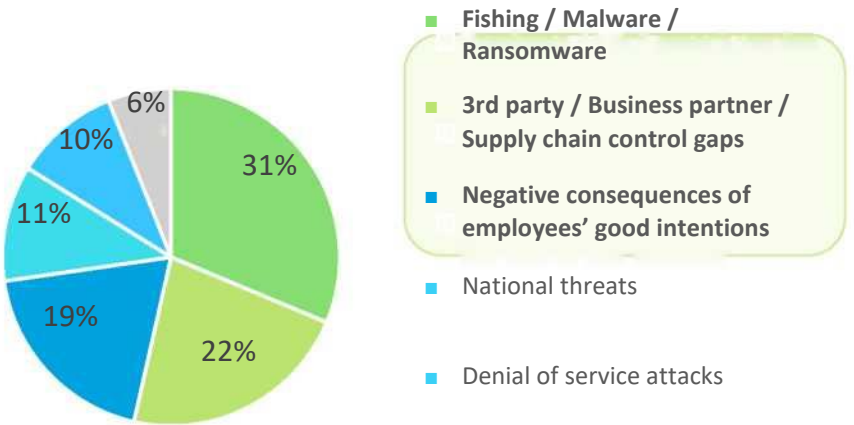
It is estimated that in 2023, **~5 billon people**, which corresponds to more than 70% of the gross domestic product, will have free access.

Source: Gartner, IBM, Mordor Intelligence, Tenable

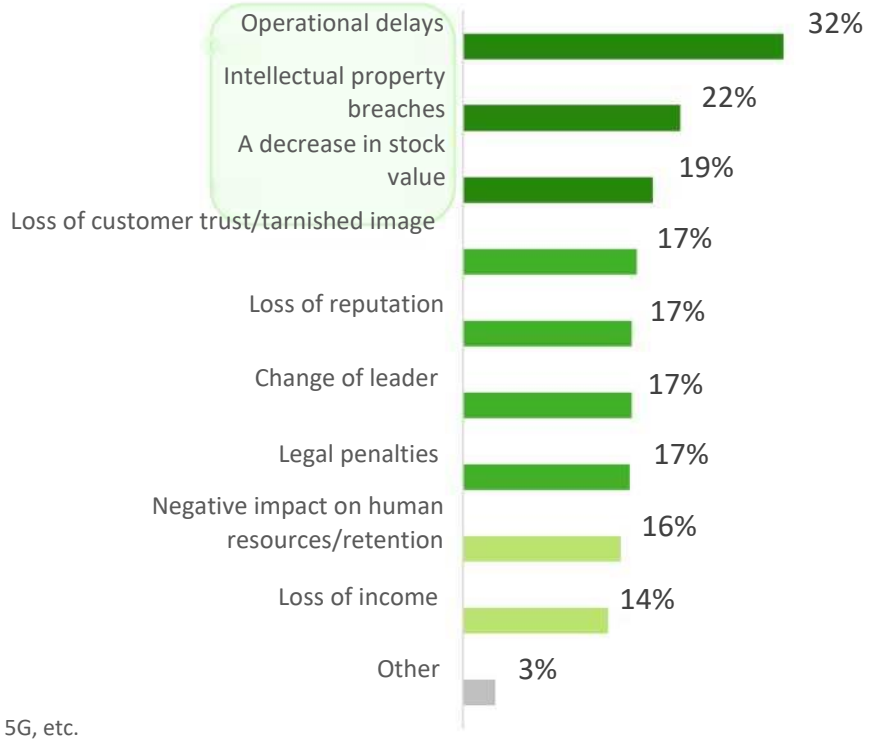
Organizations' View on Cyber Security and Data Privacy

According to the cyber security survey carried out with 577 top executives from 26 countries, cyber security attacks cause the highest concern while it was stated that the biggest impact was the delay in operations.

"According to the business model of your organization, what is the cyber threat that affects you the most?"



"What is the biggest impact of cyber attacks or breaches on your organization?"



"What do you expect adopting new technologies to change in your organization over the next 3 years?"

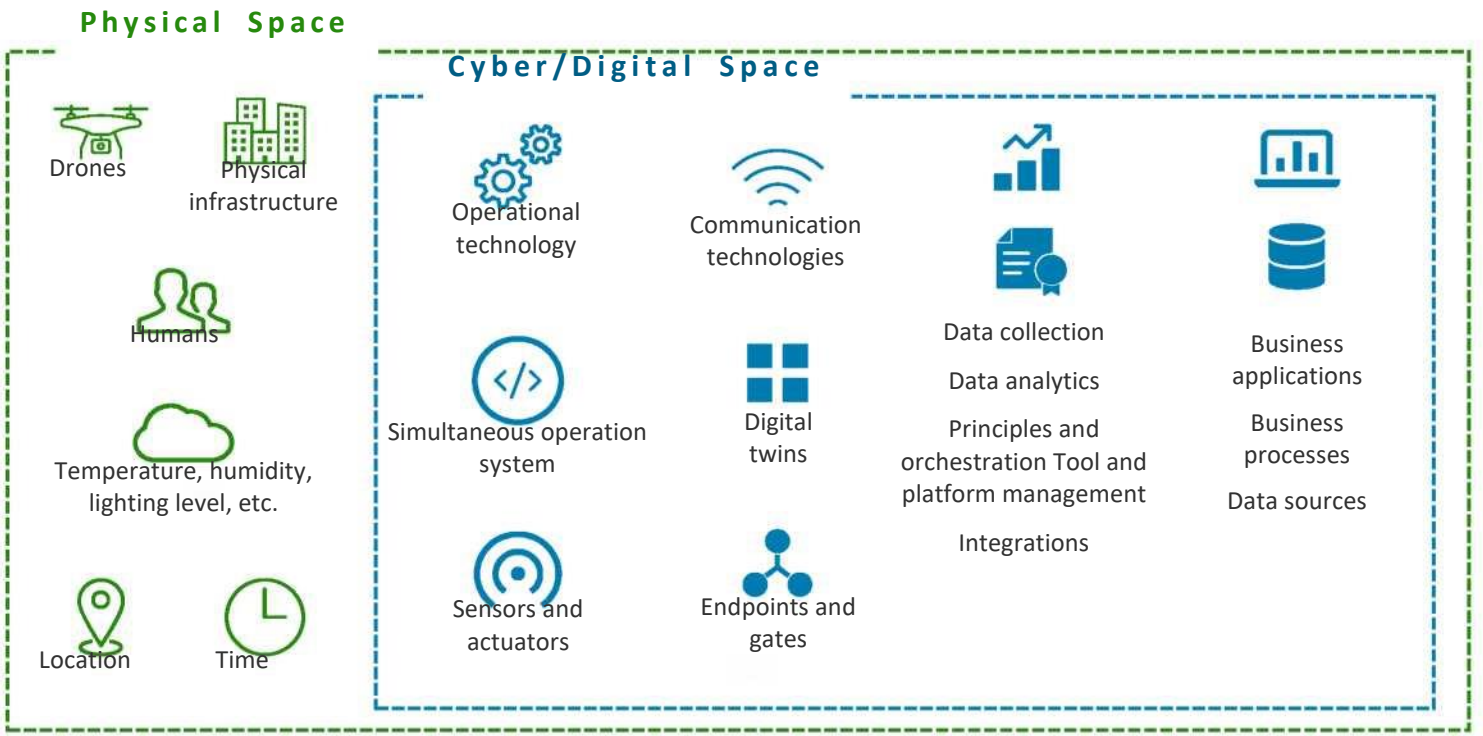
Source: Deloitte (2021 Siber Güvenliğin Geleceği Anketi, N=577)

Cyber Physical Systems (CPS)

The increasing digitalization not only risks organizational data but it also jeopardizes physical and intellectual property, business processes and human resources, causing organizations to face next-generation cyber physical threats.

Cyber Physical Systems (CPS) create a connection between the physical world and the virtual world in terms of detection, calculation, controlling, network management and analytics.

Secure connections allow to obtain **simultaneous, reliable information and** reliable system performance.



Source: Deloitte, Gartner, CISA ©

Cyber Physical Systems Risk Areas

- **Limit protection:** Failure to detect unauthorize actions in critical systems
- **The least functionality principle:** Using malware to access critical systems and internal fraud
- **Identification and authentication:** Inadequate responsibility and traceability of user actions in data breaches, and reduced account security due to leaving employees
- **Physical access control:** Unauthorized physical access to field equipment
- **Account management:** Unapproved access from shared accounts or system accounts

Application Security Requirements and Threat Management (ASRTM) Tools

The ASRTM tools ensure automated creation of security requirements and threat models.
They can be integrated into SDLC (software development life cycle) tools to manage requirements and perform verification.

Many organizations jeopardize their areas of activity unless they prioritize application security.

Cyber attacks to applications working on internet is easier compared to other applications.

Today's organizations are **trying to manage** more applications with increased complexity.

The gaps that have existed in coding standards sometimes cause great challenges as the number of applications increases.

The success in risk detection and prioritization depends on the tools used**, resource skills and the maturity in managing application security vulnerabilities**.

Each organization must regularly **follow advances and updates** to develop applications compliant with laws and regulations.

Application Security Requirements and Threat Management (ASRTM) Tools

Why is it important?

- Threat modelling and security requirements **are vital to develop secure applications.**
- ASRTM tools not only ensure security but they also facilitate the creation of secure coding and application architecture together with the processes defined.
- They help provide suitable security requirements, in contrast to broad-scope standards that brought extreme loads to low risk projects while not providing enough protection for high risk applications.
- They reduce the effort required and the risk taken to meet security requirements in the project, **which in the end reduces costs.**

How does it work?

- Tools are updated through the changes that regulations, platforms and the changing threats are subject to.
- The ASRTM tools **dynamically highlight the possible security consequences of functional requirements and recommends** suitable secure coding practices or architectural counter measures**.**

Source: Deloitte, Gartner

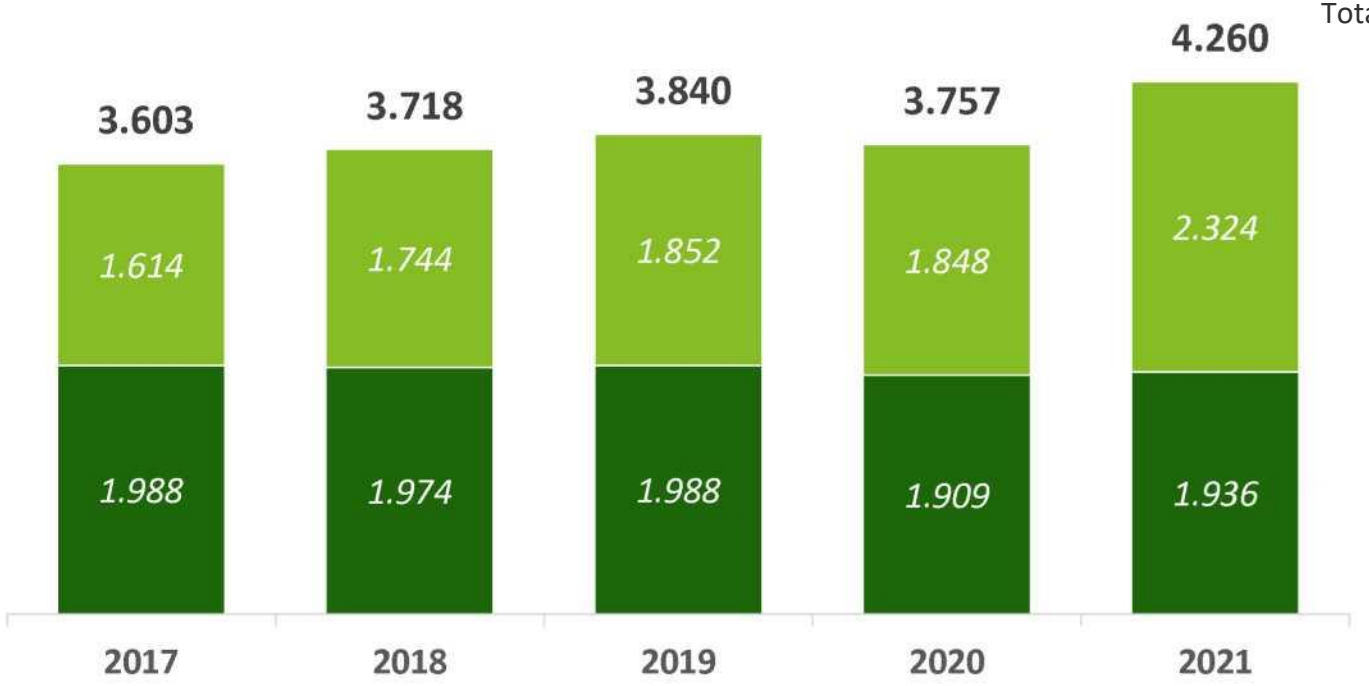
2. Size of the global sector

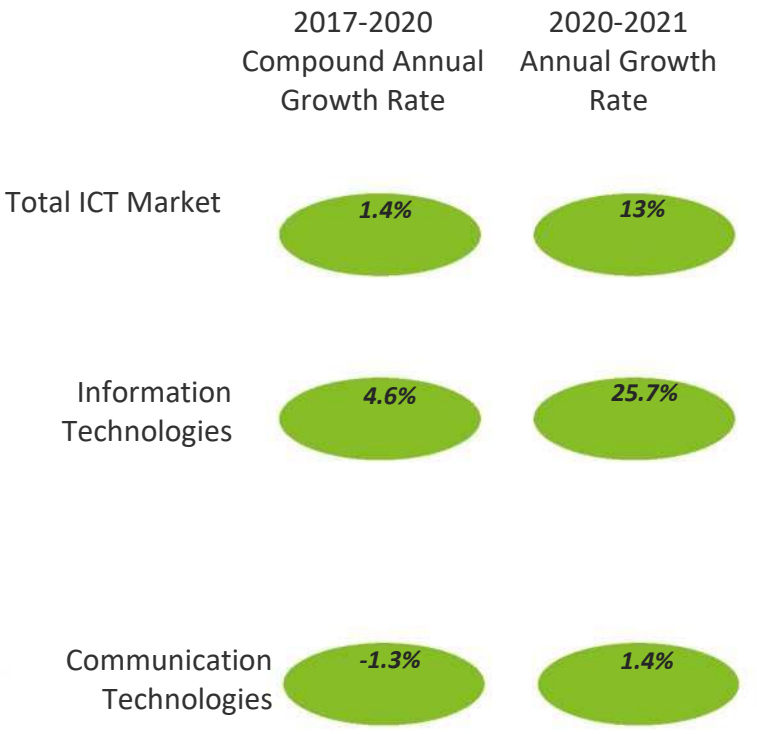
Total size of Global Information and Communications Technologies Sector

Size of the Global ICT Market in 2021

The size of the global ICT market grew by 13% to 4.3 trillion dollars in 2021, while the information technologies and communication technologies market sizes increased by 25.7% and 1.4%, respectively.

ICT Market Size in Turkey (billion USD)





Note: Sums may differ due to rounding.
Source: Gartner, Deloitte analysis

Future Expectations and Global ICT Market Growth Expectation

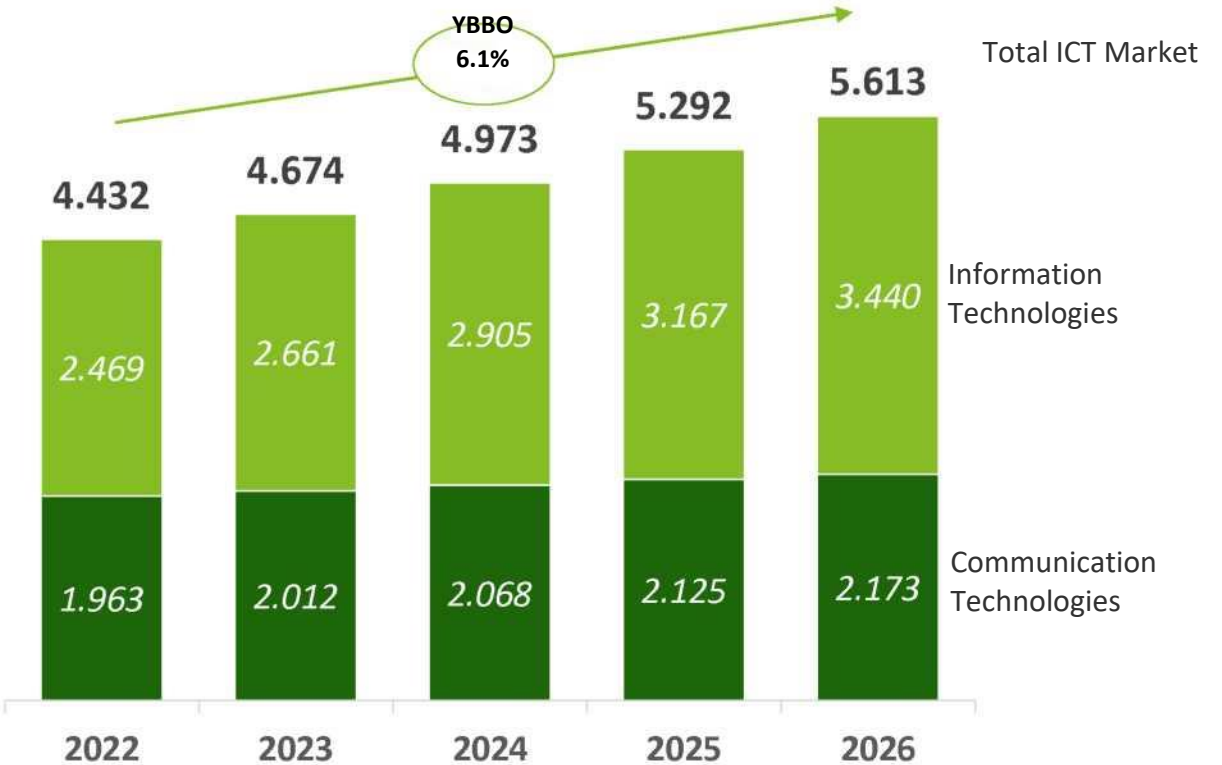
It is estimated that the global ICT market will grow by 4% in 2022 to reach 4.4 trillion dollars before achieving an annual growth rate of 6.1%, reaching 5.6 trillion dollars in 2026.

Future Expectations

- Geopolitical and economic uncertainties and the delays in the supply chain increasing expenses in flexible and agile solutions
- The increased focus on digitalization causing companies to prioritize digital transformation as a strategic component
- The increased interest in emerging technologies such as analytics, cloud computing, digital customer experience, client solutions, etc.
- Remote working becoming permanent and the expectation that more than 50% of the overall employees will switch to remote working in 2024

ICT Market Size

(billion USD)



Note: Sums may differ due to rounding.
Source: Gartner, Deloitte analysis

3. Stakeholders of the Study

Data sources used, and stakeholders collaborated with, for subsector categories when calculating the sector size in Turkey

Stakeholders of the Study

Project Consultant

Deloitte.

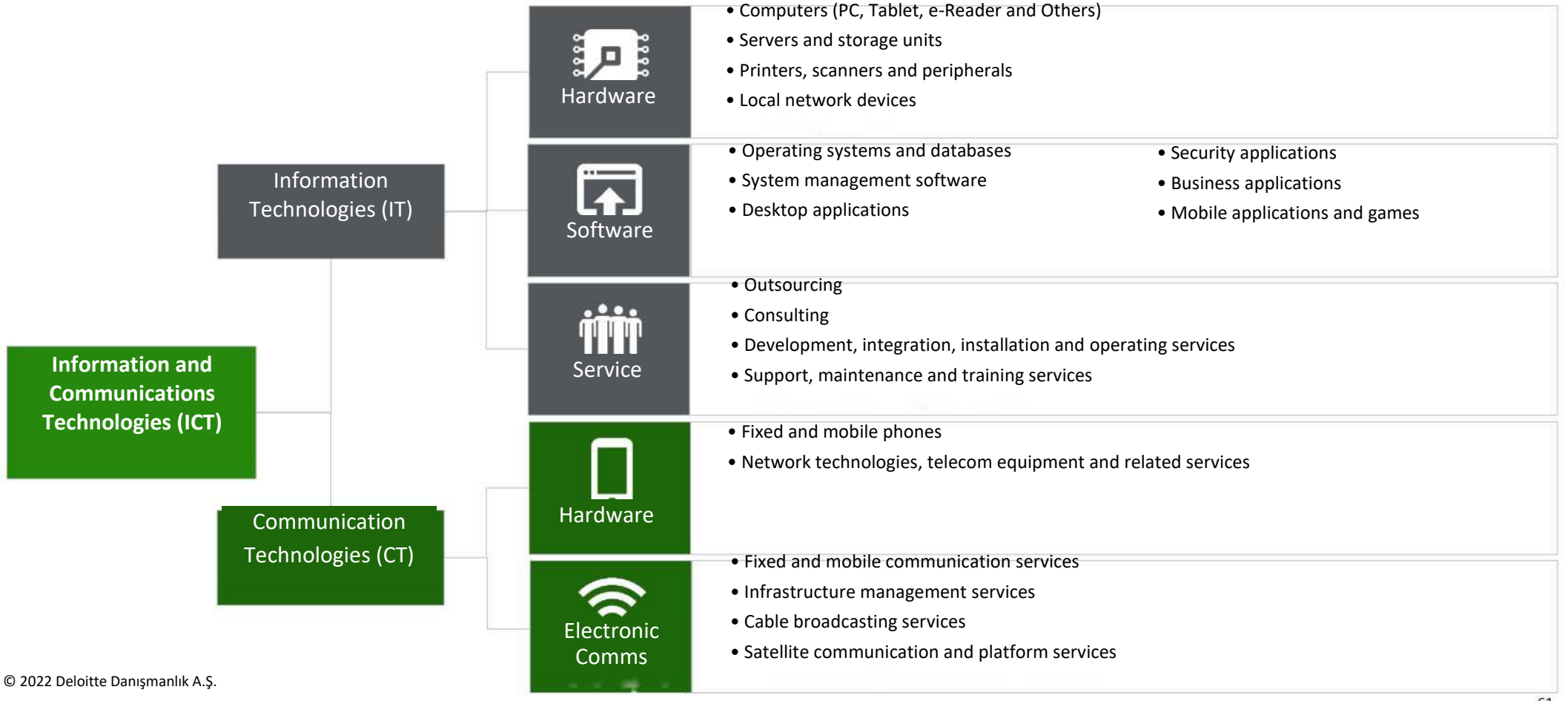
Project Data Partners

4. Scope of the Project

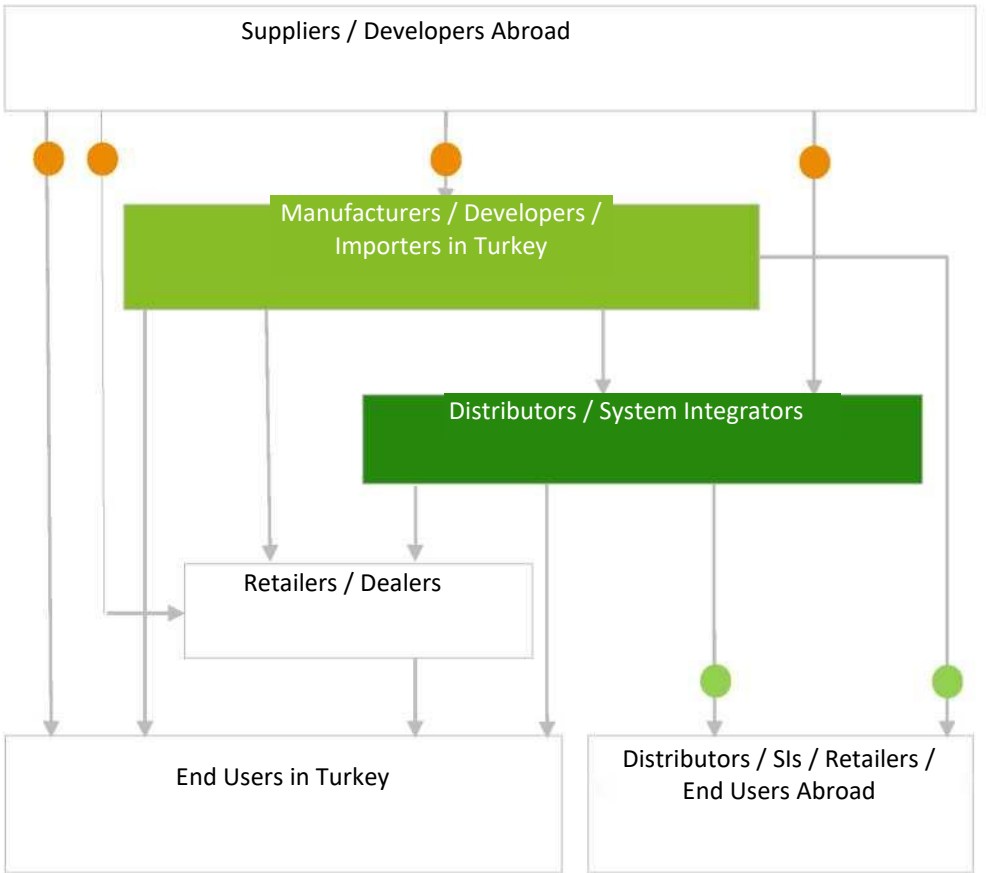
Subsectors assessed as part of the study when calculating the sector size, and the types of products and services produced by such subsectors

Scope of the Project

TUBISAD's Market Data study, which has been conducted since 2012, has been performed with Deloitte with a standardized scope and methodology for the last 10 years



Measurement methodology



Sector size is calculated and verified through a bottom- up approach.

In addition to the data provided by our sector companies through a comprehensive survey, data from institutions such as BTK, Context, SASAD and the Ministry of Industry and Technology are also utilized.

- Company and sector data are measured properly to avoid any overlaps or duplicate calculations
- Company data are gathered together with different breakdowns:
  - Sales direct to End-users vs through distributors
  - Import vs export
  - Origins of products and services
  - R&D center share

= Import

= Export

Sector Players in the Scope of the Study

Market data is provided by sector companies. The number of companies whose data are being measured within the scope of our project has increased more than eight times over the last ten years and reached 7,812 in 2021.

5. Turkish Information and Communications Technologies (ICT) Sector

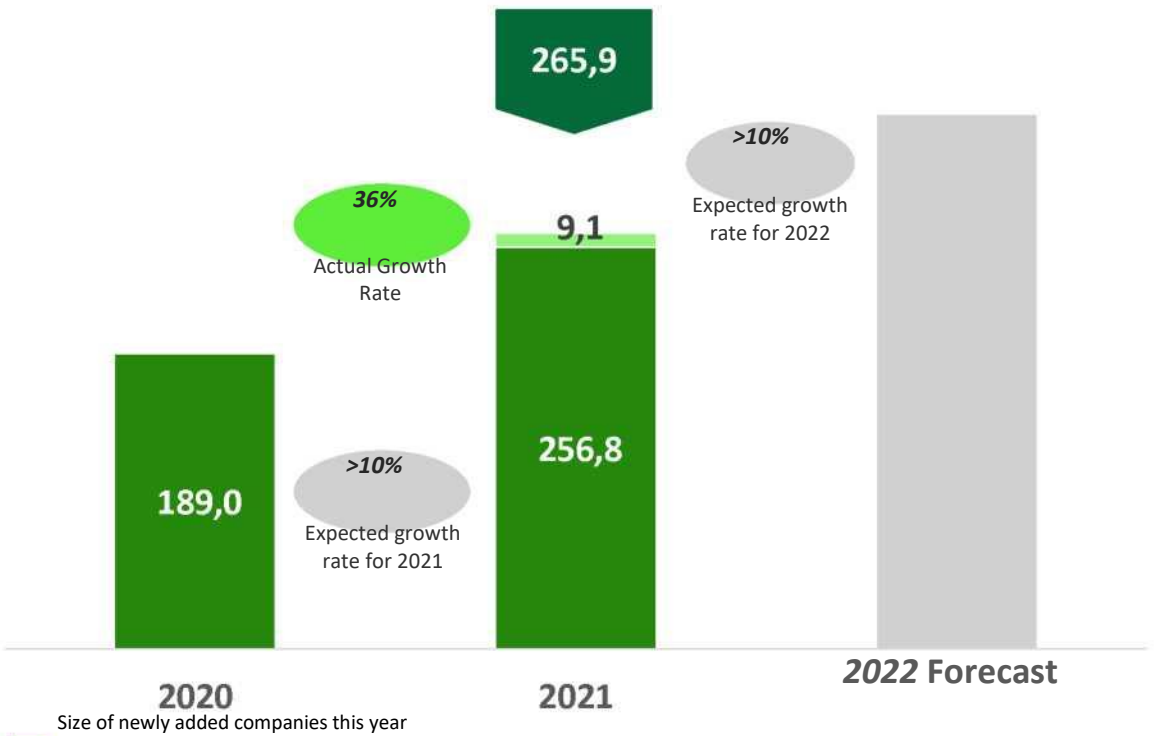
Size of the Turkish Information and Communications Technologies Sector

Total Sector Size (bn TRY)

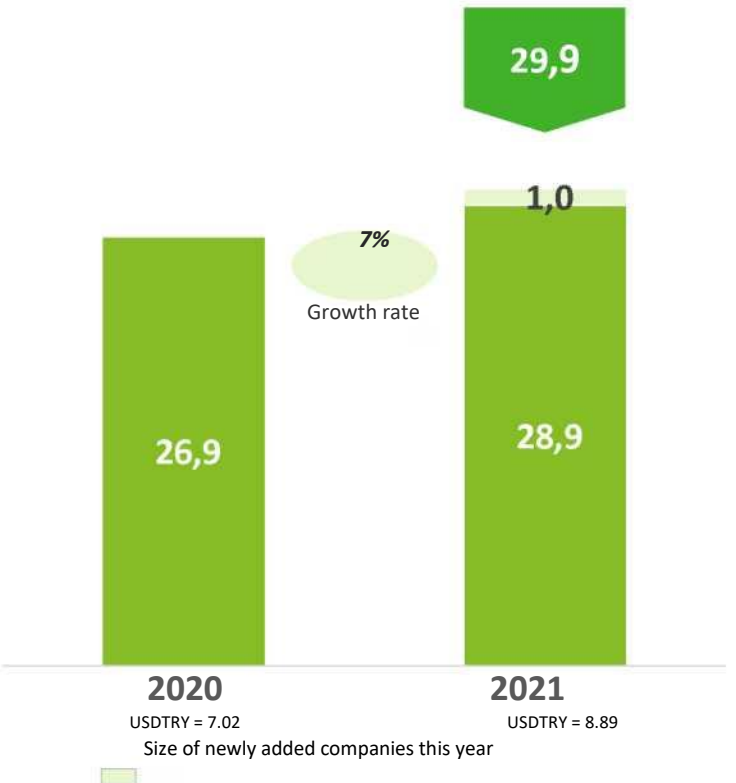
In 2021, the market size reached 265.9 billion TRY (US$29.9 billion).

ICT Market Size

(billion TRY)



(billion USD)



Annual changes refer to comparable rates of growth.

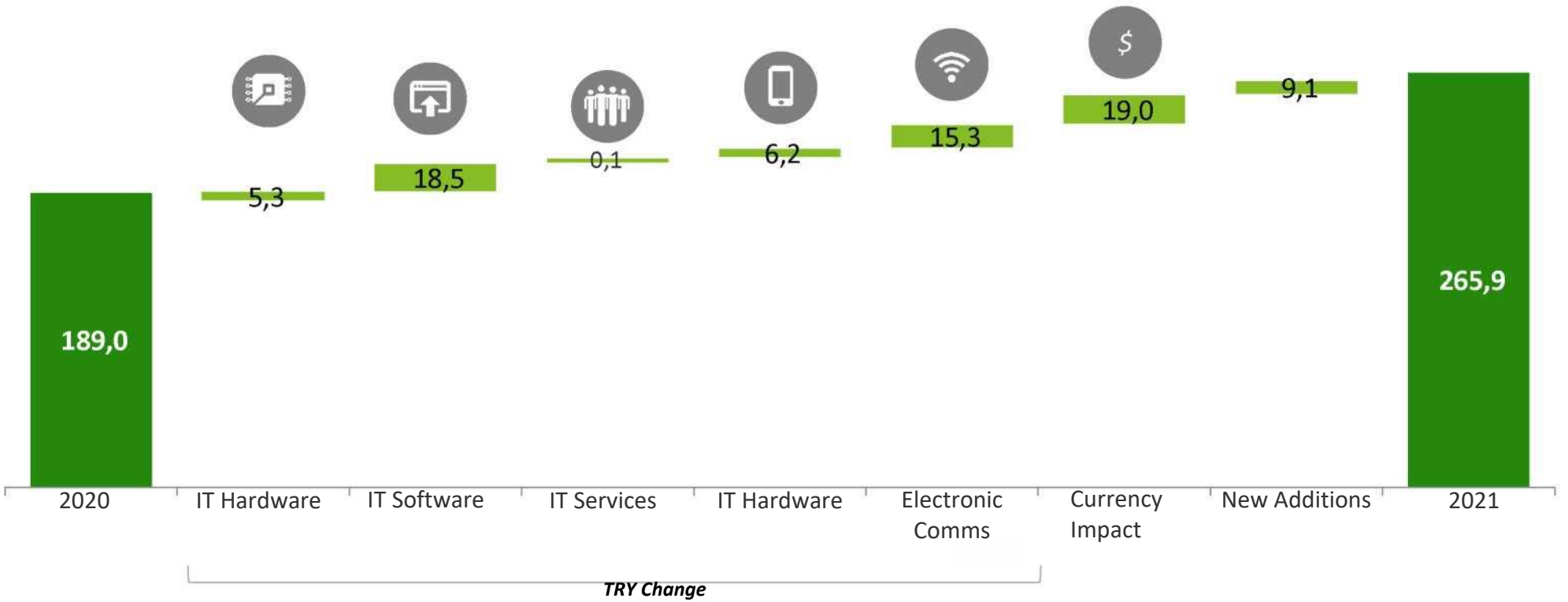
Note: Sums may differ due to rounding.

Sector Growth Components

Information Technologies Software and the currency impact contributed to the growth in the sector with 18.5 bn and 19.0 bn TRY, respectively.

ICT Market Growth Components for 2020-21

(billion TRY)



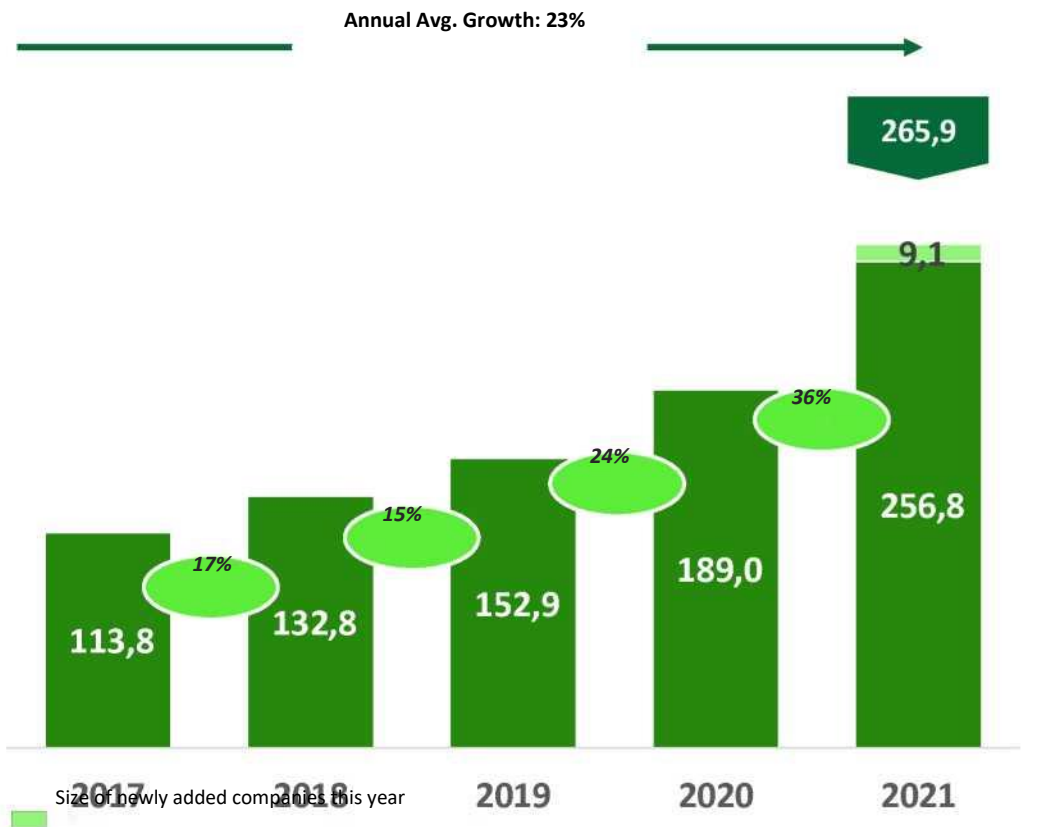
Note: Sums may differ due to rounding.

Total Sector Size (bn TRY and US$)

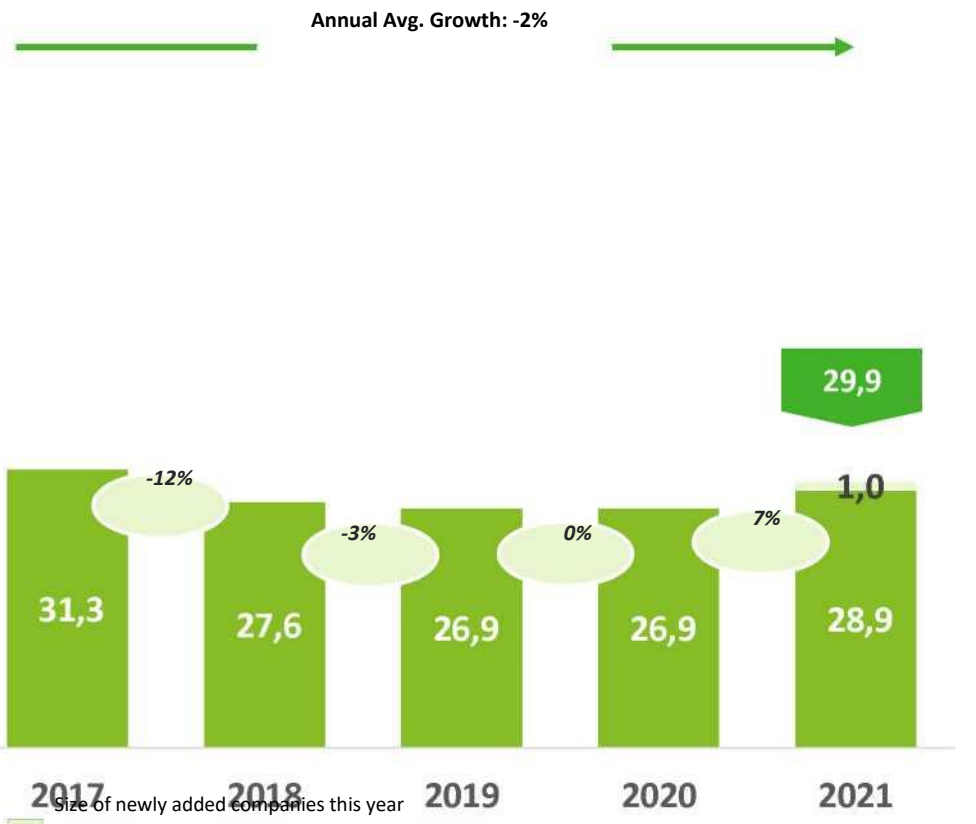
Between 2017 and 2021, the annual average growth of the sector on a TRY basis was 23%.

ICT Market Size in Turkey

(billion TRY)



(billion USD)

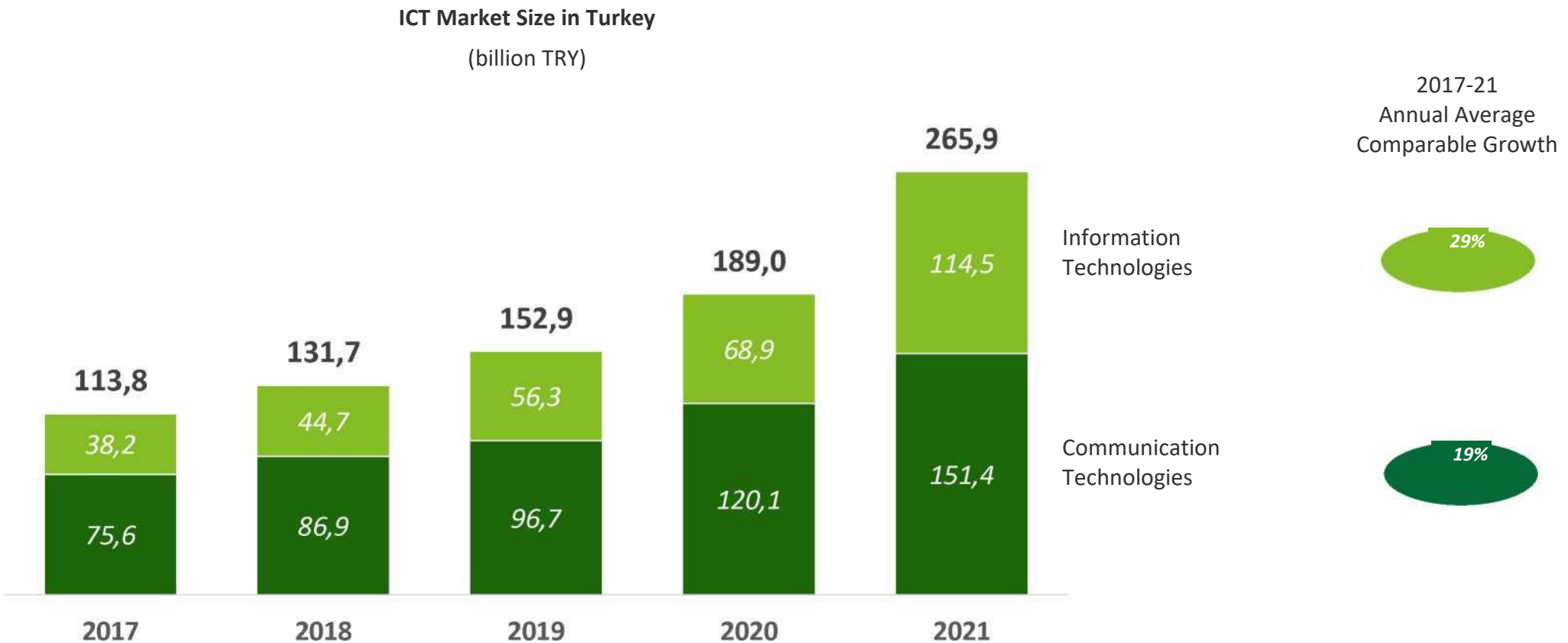


Annual changes refer to comparable rates of growth.

Note: Sums may differ due to rounding.

Information and Communications Technologies Market Breakdown (billion TL)

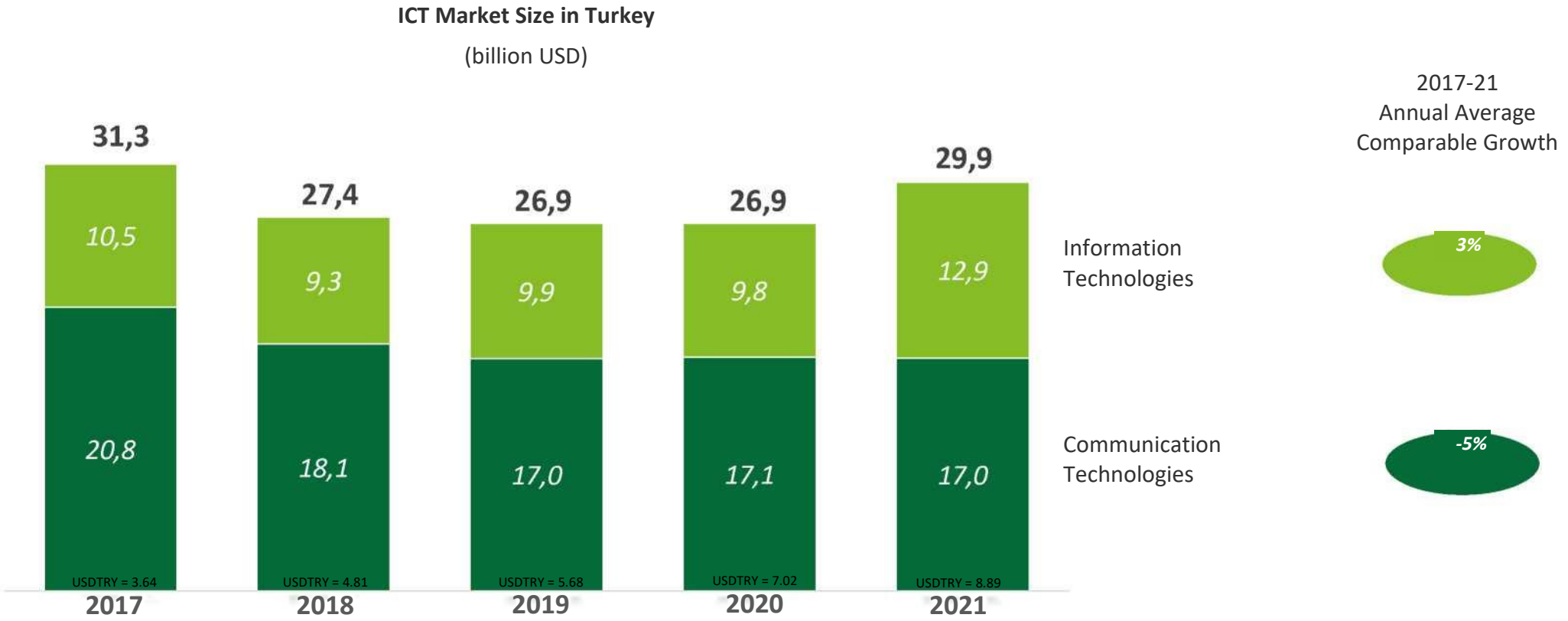
Information Technologies grew faster between 2017-2021 compared to Communication Technologies.



Note: Sums may differ due to rounding.

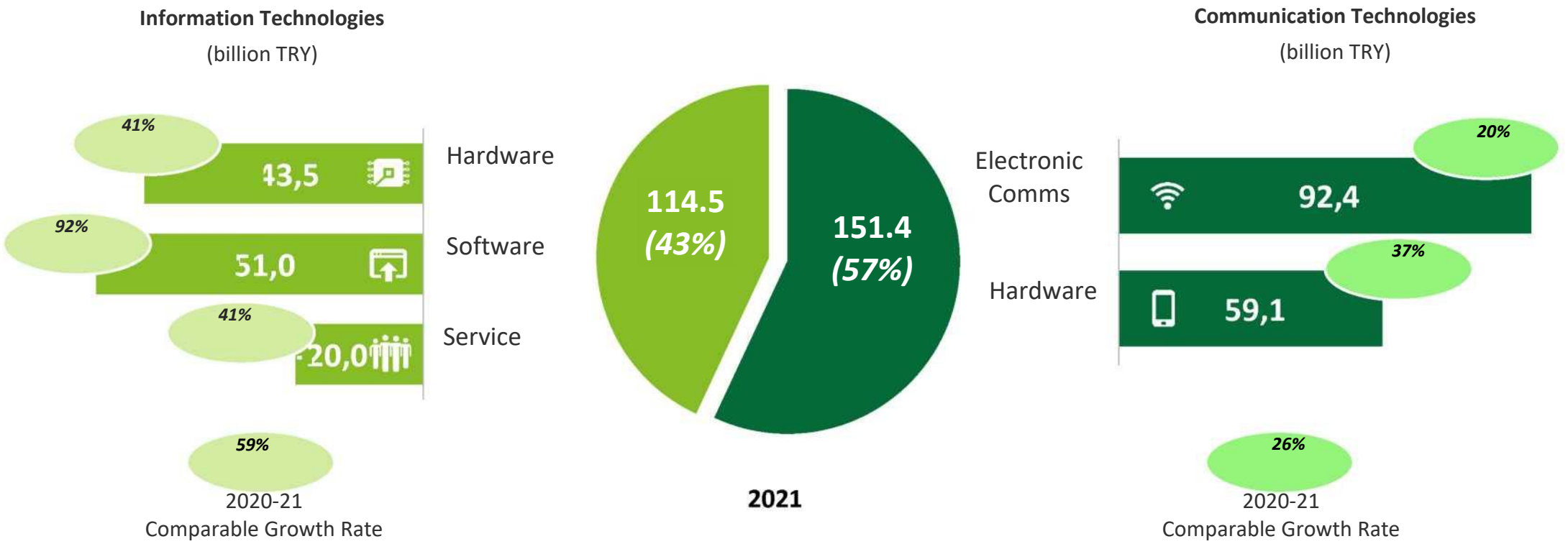
Information and Communications Technologies Market Breakdown (USD bn)

Information Technologies grew in spite of the increasing exchange rate, while Communication Technologies were affected by said exchange rate and shrank.



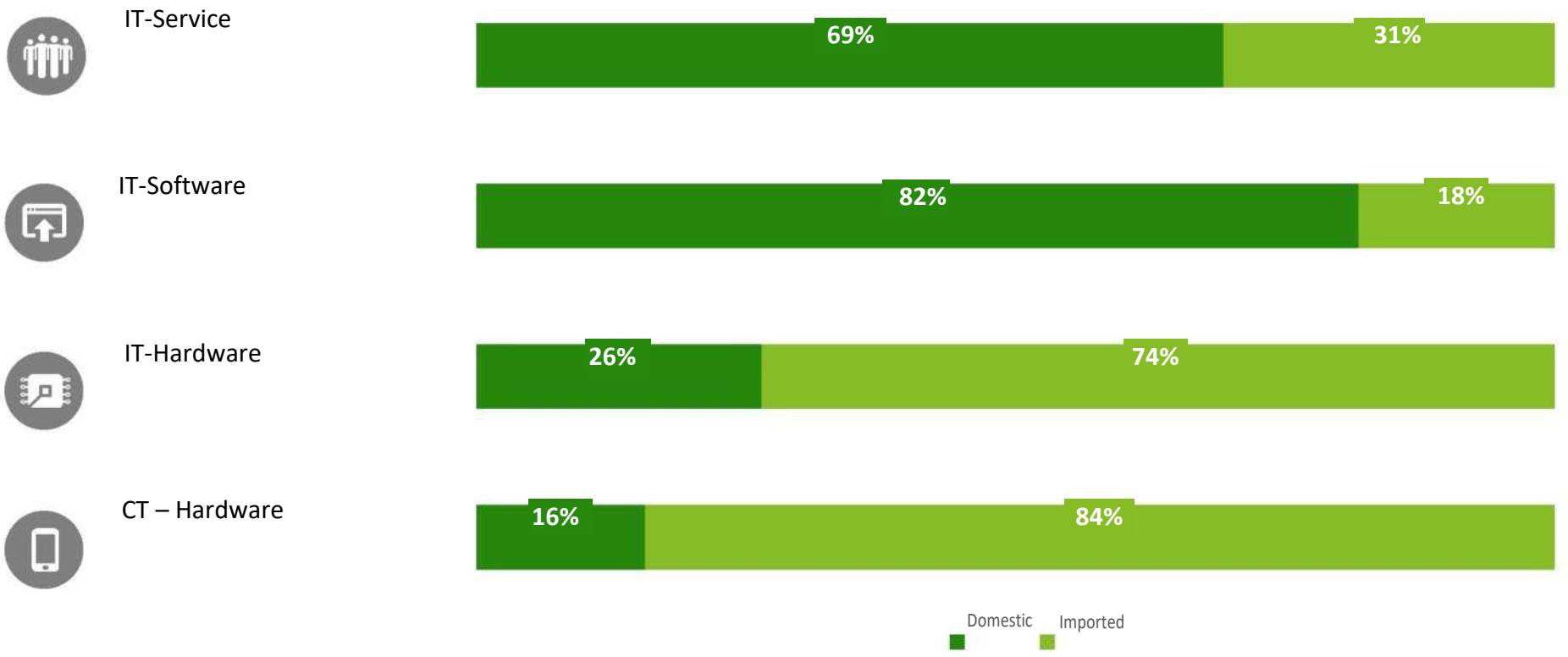
Note: Sums may differ due to rounding.

Information and Communications Technology Industry Subcategories



Origins of Products and Services in 2021

The weight of domestic products is highest in the software category within Information Technologies.



Source: Deloitte analysis

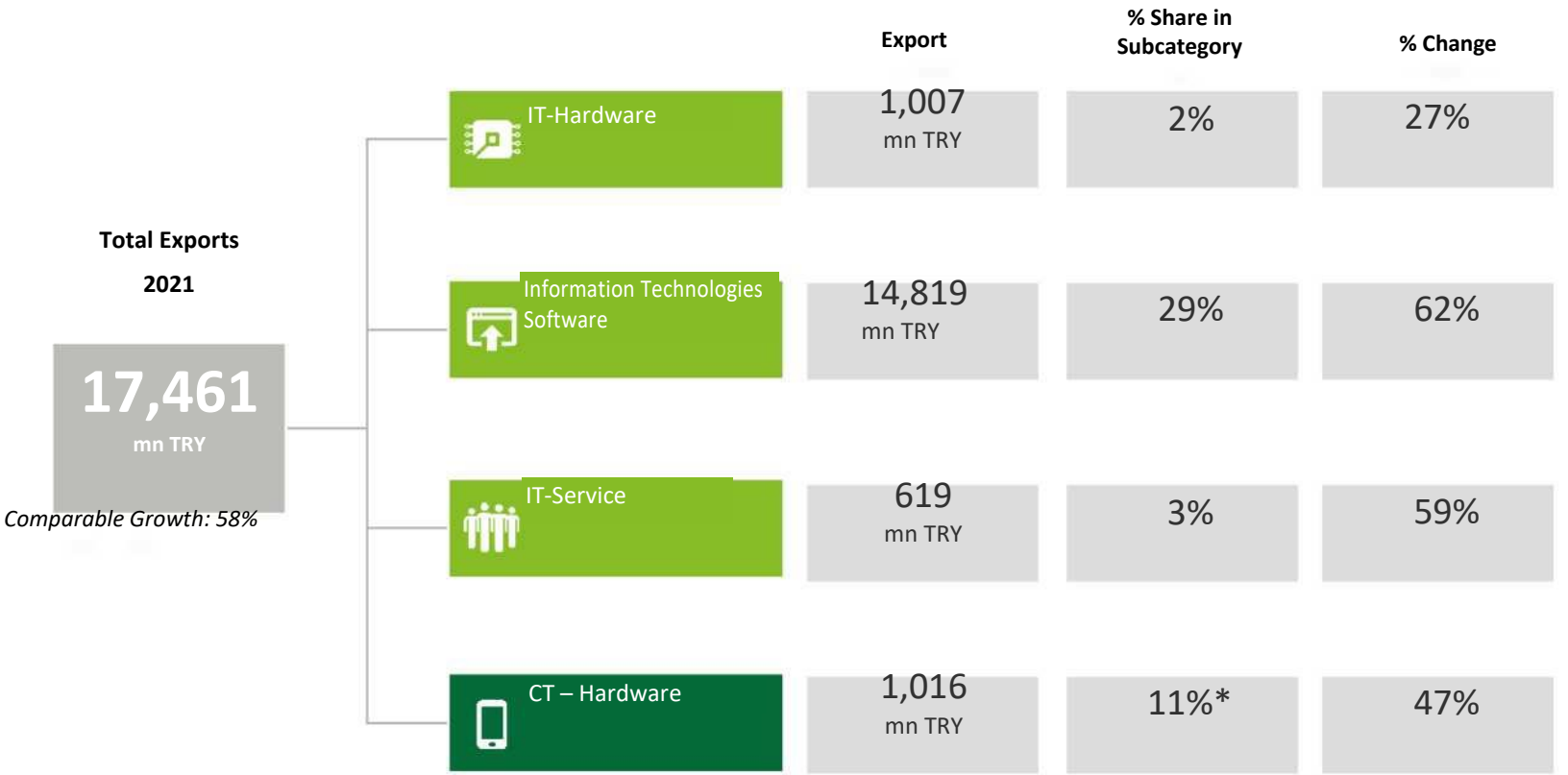
Technology Development Zones (Technoparks)

Technoparks in Turkey	2021	2022	Change
Number of Technoparks	87	92*	6%
Number of Companies	6,267	7,707	23%
Number of Employees	64,866	79,641	23%
Total Revenues (bn TRY)	20.8	51.8	149%
Total Exports (bn TRY)	7.7	13.3	73%
Revenue per Company (million TRY)	*3.3*	*6.7*	*103%*
Revenue per Employee (thousand TRY)	*321*	*650*	*103%*
Exports per Technopark (million TRY)	*88.6*	*144.9*	*63%*
Exports as a share of Revenues	*37%*	*26%*	*-1100 bps*

Source: Data were shared by the Ministry of Industry of the Republic of Turkey in March 2022.
*There are 77 operating technoparks from a total of 92. Remaining 15 technoparks are not operating due to ongoing infrastructure construction.

ICT Sector Exports

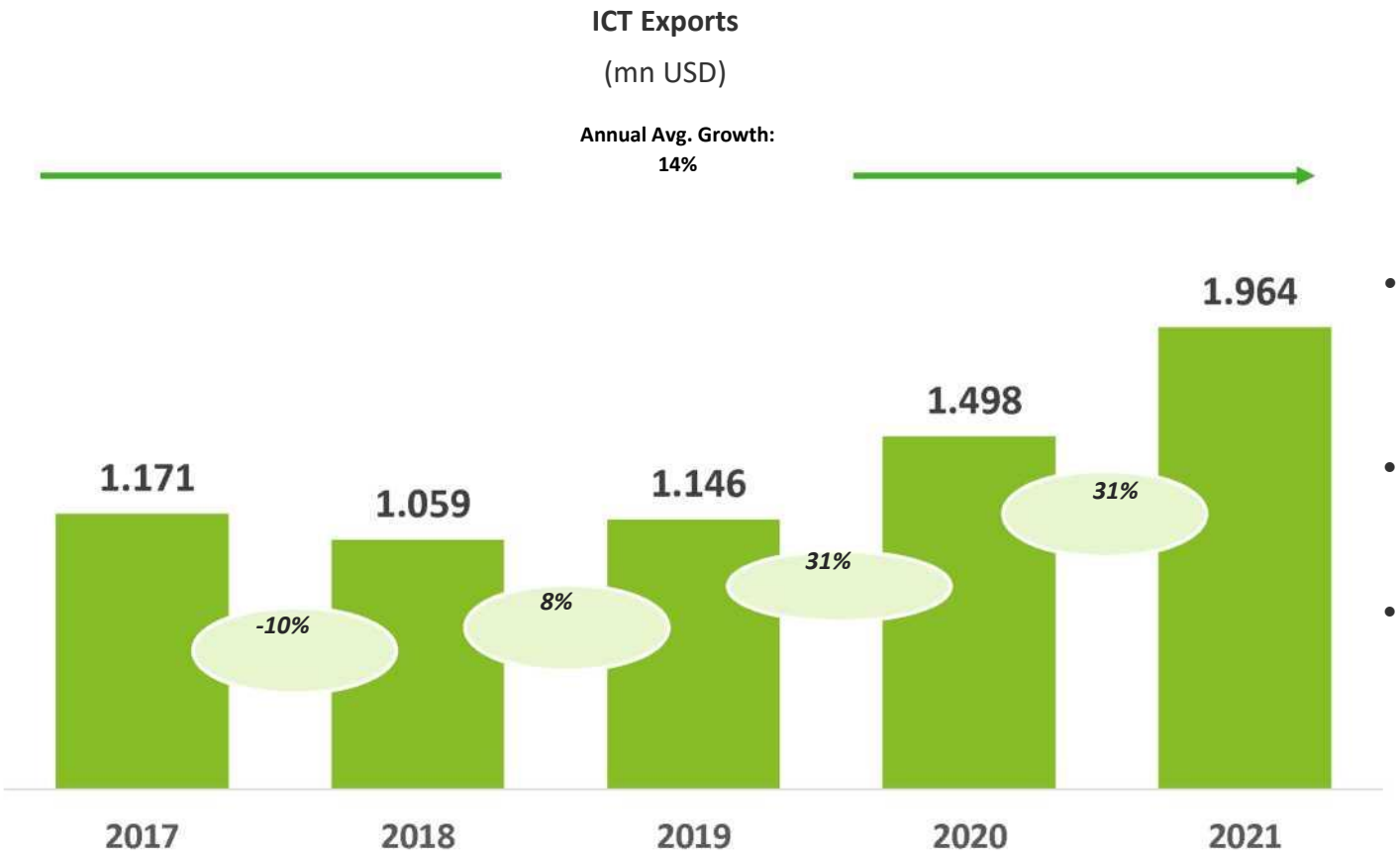
The largest share in total exports is that of the Information Technologies Software category.



Mobile phones are excluded.
Annual changes refer to comparable rates of growth.
Note: Sums may differ due to rounding.

ICT Sector Exports

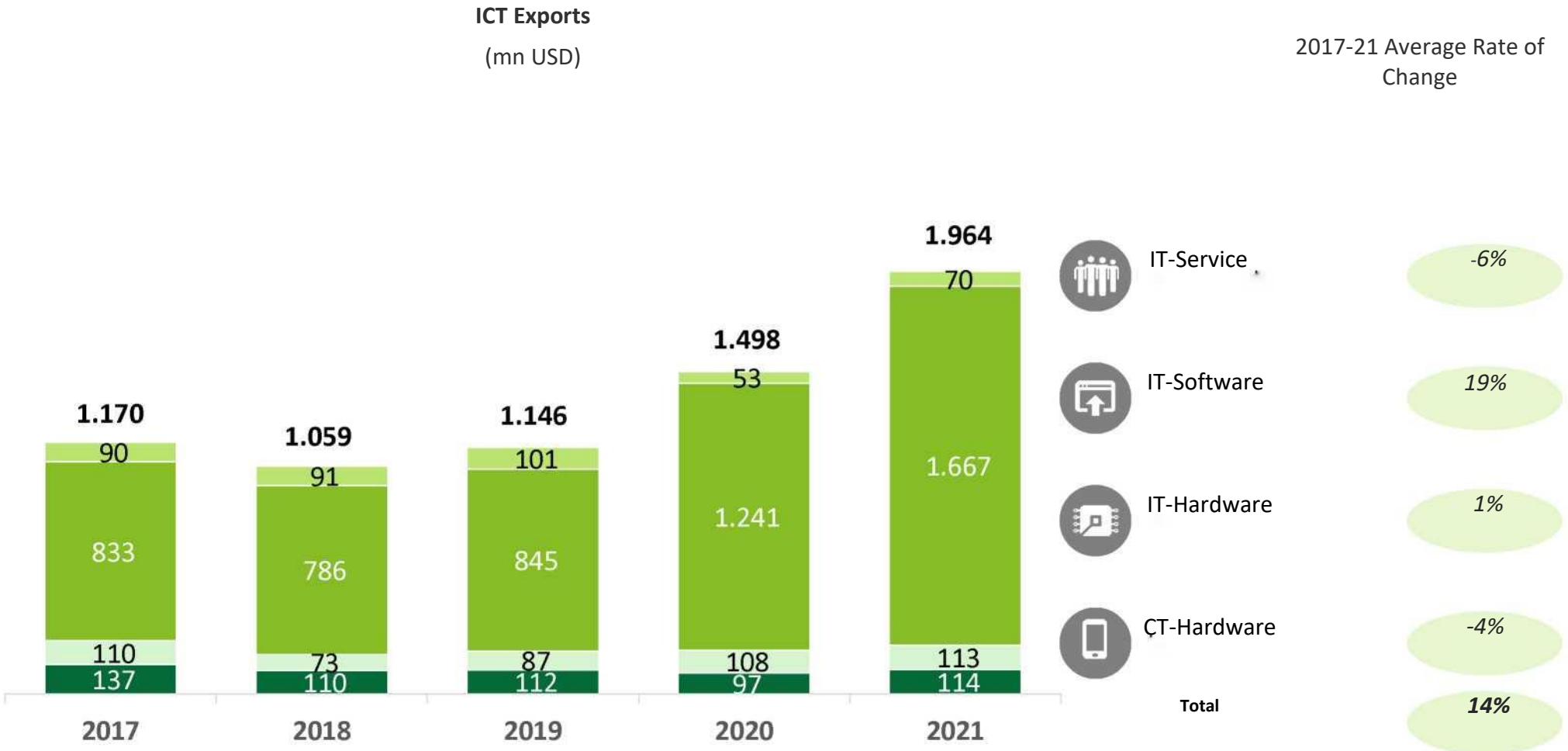
The total exports of the sector grew by an average of 14% annually on a dollar basis between 2017 and 2021.



- In 2021, the total sector size grew by 7% on a dollar basis and the total export of the sector was parallel to that of last year with an increase over 30% on a dollar basis.
- The growth in 2021 happened due to the growth in export in both Information Technologies and Communication Technologies.
- The most important category driving the increase is the growth in the Information Technologies – Software category, which also has the largest share in exports.

ICT Sector Exports

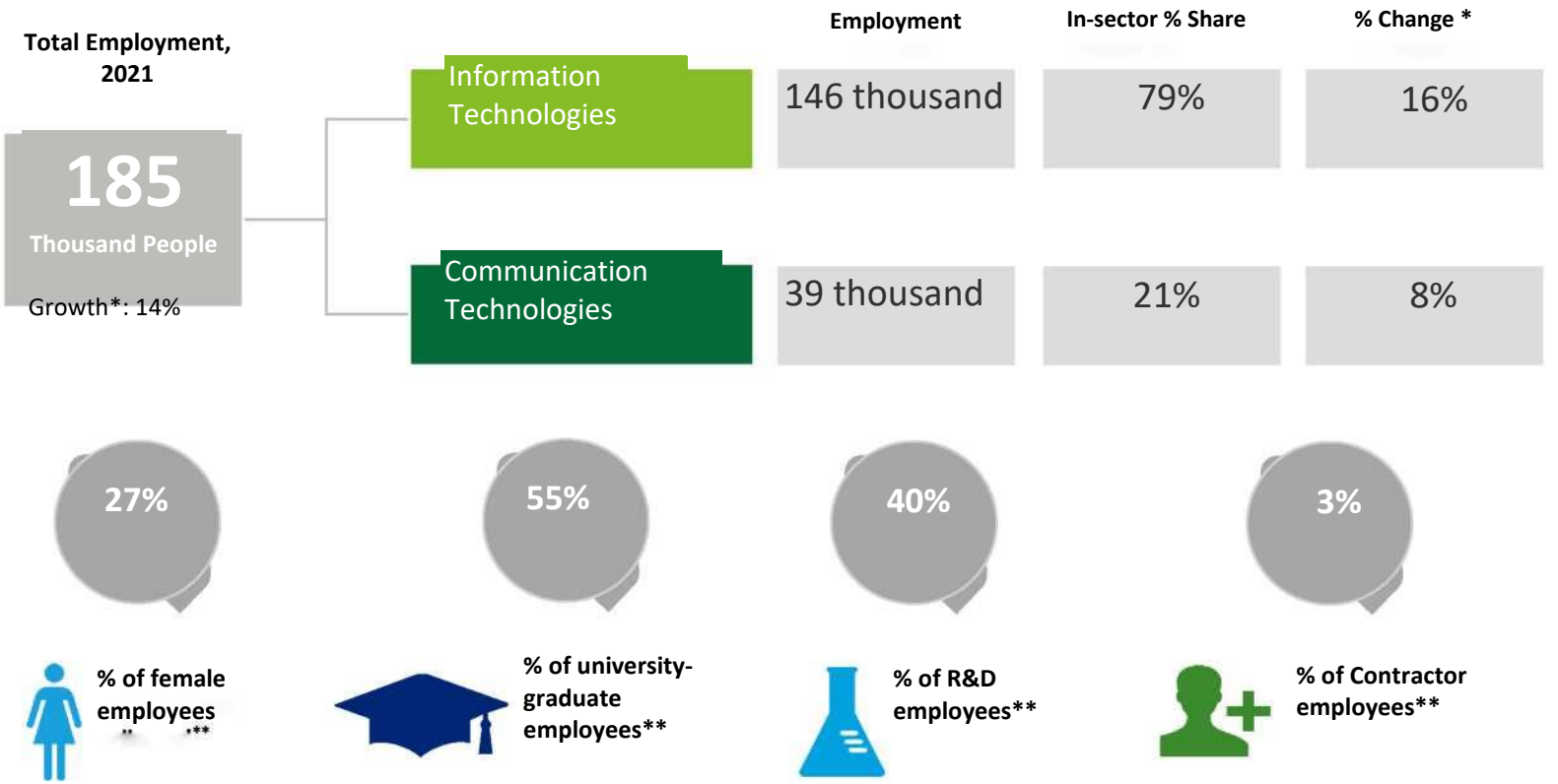
Development based on subcategories - million USD



Note: Sums may differ due to rounding.

ICT employment in thousands

The total jobs in the sector reached 185 thousand in 2021 with a growth rate of 14%.

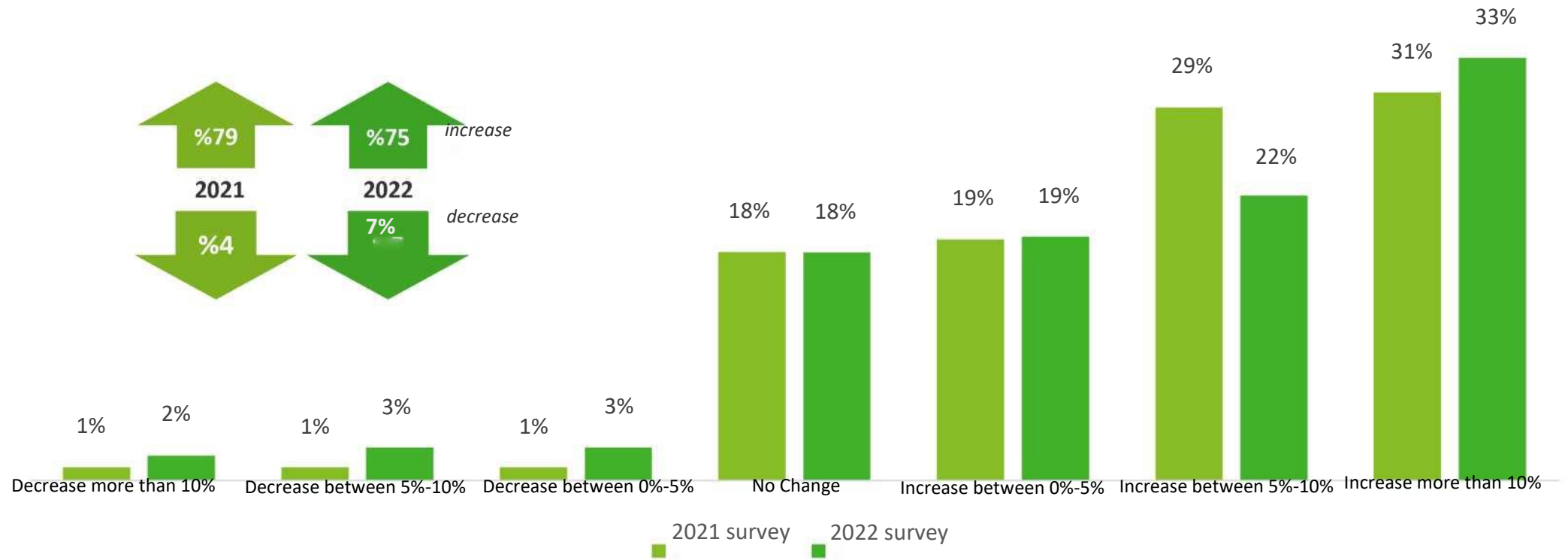


*Growth rates refer to comparable rates (calculated by excluding surveyed firms for the first time this year)
**: Based on Survey Respondent Firms and BTK data
***: Survey Respondent Firm, data from the BTK and the Ministry of Industry and Technology of the Republic of Turkey

Employment

In 2022, the rate of sector players expecting a growth in the sectoral employment has reduced compared to 2021.

In your view, how is the number of employees for your company likely to change this year?

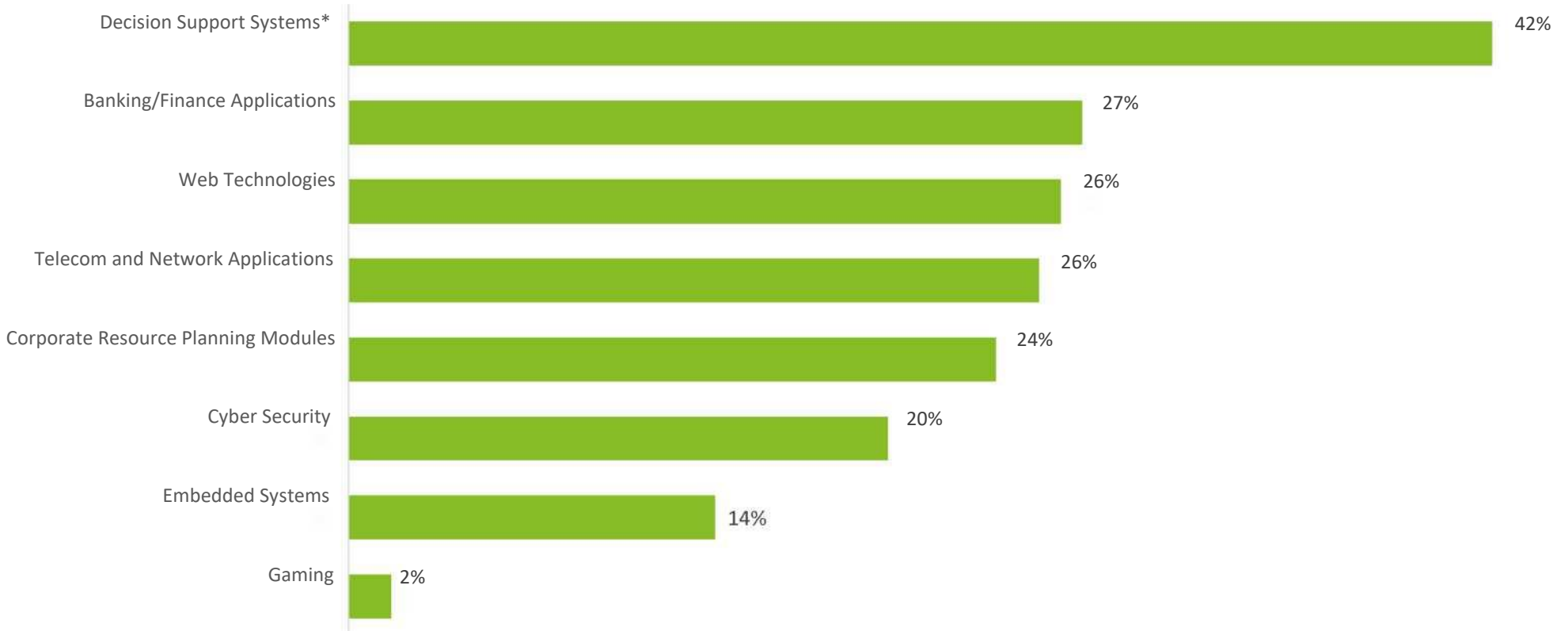


Note: Totals may not add due to rounding
2021 questionnaire, N = 156; 2020 questionnaire N=85,

Software Development Activities in the ICT Market

Among the companies participated in the survey, the ones that come to the fore are those working in decision support systems and banking/financing applications in the software industry.

What are the areas in which your company have software development activities?



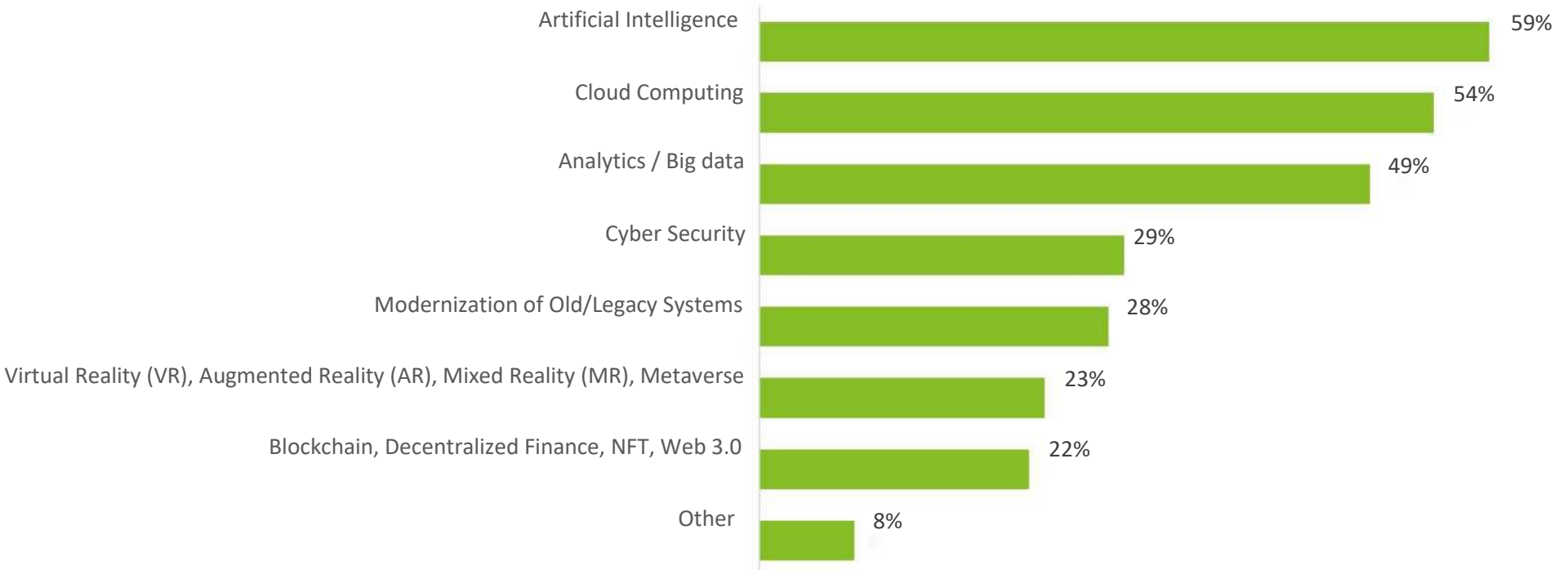
*It contains artificial intelligence, business intelligence and data integration, analytical models, optimization and simulation models.

Among respondent firms with software revenue, N = 125

Impact Areas of the Sector

Participants expect that the artificial intelligence will be the main technological area in the 1 to 3 years to come.

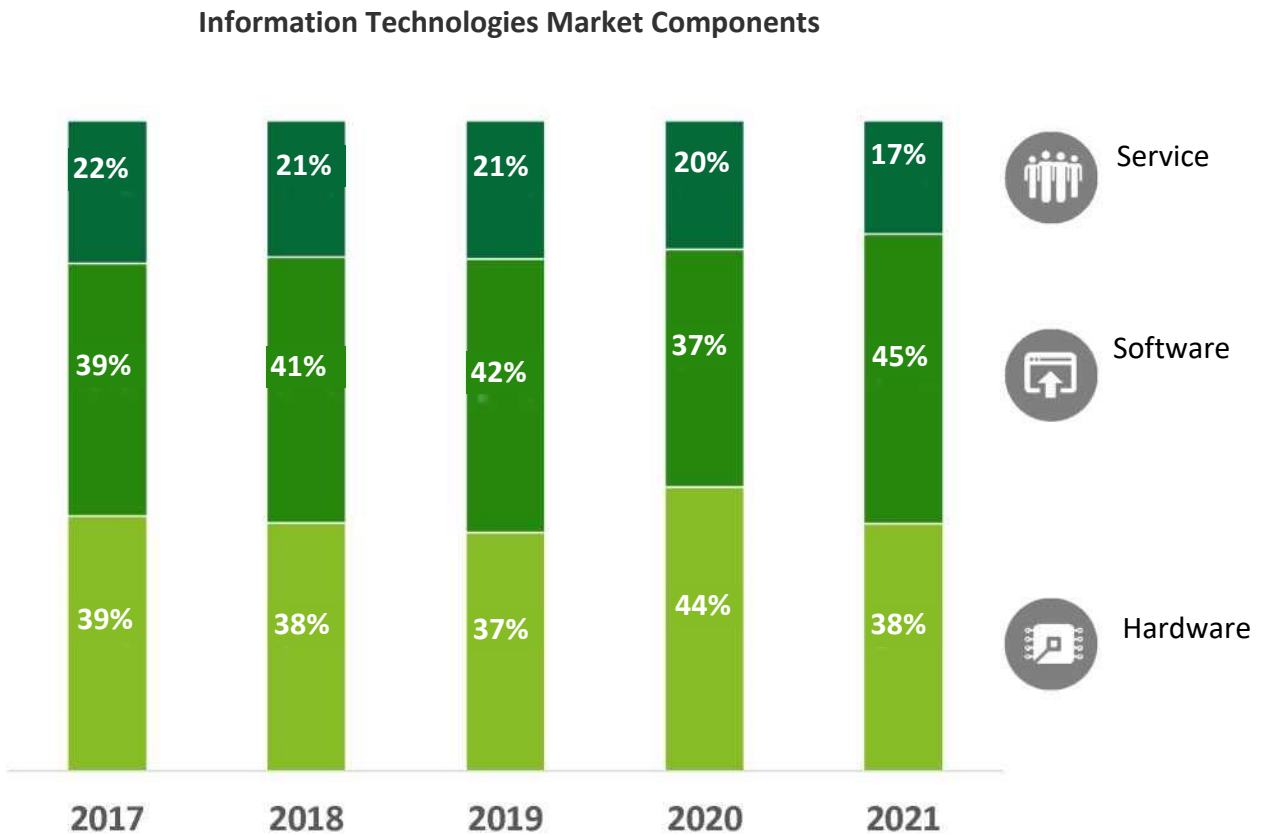
For the next 1 to 3 years, which of the following technological areas will have the most impact on your sector (Choose at most three answers)



2021 survey N = 156

Shares of Subcategories Over Years

The changes that happened in 2021 caused the distribution of information technologies market components to be similar to 2019 and previous years.

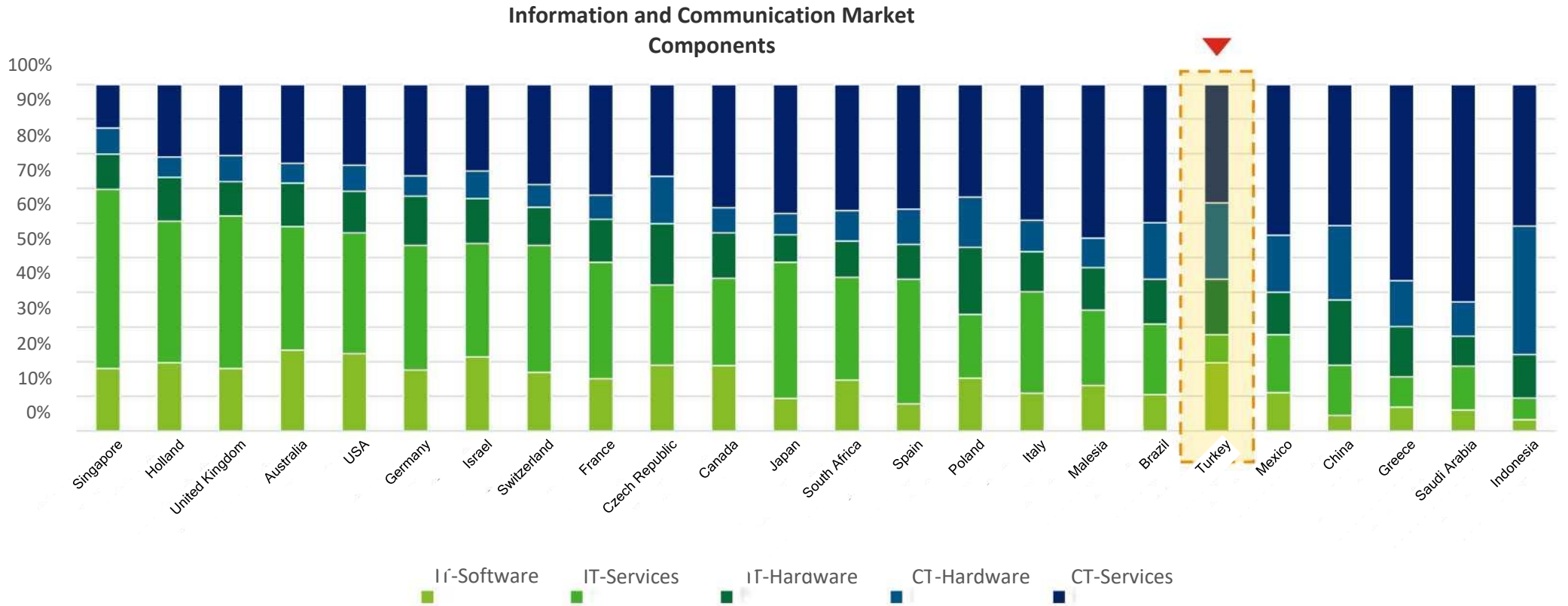


- In 2021, a significant change was observed in the share of Information Technologies in the overall market.
- Similarly, there is a change compared to last year in the subcategories of Information Technologies.
- While the share of hardware decreased from 2017 to 2019, an increase was observed in 2020 with the impact of the increasing exchange rate, and in 2021 it dropped down to its usual level.
- On the software side, the decrease in 2020 was reversed, reaching a rate higher than the shares in 2021 and the periods before 2019, and consequently almost half of the Information Technologies sector has become software related.

Note: Sums may differ due to rounding.

Shares of Subcategories by Countries

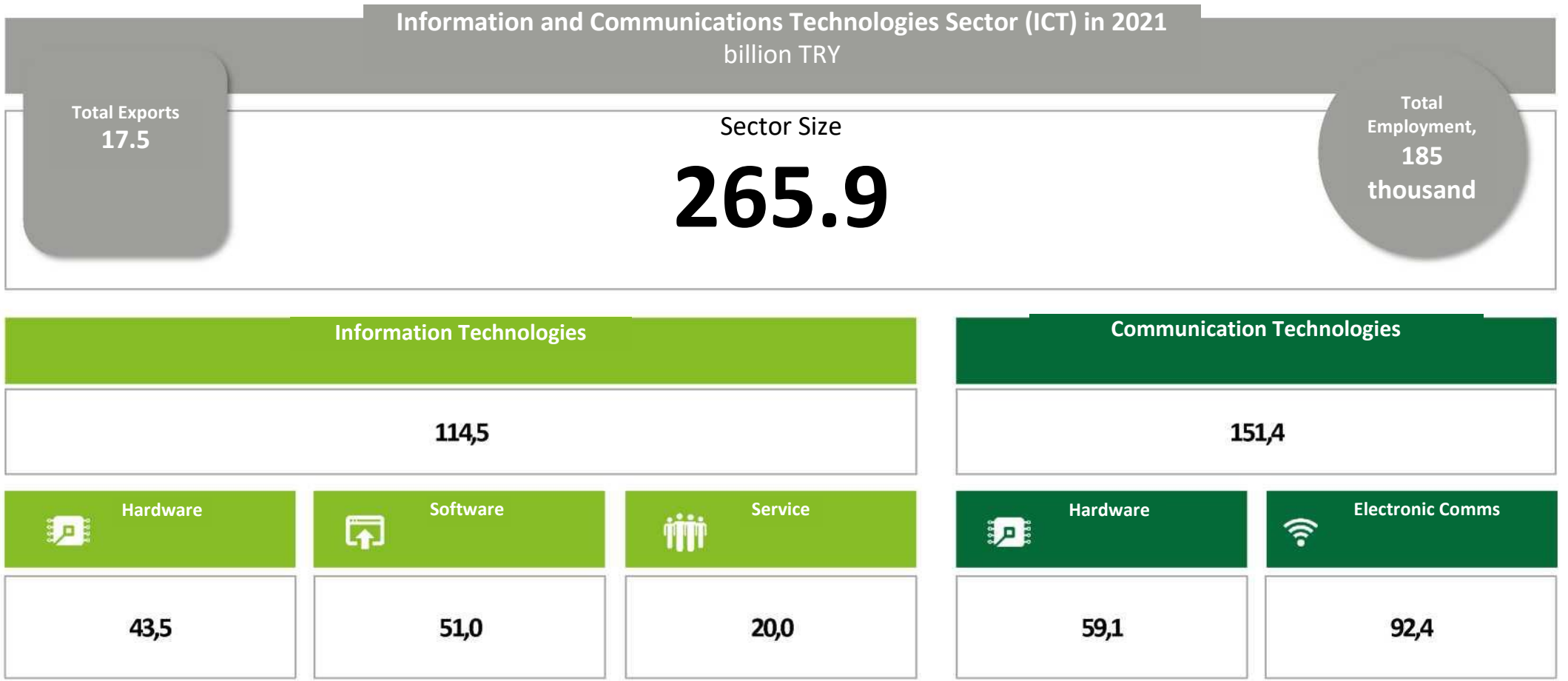
When the countries assessed are ranked according to the share of Information Technologies in the overall sector size, Turkey's profile is similar to that of developing countries.



Source: TÜBİSAD, Gartner, Deloitte analizi

Information and Communications Technologies Market (ICT) in 2021

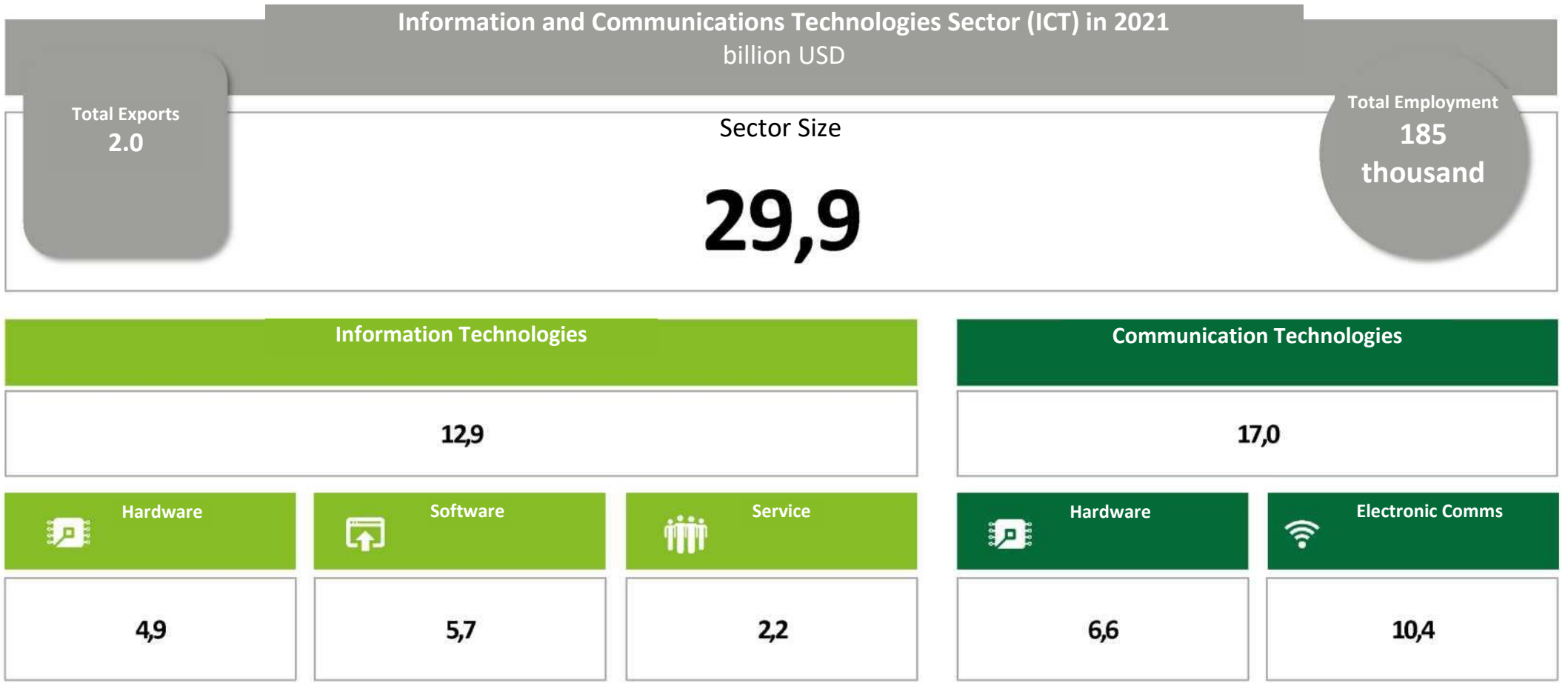
billion TRY



Note: Sums may differ due to rounding.

Information and Communications Technologies Market (ICT) in 2021

billion USD



Note: Sums may differ due to rounding.

THANK YOU

We would like to thank the Ministry of Industry and Technology of the Republic of Turkey, BTK, Context, TÜBİSAD members and sector companies for their valuable contributions.