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TURKEY-EU BUSINESS DIALOGUE

Digital Transformation in the Industry

CFCU
EUROCHAMBRES
İSTANBUL CHAMBER OF INDUSTRY
CIVIL SOCIETY SECTOR

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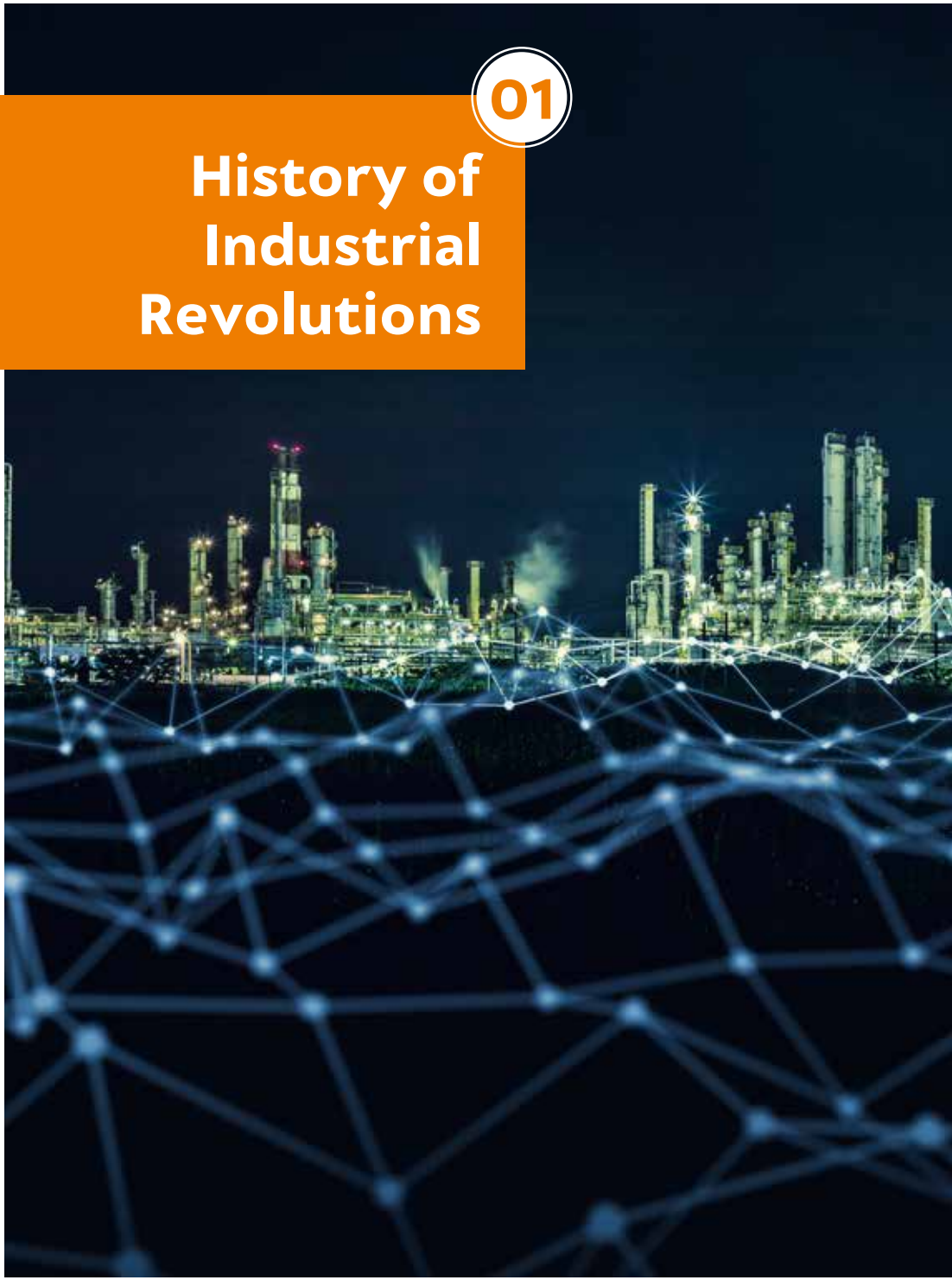
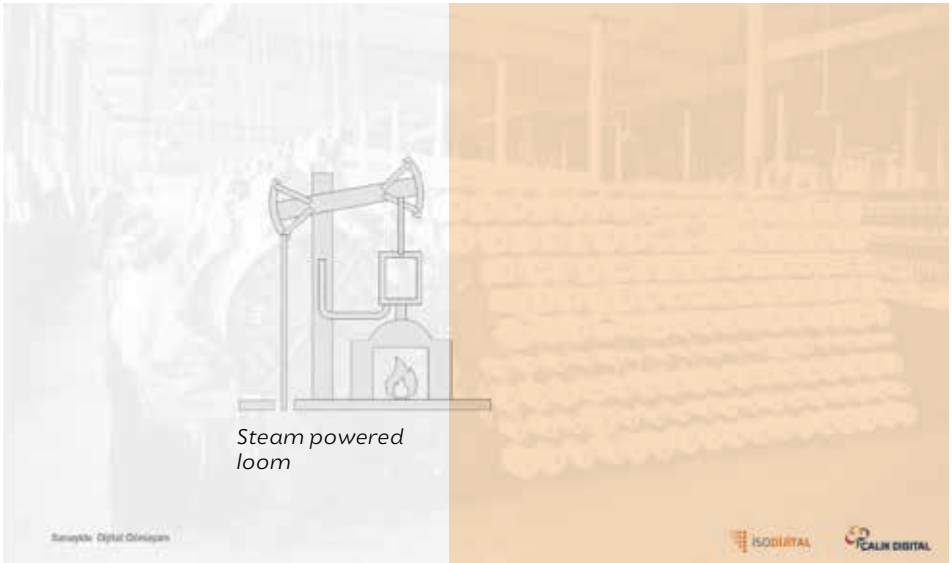
Digital Transformation in the Industry

01

History of Industrial Revolutions



The brief history of industrial revolutions will be discussed in this chapter. Today's objective of the industrial transformation which started with Industry 1.0 is Industry 4.0.



Steam powered loom

History of Industrial Revolutions

1. Industrial Revolution

1800

Use of water vapor power and mechanical technologies 1784 Knitting Machine, England

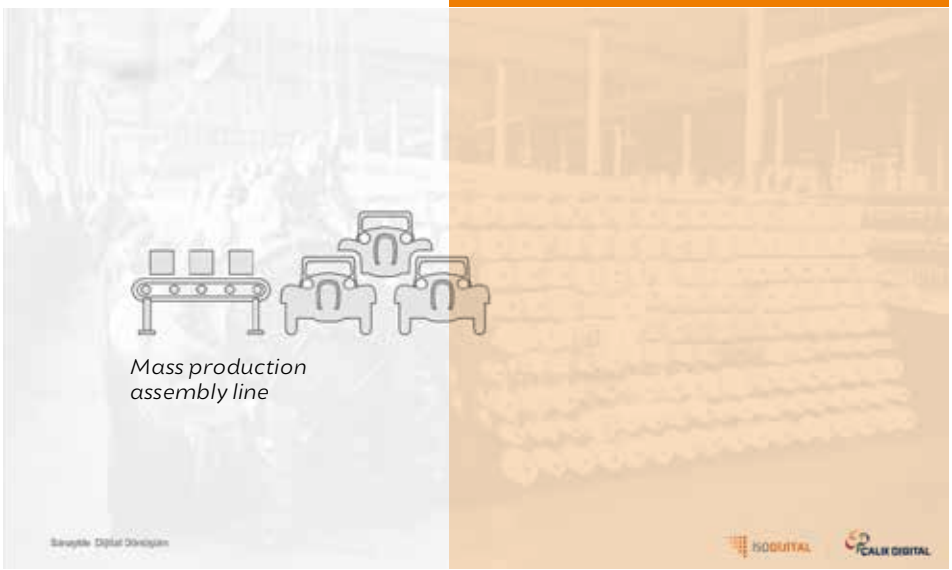
The first industrial revolution starts with the usage of water and steam power technology. The best example for this is the weaving looms working with steam power in England in 1784. As the result of the rapid and cheap production carried out thanks to such weaving looms, thousands of people lost their jobs and died from poverty in India which was under the rule of England during those times. With the products produced in a rapid and cheap way, England became a powerful economic power in the world's market. This development caused a trigger in the Europe, and while the West were developing itself in the industry, the governments which could not catch up with the West lost their power in time.

2. Industrial Revolution

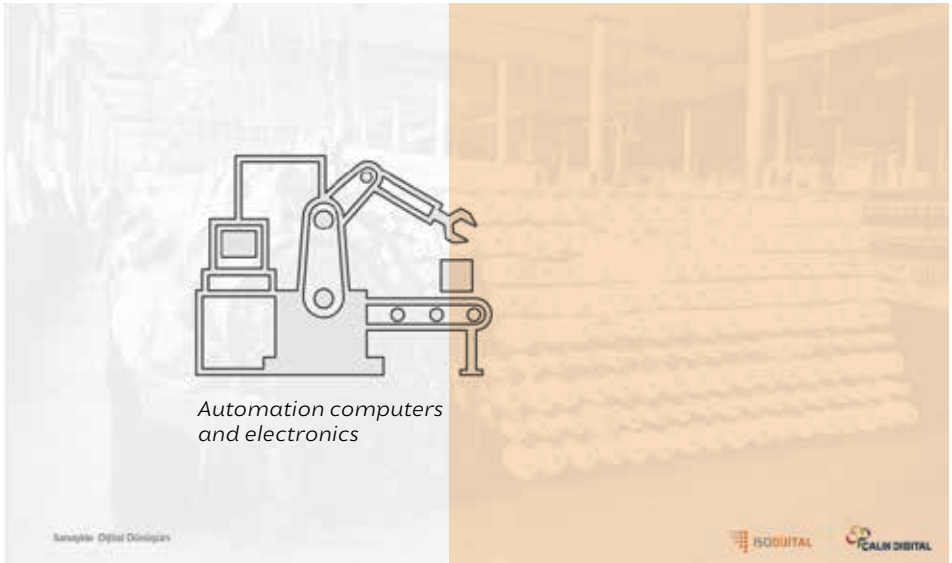
1900

Mass production with electric motor and production line. Optimization of production capacity
1870 Slaughterhouse, Cincinnati

The second Industrial Revolution dates back to the usage of electrical engine and mass production line. The best example for this is the manufacturing of T series vehicles in Ford factory in USA within the electrical mass production line. Until that time, each and any vehicle had been manufactured by a separate team. It resulted in needing higher level of labor force and longer time, on the other hand, vehicle prices were high because of craftsmanship costs. Using electricity in production lines and merging the mass production lines resulted in cheap and rapid production; and accordingly, price advantage was obtained while thousands of people could afford to purchase vehicles thanks to low prices. Ford is still one of the leading vehicle manufacturers in the world.



Mass production assembly line



Automation computers and electronics

3. Industrial Revolution

2000

Production optimization by electrical and industrial IT usage. 1969, First PLC usage, Modicon

The third industrial revolution originates from the use of electronic and industrial IT. It is considered as the date when digitalization initiated. The best example of it is the usage of PLC (Programmable Logic Controller) in the industry. Data transmission could be realized from devices thanks to PLC. Upon the usage of such data, high increases in awareness, production and quality level were observed. Intermachinery transmission and usage of data resulted in obtaining great developments in integration and automation. Numerous electronic devices used in the industry were imported in that period. Telecommunication technologies gained strength as well. Besides, the foundation of the strong increase in technology during the 80s based on the third industrial revolution.

3. Industrial Revolution

Today

Cyber Physical Systems - Smart and Autonomous Systems

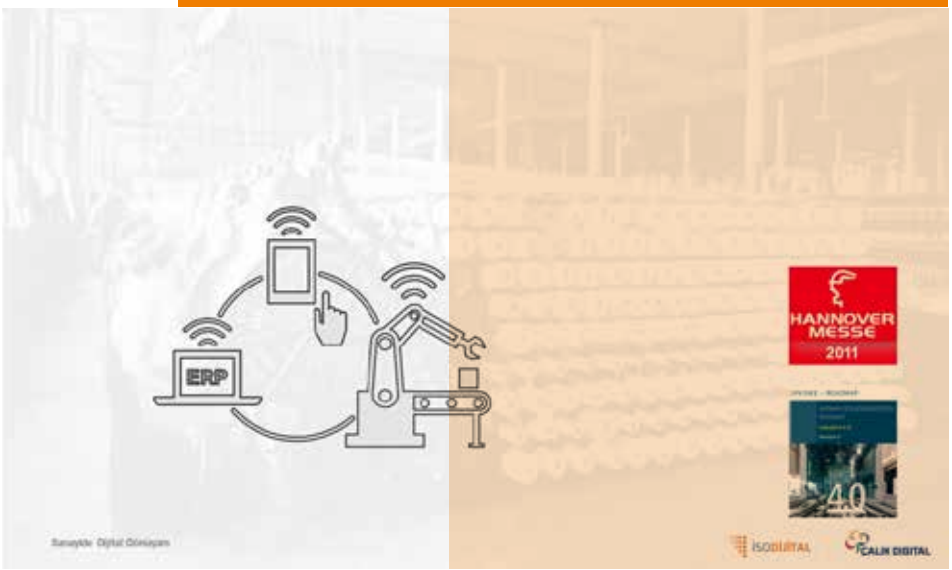
The forth industrial revolution is a transformation minimizing the impact of human factor in the production, and combines the usage of tools such as artificial intelligence, Internet of Things, intelligent robotics usage and aiming the dark factories.

In today's world, in the 4th Industrial Revolution, informatics, integration of Internet processes into production phases, creation of networks between the processes and Internet services come to the forefront. Since it is aimed for computers to direct the factories, this period is called as "Intelligent-Smart Factories".

Artificial intelligence applications will assess the data collected and provide significant improvements in maximum profitability and production by taking an active and efficient role in main processes such as production, quality and maintenance. Through predictive maintenance and quality, efficiency will be maximized.

With Industry 4.0, communication systems, virtual reality, simulation and creation of virtual prototypes will enable us to produce high quality, fast and low-cost products by foreseeing the future without presenting the product to the market.

Additionally, 3D printers have facilitated the most difficult designs and we witness that numerous new and customized products are presented in the factory.



02

Why Digital Transformation?

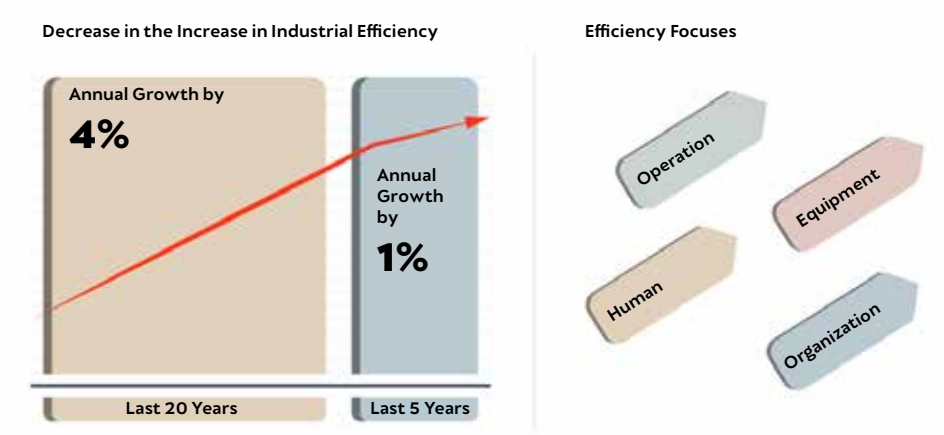
It is of vital importance to understand why digital transformation should absolutely be realized. Despite of several challenges, it is obvious that the cost of avoiding from the transformation will be considerably high.

3 Motivations in Digital Transformation

Digital transformation has three main motivations (factors):

- Profitability improvement: Increase in the profitability with rapid production of more and great variety of products. Since rapid production of the products cause decrease in costs, fulfill the demands would be much easier, and it would result in improvement in income and profitability.
- Producing great variety of quality products within a short time will bring competitive advantage in the market. Production and fast delivery of the customized products will result in a superiority for the firms using this technology without no doubt. The firms which cannot catch up with this technology will come across with major-scaled risks and challenges.
- Upon the creation of new fields and products resulted from the use of advanced technologies, an increase will be experienced in income. Creation of different products is much easier with the application of new technologies such as 3D printers and digital twin. New products which can be created swiftly will enable to obtain new income resources.

Why Digital Transformation?



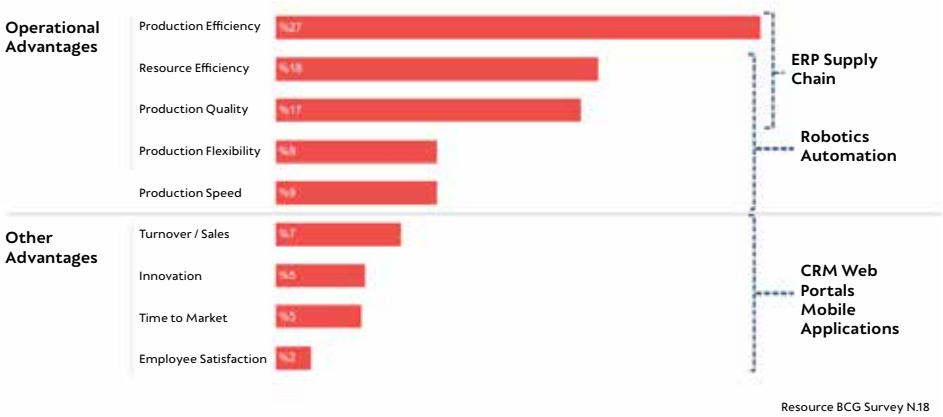
In the world, a reduction in the increase of efficiency has been observed in recent years. Annual efficiency increase obtained between the range of 4-5% in the last 20 years has decreased around 1% in the last 5-6 years. By using the current technologies and processes, further efficiency increase cannot be experienced in growth. Before that, most of the productivity increase opportunities offered by structural transformations in the manufacturing industry (widespread automation systems, adoption of lean manufacturing techniques, etc.) were used. Even though efficiency levels differ from facility to facility, efficiency increases to be recorded for the workforce have already reached to the limit. On the other hand, digital technologies challenge the efficiency limits and make efficiency increases possible beyond the traditional methods. It is aimed to realize spike in efficiency increase with Digital transformation and Industry 4.0.

One of the primary reasons why the digital transformation will provide improvement in great majority of the efficiency increase is that costs will be reduced with the operation management.

Digitalization in the manufacturing industry has the potential to create value with the activity and efficiency increases in each phase of the value chain.

Why Digital Transformation?

Graphic 8: In which field will the digital technologies provide advantage?



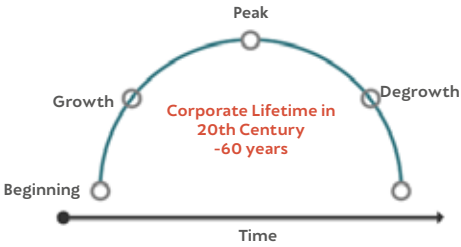
Resource BCG Survey N.18

Advantages of Digital Transformation:

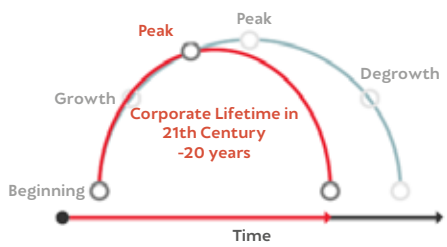
- Operational advantage: It will bring great increases in quality, speed and variety of product by using the production and resources more effectively. In addition to the potential of creating high value in the manufacturing industry, it will make significant contributions to the efficiency increase in such processes and producing higher quality products. Also, thanks to the effective use of data, customer demands will be better and faster understood "time to market" will decrease. Besides, flexible production processes will be realized since m2x (machine to human, machine to machine, etc.) communication will be improved and machines will be able to take decision autonomously.
- Other advantages: More frequent use of digital devices will result in increase in innovation, sales, market accessibility and competition. It will be a vital benefit for companies to continue their activities by increasing their international competitive capacity.

Lifetime of Corporate Companies in 20th and 21th Centuries

Corporate Lifetime in 20th Century



Corporate Lifetime in 21th Century



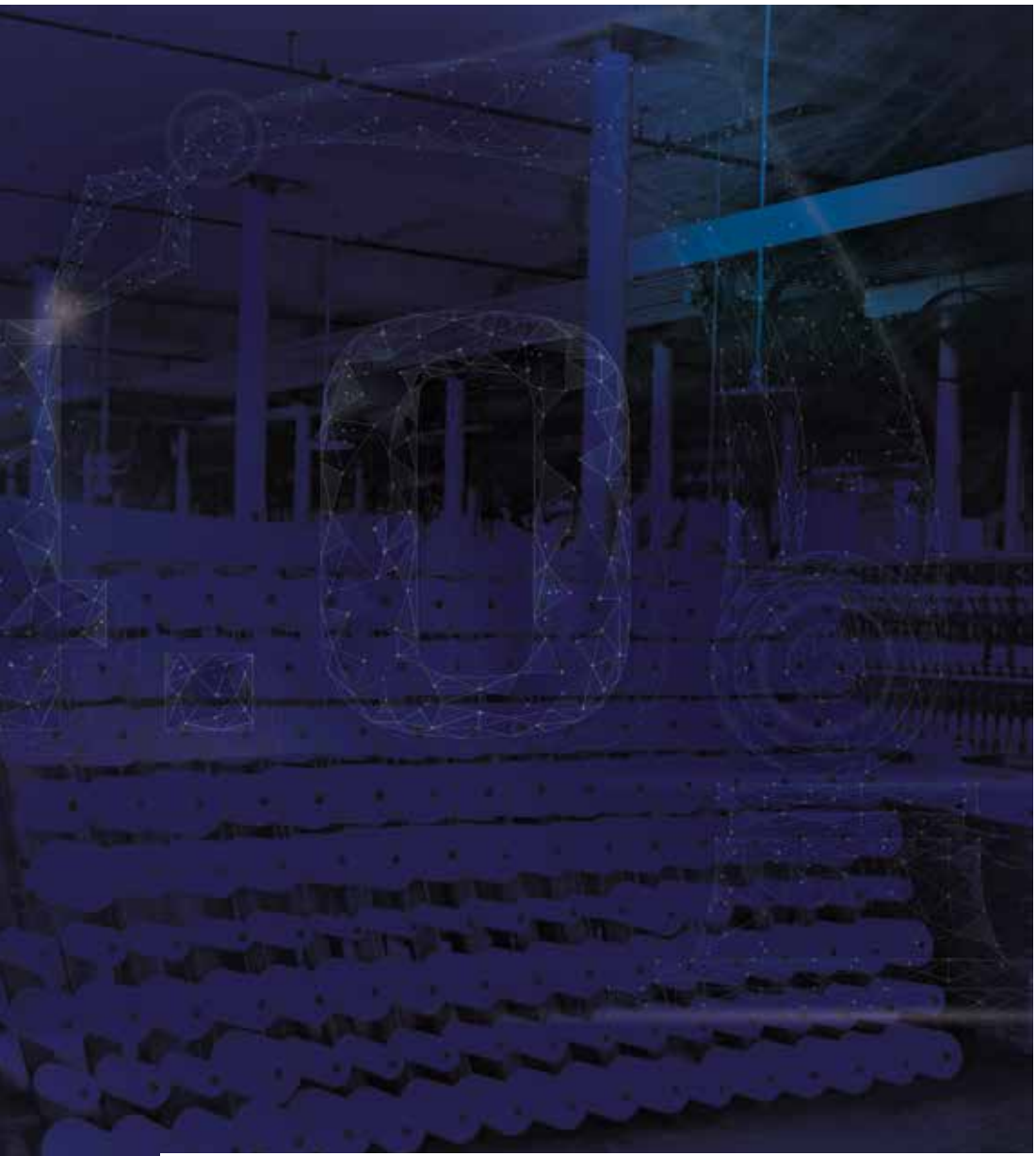
Another point to require digital transformation is that the companies which have resisted to change fall behind the competition much faster and face with the risk of being destructed.

It is foreseen that while the average lifetime of corporate companies was around 60 years in the previous century, it will be around 20 years in 21th century. It is an unavoidable fact that the companies which cannot catch up with the technology and changing circumstances will expiry in a shorter time period.

As the result of the increase in the competition with the digitalization, when major-scaled companies in the world cannot catch up with the change expiry in a shorter time period. They will be substituted by the small and medium-scaled companies which can use the advanced technology, catch up with the changes that the world has gone through and operate in a more agile and dynamic manner.

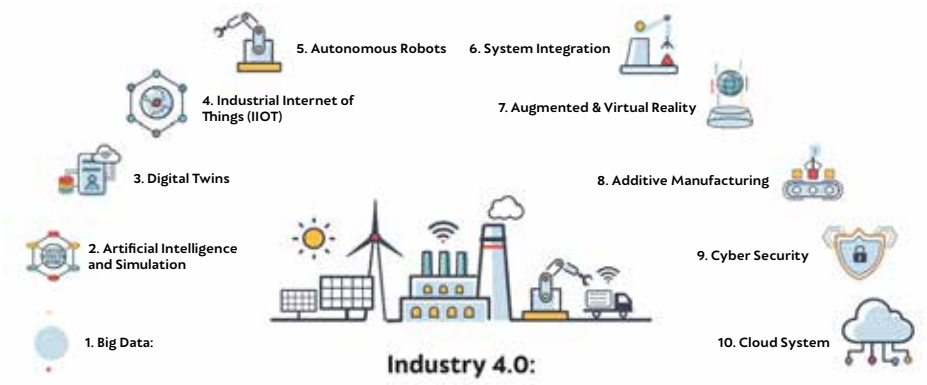
03

Industry 4.0 Technologies and Advantages



It is of crucial importance to fully understand the Industry 4.0's technology and applications. Even though different technologies come in sight in this field in the recent years, the applicable technologies of which practical results we can observe are as follows:

Industry 4.0 technologies



Primary Industry 4.0 Technologies are as follows:

- Big Data
- Artificial Intelligence
- Digital Twins
- Industrial Internet of Things
- Autonomous Robots
- System Integration
- Augmented & Virtual Reality
- Additive Manufacturing with 3D printers
- Cyber Security
- Cloud System

Big Data:

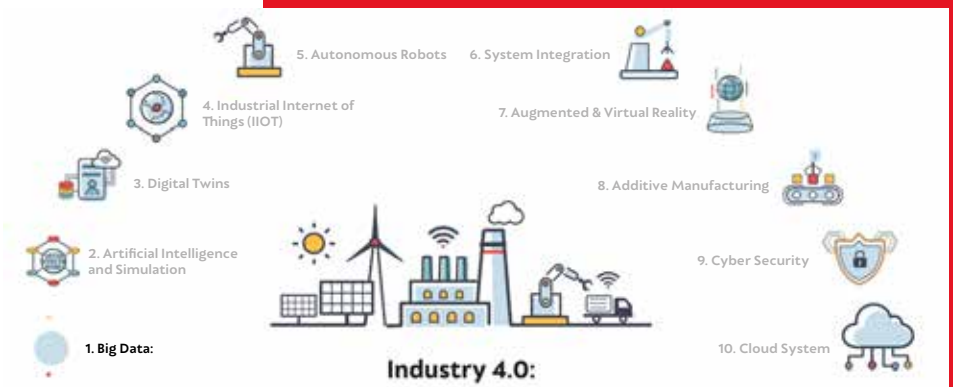
It is one of the milestones of Industry 4.0. Scada used in the industry is a big data analysis platform which interprets millions of data produced by the Internet of Things and sensors by real-time analyses and presents the outcomes of the analyses over the easily comprehensible and interactive dashboards.

Developing applications such as smart production process and product life cycle started to be used in the real life with the big data. Active preventive maintenance in smart production systems can be applied by big data analytics. Many real-time device data such as device alarms, device problem records and corporate notifications, can be collected in order to assess the current situations of production devices and detect the faults beforehand with the support of big data in the production field.

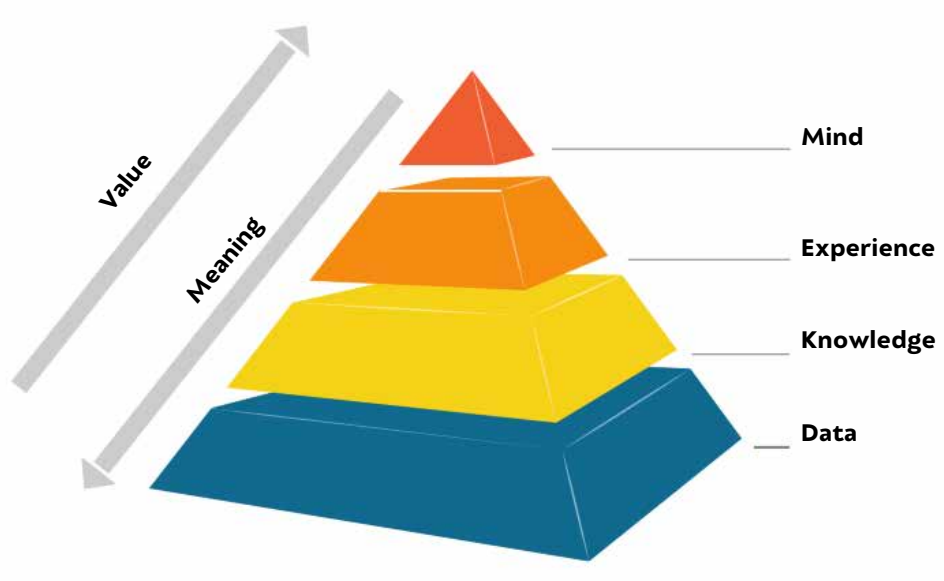
An industry equipped with a prediction to be provided by big data can increase the quality, reduce the losses and obtain the operations that have a key role in today's market which is very competitive and active. Increase in the number of producers operating based on analytics refers to more agile business decisions and faster solutions.

01

Great development and innovation will be recorded in any field of the industry upon the analysis of the big data.



DIKW (Data, Information, Knowledge, Wisdom) Pyramid:



Information is obtained by collecting and analyzing data from devices. Experience is gained by gathering and evaluating information. Wisdom (reason) is reached based on these experiences in the last step of the pyramid.

Information is obtained from the data after the production, acquisition and evaluation of data with information systems. Questions like who, what, when, how many/much can be answered in the explanation. Information is objective, transmissible, transformable, visible and measurable.

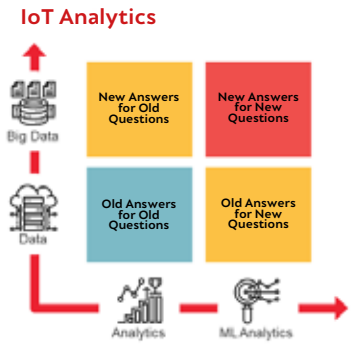
Experience is created upon collecting and assessing the information. We can say that you have collective knowledge that is processed and ready to be used now.

Transformation of information into instruction and then transmission to the experience result in accessing the wisdom. Decision support mechanisms lie here.

Big Data

AI and IOT are irreplaceable!

Companies investing in three fields -AI, IoT and big data- have a chance to be leading and innovative organizations in the fourth industrial revolution.



- The value of collecting all possible valuable data is increasing in each day.
- Associative data bases such as SQL and Oracle are ponderous data bases designed for corporate usage purposes.
- Prefer Industrial data bases for long term industrial process data.
- Big data sets are irreplaceable value for AI and IoT solutions.

Big Data is irreplaceable for the Artificial Intelligence and Internet of Things. Therefore, all possible data in the system should be collected and used. Such data should be kept in time-based data bases called as Historian developed for industrial processes instead of classical data bases.

IoT analysis (analytics) is the combined use of data analysis tools and procedures to obtain value from big data produced&sent by IoT devices. These values obtained can be used in any stage of the industry.

It is of crucial importance to use and prospectively store the instant data in order to realize analyses properly and correctly It is aimed to take decisions with big data by realizing minimum human intervention with machine learning.

Usage Areas of Big Data:

	How long is it used?	The change expected for the following 5 years?	How long will it be used in the following 5 years?
Predictive maintenance	%28	+%38	%66
Big data driven process and quality optimisation	%30	+%35	%65
Process visualisation /autmation	%28	+%34	%62
Connected factory	%29	+%31	%60
Integrated planning	%32	+%29	%61
Data-enabled resource optimisation	%52	+%25	%77
Digital twin of the factory	%19	+%25	%44
Digital twin of the production asset	%18	+%21	%39
Digital twin of the product	%23	+%20	%43
Autonomous intra-plant logistics	%17	+%18	%35
Flexible production methods	%18	+%16	%34
Transfer of production parameters	%16	+%16	%32
Modular production assets	%29	+%7	%36
Fully autonomous digital factory	%5	+%6	%11

In the industry, big data is used and aimed to be used in many areas especially in predictive maintenance, production and quality optimization, digital twin, autonomous digital factory, flexible production methods, online factory, integrated planning, production planning, sales prediction and other fields. It is predicted big data will be used in these fields for minimum two times more frequent in the following five years.

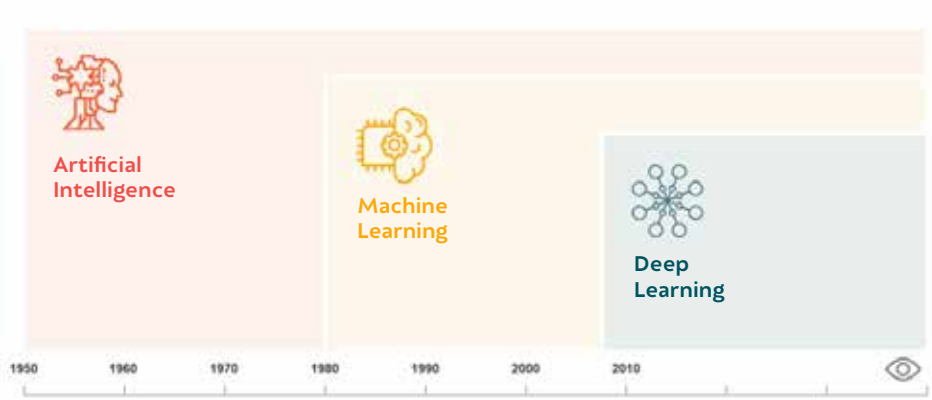
Based on the value created by data for the organization, even if there is no possibility to use in today's world, it is of crucial importance to collect and store operation data at reasonable cost to be used as a resource for the future analyses.

Artificial Intelligence and Simulation

One of the most important outcomes of the Industry 4.0 is to collect data and obtain actions to create difference from such data. Data amount, speed and volume to be produced in a production facility are taken into consideration, it is of high importance to realize automatic data analyses. Artificial Intelligence applications have a key role in this aspect and contributes to the support processes of the decision takers. It enables the decisions to be based on real-time data.

02

Artificial Intelligence



Artificial Intelligence (AI) refers to the applications imitates the human intelligence to fulfill the obligations and improve themselves repeatedly based on the information that they collect. These applications and collection of data during early-1980s, the process of machine learning initiated. For example, Kasparov was defeated by an artificial intelligence in a chess game. In the last ten years, deep learning gained speed. The application or the machine can assess on its own without requiring any human competence and take their own decisions accordingly thanks to the deep learning. Even they can program and use a new machine language on their own.

Artificial intelligence assess the retrospective data collected from machines and have outstanding results. It is considered that artificial intelligence will be used in each and any phase of the production in 5-10 years.

Artificial Intelligence/ Machine Learning

It is a system that investigates the work and construction of algorithms that can be learned as structural functions and can make predictions over data.

Usage Areas

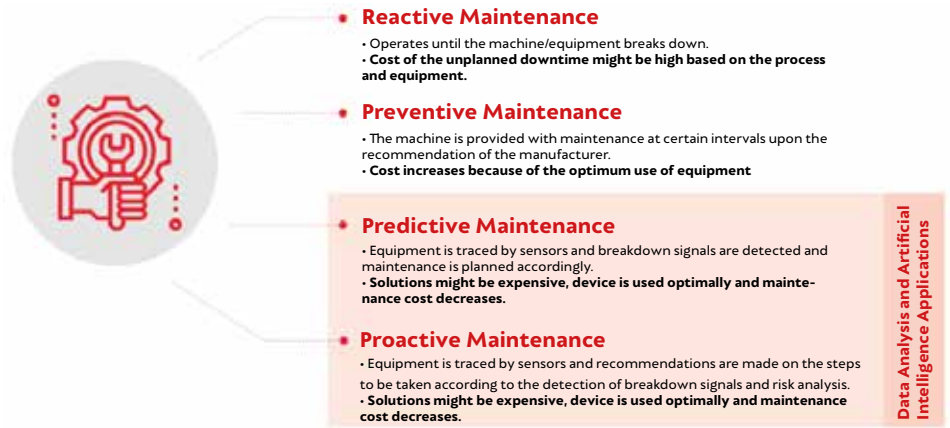
Machine learning can be used in numerous fields such as predictive maintenance, digital twin, production&sales prediction, root cause analysis and detection of quality issues. With its use in such areas, efficiency, profitability, performance, OEE can be maximized. All of these can be realized with the use of big data by the artificial intelligence. Artificial intelligence which makes predictions based on the data collected can produce better results compared to human intelligence.

Both unplanned long stops can be prevented and minimum cost is obtained by realizing the possible malfunction detections of the machines thanks to predictive maintenance,

It is significantly possible to solve all kinds of problems permanently by root cause analysis with the help of artificial intelligence. And it results in the increase of quality performance.

Artificial intelligence supports the decision processes by prospective production and sales predictions using big data.

Maintenance Technologies



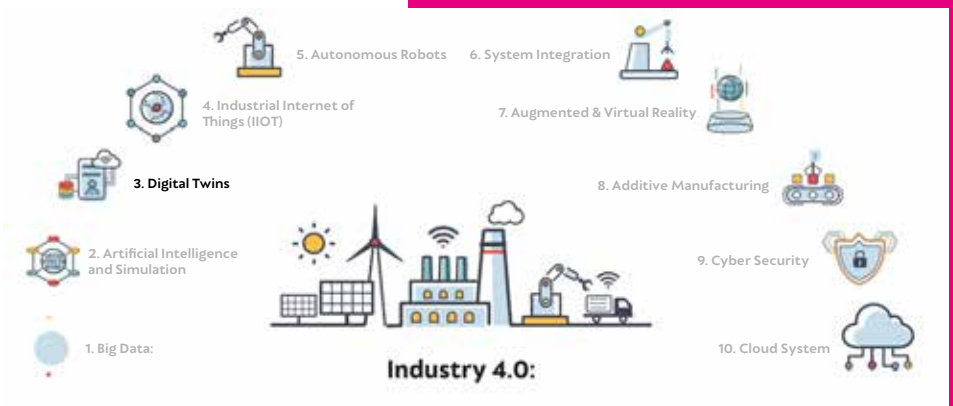
Maintenance Technologies: Four maintenance technologies are explained in this slide:

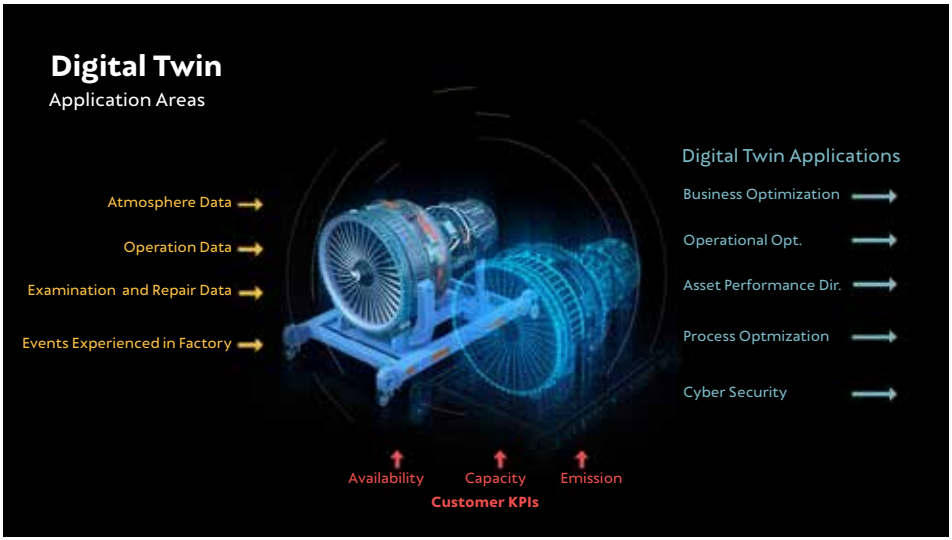
- **Reactive Maintenance:** Operates until the machine/equipment breaks down. The broken machine is intervened. The highest risk of reactive maintenance is that it causes unplanned stop and bear high part cost and lead to income and even customer losses because of affecting the production in negative way.
- **Preventive Maintenance:** The machine is provided with maintenance at certain intervals upon the recommendation of the machine & equipment manufacturer. Each machine/equipment should be provided with its periodic maintenance at specified intervals. Irregular maintenances which are not realized on time cause losses in production, quality and high costs.
- **Predictive Maintenance:** Maintenance is planned before the deterioration by collecting the data by sensors on the machine/equipment and assessing the signals. Unplanned stops can be prevented in this method. Besides, production and quality is kept at maximum level by providing minimum planned stops by taking precautions beforehand. Besides, spare part and maintenance costs are reduced. Since the predictive maintenance requires to provide enough data to the system, and the completion of the infrastructure by which the signals are checked by devices, it is an expensive solution at the beginning.
- **Proactive Maintenance:** With the collection of data by sensors on the machine/equipment and assessment of the signals, the machine assesses the risk of deterioration by itself and provides recommendations, even it calls and informs the manufacturer firm and acts accordingly. For the predictive maintenance, adequate number of data should be provided to the system and infrastructure that enables to control the signals via the devices should completed. Therefore, it might be deemed as an expensive solution at the first place.

Digital Twins

Another popular subjects to show up with Industry 4.0 is the digital twins.

03





Digital twin is the digital replica of a device or system. Significant increases might be obtained in efficiency with the use of digital twin. To illustrate, Mesarati has reduced the time to market by 35% using digital twin system.

Instead of physical systems, conducting tests on Digital twin results in reduction in test duration and test costs and enables to have more accurate outcomes.

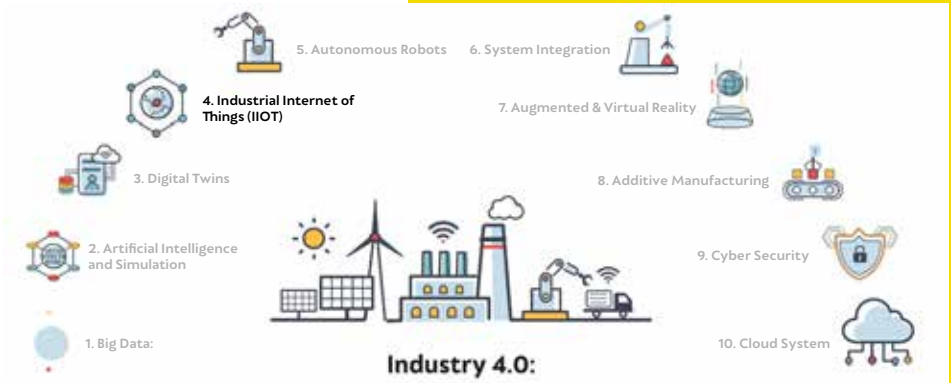
Since rapid test process facilitates the transition to the production, it creates a great competition advantage to the firms in the market.

In addition to the devices, Digital Twin of production lines, factories and processes can be created. By the digital twins, it is possible to simulate the scenarios which are not possible to test in the real life. For example, if devices in a production line operate in a particular configuration, calculation of the line's outcome and impact of maintenance needs of the devices might be tested on digital twins. Accordingly, the production plans are reviewed.

4. Industrial Internet of Things (IIOT)

Another important technology is the IIOT Industrial Internet of Things.

04



Industrial Internet of Things (IIOT)

Industrial Internet of Things represents the intermachinery data communication. IIoT includes energy tribunes, CNC Machines or white appliances such as refrigerator etc.

You can learn about the habits and behaviors of your customers by constantly collecting data with the use of Industrial Internet of Things. Along with this knowledge and experience, you can present the products and services that are appealing to your customer even before they demand, and you can have a competition advantage against your competitors.

Data means more than anything now. In today's world, anyone and any device is a data resource. You can detect and direct the expectations of the customers by using these data.

Mobile Applications actionable information at any place

Smart Operations

- Easily access to information anytime and anywhere
- Wide-spread appearance and performance trace integrated to the whole facility
- Automatic notification and reporting of breakdowns instantly
- KPI/Target Trace with Customized interface

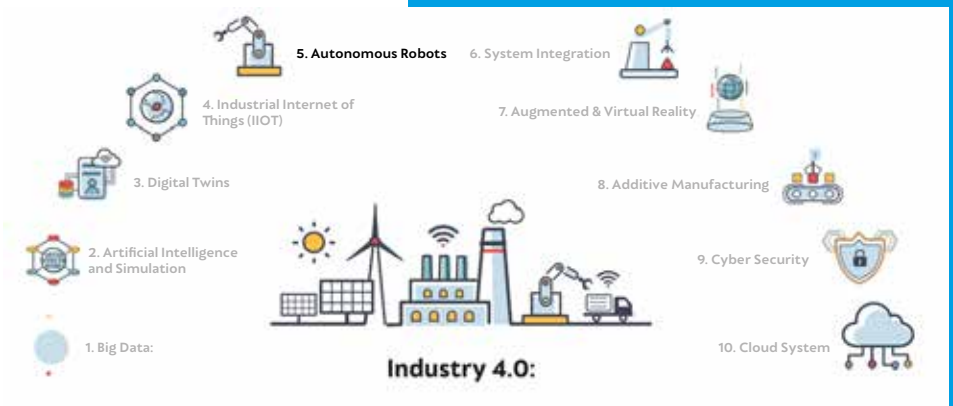
In Industry 4.0, it is of crucial importance to access the data from anywhere and without any limitation. The data should be able to be delivered to the institution, suppliers and customers easily. This can be possible by enabling access to data from mobile devices.

In addition to creating the whole flow in the digital systems integrated each other, it is also important to monitor it transparently. You can access all your smart objects from a single point and regardless of your location, and instantly access many data such as performance, report, and KPI by using mobile applications. You should be able to watch all field statuses such as any production, order, shipment, supply any time anywhere with the help of mobile devices.

Autonomous Robots

One of the fields where the Industry 4.0 applications are mostly used is the use of robots in the production processes. The number of the applications promoting to make the operation carried out by robots are increasing day by day. Autonomous Robots have a key role in such applications.

05



Autonomous Robots

Robots that are aware of the current situation and adopt into the changing situation and function without human assistance.

Industrial Robots

Robots that are commonly used in industries such as automotive and chemistry, etc.

Fixed and programmed robots

Co-bots operating with operator

Customer Robots

Robots used in the daily tasks and directions.

Provides help in daily chores such as cleaning.

Assists customers for direction.

Industrial Robots: They are re-programmable and multi-functional robots with auto-control and three or more programmable axis that are used in industrial applications and can be fixed or movable. They are programmed robots used in many stages of the production. They are used in many sectors especially automotive, metal and petrol.

Customer Robots: They are the assistant robots helping customers for their daily activities. These robots are in and out of human form and they automate most of the fundamental tasks in customer service. They can perform simple and basic works such as vacuum cleaners, that can pick up dust on the ground and guide customers.

Adaptive Robots

Adaptive robots are autonomous physical machines and used in works like lifting without human assistance.

Logistics Robots

Robots that are used in lifting any material.

Used in storages.

Help in lifting product and good.

Service Robots

Robots that are used in the industry as increased human interaction.

Human robots are those that can establish interactive communication with humans.

Adaptive robots are used in works such as human lifting, rescuing

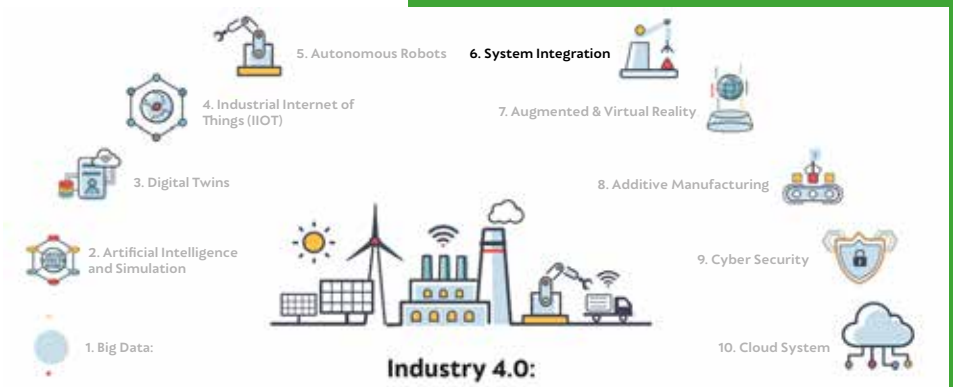
Logistics Robots: Logistics robots automate the process of storing and transporting goods. They generally used in storages and storage facilities in order to organize and move a process called as intralogistics; however, they can also be used in other places. In dark factories, these robots perform carriage works.

Service Robots: They are robots that have human-like appearance and perform some useful tasks for humans. They provide service in operations such as health, fire and customer direction and rescue.

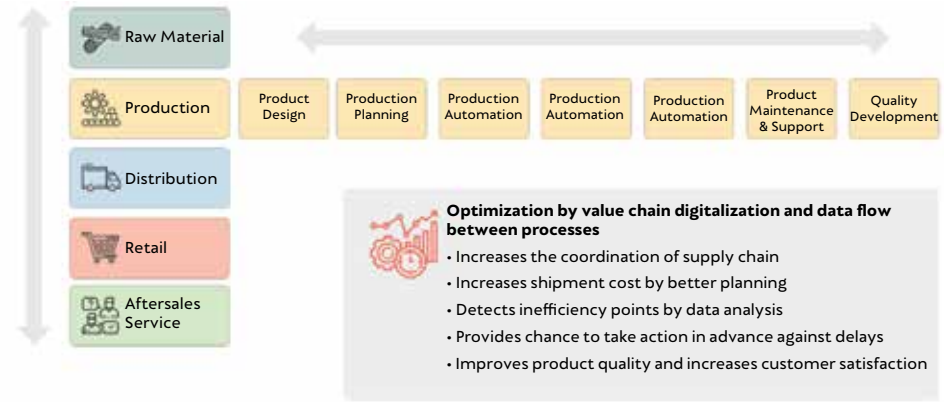
System Integration

One of the significant transformations promised by Industry 4.0 is to digitalize the value chain and enable the systems between supplier, manufacturer and customer on the value chain to communicate with each other through the digital processes. In this way, the developments on the value chain are reflected to all stakeholder systems promptly and total efficiency can be managed by automating the actions.

06



Horizontal and Vertical Integration: Digital Value Chain



Improvements in supply chain coordination, shipment planning, product design process, production automation and customer satisfaction etc. can be gained with digitalization of value chain.

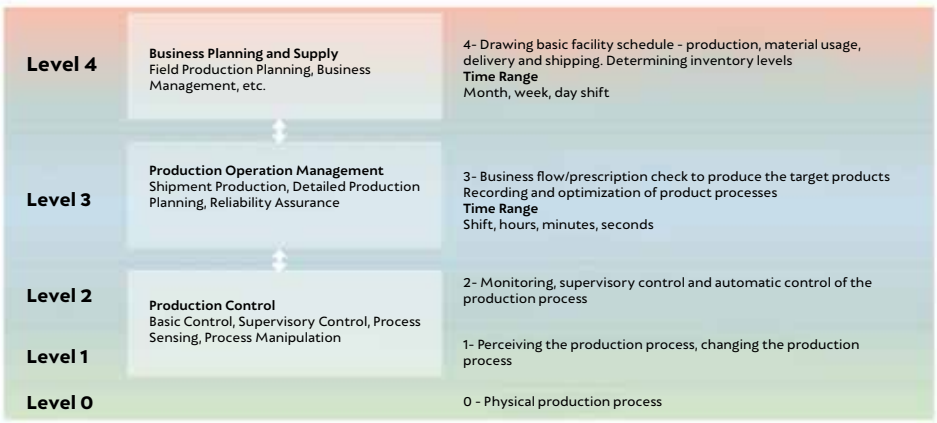
In order to create a digital value chain, business process should be mapped firstly. The most important way to be ready for the digital value chain is to enable the decision makers to perform self-assessment to help the map preparation for their digital future.

It is of crucial importance to adopt an end-to-end and integrated digital mindset. This perspective will help to determine the potential for the smart products and network on expanded value chains and for companies to engage in customers who are strengthened digitally across the world.

Digitalization of value chain enables to create complete and end-to-end supply chain management system perform order management and provides opportunity to trace the information including suppliers, manufacturers, wholesalers, shipping providers, logistics providers and retailers; and brings out a more effective business environment upon the increase in the coordination.

Horizontal and Vertical Integration: Production

ISA- 95 Model
Commercial and Control Systems



ISA-95 Model is an international model for the integration to the system and processes included in the production organization. Accordingly, there are 5 levels for the integration of commercial and control systems in the manufacturer.

Level 0: Conducting the production physically. For example, production of a chemical substance.

Level 1-2: The level where the production process is assessed and changed. It is the level or phase where the actions are taken upon the requirements observed in the production and quality controls.

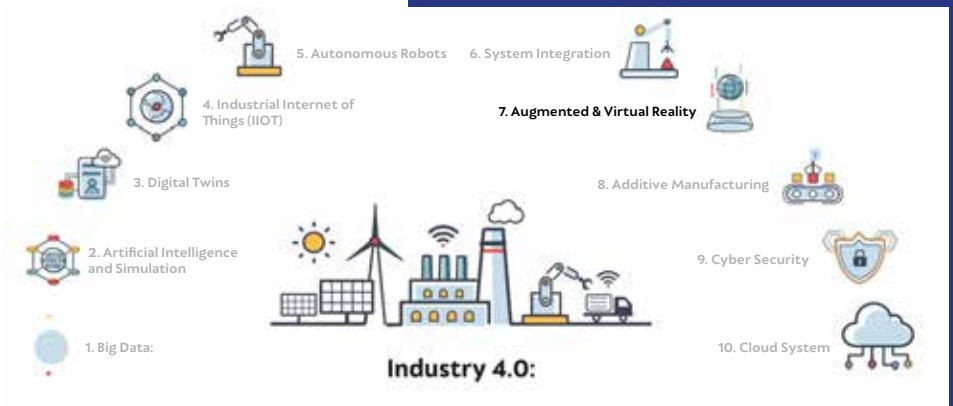
Level 3: The operational management level where the prescription of product is checked, all records are kept and time management is realized.

Level 4: Business plan and supply is conducted in this level. Many processes such as inventory levels, production status, material usage, delivery, shipment take place in this level.

Augmented & Virtual Reality

In Industry 4.0 applications, the usage areas and benefits of the terms of augmented and virtual reality are as follows.

07



Augmented & Virtual Reality

Usage Areas

- Occupational place safety
- Education
- Maintenance
- Quality Control
- Field Operations
- Production

Augmented Reality: Real or indirect physical appearance of objects produced by computer and created by being enriched with data such as sound, image, graphics. In other words, it is the process of putting the virtual objects on the real images by using the object identification feature of devices. For example, digital contents such as graphic, sound and video are monitored on the screen in order to provide an augmented reality experience by using the camera of the device. Augmented reality uses digital content in order to improve the daily experiences and make your physical area more meaningful. When you show the device with this feature to the machine, you can see all data about that device. In this way, use of materials such as paper, form, etc. are removed.

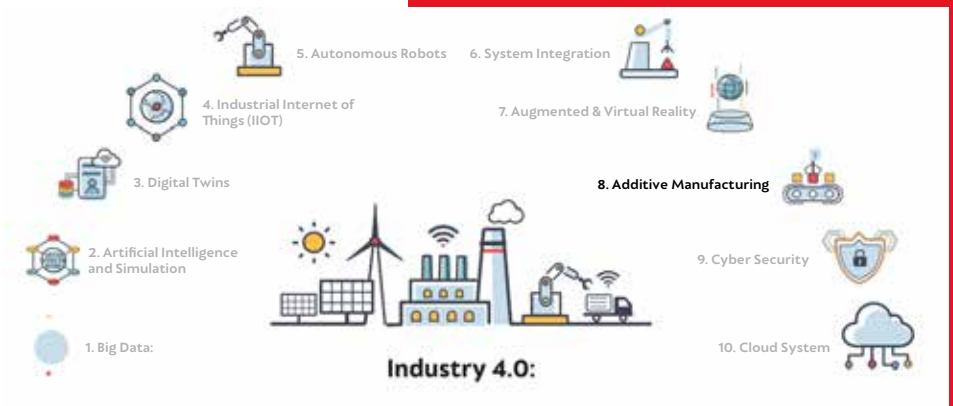
Virtual Reality: It is a digital environment created by 3D computer technologies. Oppose to the augmented reality, images are completely virtual. In order to exercise this feature, virtual reality glasses should be used for now. Technical classes are held practically with the digital platform created by the operators in the industry. Additionally, its other advantages provide cost efficiency supporting the business processes, enable to perform daily tasks in the field more easily and fast, increase the usability and accessibility of information and make the learning experience more interactive, interesting and entertaining.

Both technologies are used in maintenance, quality control, production, business safety and many other fields in the industry. It is an important method in reducing the costs in these fields.

Additive Manufacturing

Another important Industry 4.0 technology is additive manufacturing (3D Printing) applications. It is foreseen that such applications will deeply affect the production processes in some sectors.

08



Additive Manufacturing

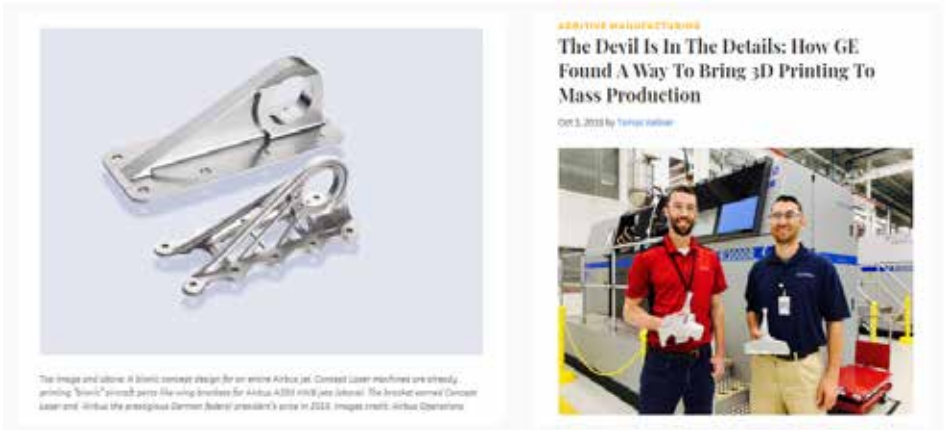
It is the process of combining the materials as one over the other in general by 3D printers in order to create objects out of 3D model data.

Additive Manufacturing: It is the process of bonding the materials as one over the other in general by 3D printers in order to create objects out of 3D model data. It is known as 3D Printing as well.

3D Additive Manufacturing technologies do not process any block part and not operate as CNC lathe since they produce the object by making additions. On the other hand, it creates the object from scratch by adding thin layers and in this way, it does not create waste like CNC. Therefore, it increases the quality while reducing the production period.

There is no limit in the design of objects you want to create in additive manufacturing. You can produce the object by transmitting its 3D design into machine without being required to use any additional method.

Additive Manufacturing



Here is a part of Airbus plane made by 3D printer. Highly complicated parts can be produced in a shorter time period and as higher quality thanks to additive manufacturing and 3D printers. The part above has been produced in a shorter time period, as higher quality and less cost and more endurable compared to the original part. Thanks to these features, it was awarded in 2015.

Cyber Security

One of the significant risks posed by connecting more systems together and making them instantly traceable is cyber security threats. Security threats in information technologies started to apply for factories upon the digitalization of production fields.

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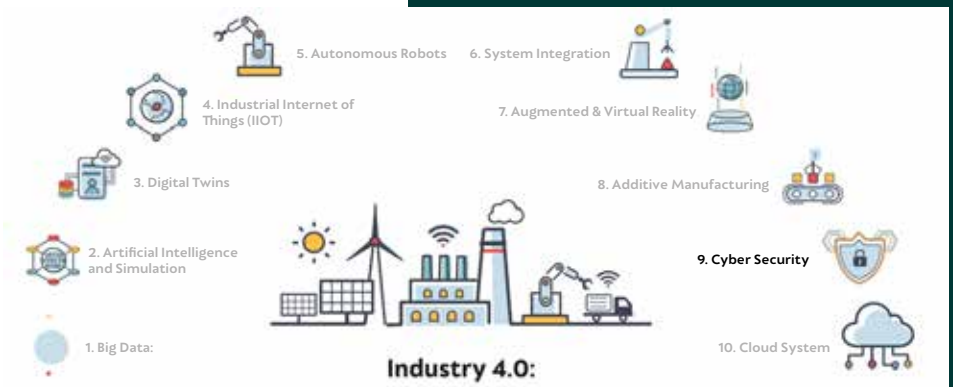


Global Industrial Cyber Security Attacks (2016)

Top 15 countries based on the percentage of industrial computers attacked.

1	Vietnam	66.06
2	Algeria	65.56
3	Morocco	60.39
4	Tunisia	60.17
5	Indonesia	55.69
6	Bagladesh	54.19
7	Kazakhstan	54.14
8	Iran	53.89
9	China	53.31
10	Peru	53.08
11	Chile	52.75
12	India	52.48
13	Egypt	51.61
14	Mexico	49.58
15	**Turkey**	**46.20**

Industry 4.0, digitalization, Internet of Things (IoT) and similar new technologies pave the way of data thefts for hackers. With the 4. Industrial Revolution, cyber risks increased, and solutions are being developed.

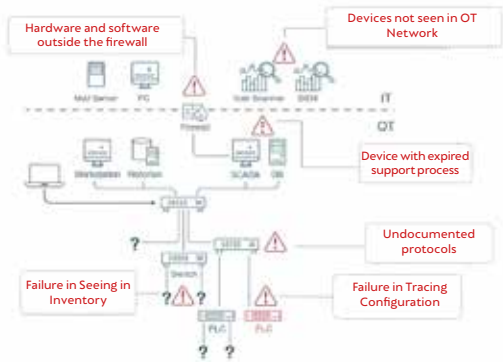
Also, efficiency-increasing new technologies used in the storage, processing and real-time transmission of data bring in unexperienced threats and require producing new security solutions against cyber-attack methods.

Internet or extractable media tools such as USB or e-mail and harmful software sneaking into industrial systems might be used to attack. Such cyber-attacks can harm or stop industrial control systems such as SCADA, DCS, PLCs etc. In addition, malwares can slowdown the systems by hiding themselves.

Turkey is among the countries exposed to industrial cyber-attacks in the most frequent rate. Turkish Industry need to be more conscious about the cyber-attacks and take further precautions.

Industrial Cyber Security

Security Points in IT and OT



- Do I update not only my computer and servers but also my automation equipment?
- Are there unknown devices or data flow in Network traffic?
- Are there structures that instantly monitor and notify me about IT and OT systems?
- Is my IT and OT network open for Internet?
- How much do my employees have knowledge or educational background about cyber security?

It is of high importance for IT and OT networks to be separate from each other in order to protect the industrial systems against cyber attacks.

Also,

- Automation devices should have updated and upgraded applications in addition to all computers included in the network.
- All data traffic in the network should be traced.
- Computers and devices that are required to be close for Internet should be isolated.
- Access controls of ICS (SCADA, DCS, PLC) components in and around the industrial network should be inspected frequently.
- You need to restrict the network traffic of ports used in OT networks and protocols at end router and organization.
- All employees should be trained against cyber attacks.
- Awareness trainings should be provided on a regular basis.

Cloud System

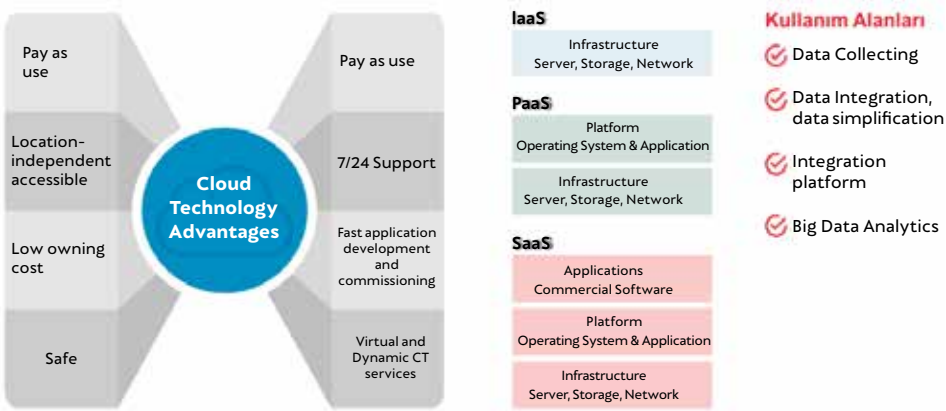
The most important information technology's transformation of our era is the Increase in usage of cloud systems.

Through such systems where it is possible to pay as you use, firms could get rid of the expenditures they made for information technologies operations and use added value services (CMR, ERP, MES, etc.) as a user.

10

Cloud Technology

Cloud Technology is the presenting CT resources on Internet upon the request or through the system of pay as use.



Upon the developing technology and decreasing costs, firms are recommended to use cloud systems instead of establishing data center at their own locations. Through cloud services

- you can have a safer data environment.
- Your systems are stored in a more stable environment.
- Cyber-attack risks are minimized.
- Data center establishment and maintenance costs are saved.
- 7/24 technology support is received.
- Locational risks are minimized.
- Higher quality and constant service is received through cloud.
- You can get rid of the new equipment costs born by old technology.
- You can get rid of license costs by purchasing as much as you use.
- You can provide higher quality service after the professional teams realize your updates and new installations.
- Since patch trace is performed by data center teams, you don't have to put extra effort.
- Mobility advantage is provided for your systems.

04

Current Situation of Digital Transformation in the World and Turkey

Surveys on digital transformation, digital transformation awareness and risks in the world and Turkey will be discussed in this chapter.

The world is changing

The world transforms rapidly. Several important factors of this transformation are as follows:

- Employees both get digital employee profile and become data consumer by using mobile applications especially.
- Organizations become smaller and dynamic companies. The number of start-ups increases.
- Companies that could not catch up with this transformation complete their life cycle very fast.
- The organizations change as well. Organization culture that is constantly learning and open for innovation gains importance.
- To take decision swiftly regarding the new products and services carries the firms a step further in the competition arena.
- Use of agile project methods such as "Fastworks" and Agile" increases in order to produce and present new products into market.
- New ecosystems develop. Closed and isolated systems disappear.
- Collaboration is increasing even with the competitor companies.
- Information access become liberalized by using the Internet opportunities to the largest extent.

How did top 5 companies of the world change?

The above graphics show the transformation processes of the top 5 companies of the world to have the highest turnover rate in years.

While at the beginning of 2000s, corporate companies operating in banking, service and petrol fields ranked as the first five, they have been replaced by the technology companies in the recent years. Companies that invest in creation and sales technology seized the leadership in total revenue amount.

Companies that produce technology gain incredible amount of revenue by investing in many fields such as health, transportation, automation, nanotechnologies and other fields, not only in technology. Google, which is known as search engine, started to create autonomous vehicles.

Firms like Facebook, Google can provide service to the users by customized announcements and service by using the user data densely.

While Amazon that has no physical store can market and send numerous products to each corner of the world, it can be the biggest cloud service provider of the world with Amazon Web Services (AWS) at the same time.

Business model or Innovation?

Business Model or Innovation?

It is no longer enough to have a good sales network, qualified human resources or a strong technology in order to be successful in today's economy. The most important way of success in economy has become to create and implement the correct business model. Companies operating in the market through innovative business models have the chance to get the biggest share out of new opportunities.

Companies can produce new products which are the rivals of their own products in order to stay in the market and expand their markets. Products of a firm can be competitors for each other by producing new business models when necessary instead of innovation.

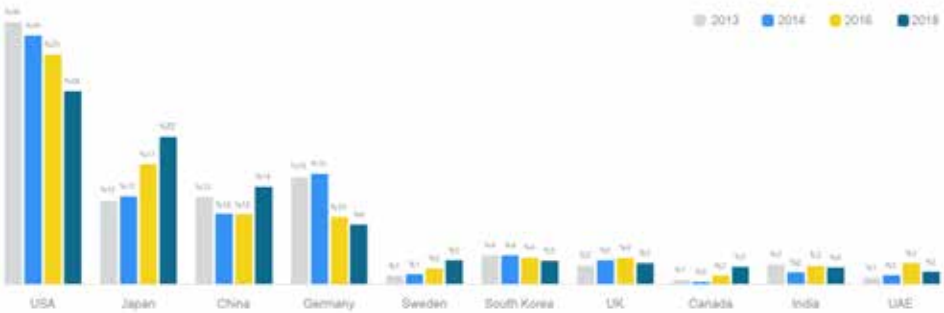
For example, Apple had great success against Cabo by presenting iPod to the market in 2003. However, Apple presented iPhone brand to the market 4 years later and caused a decrease in the sales of iPod, its best seller, and it gained a higher income rate and market share with its new brand.

GE Innovation Barometer

The firm of General Electric conducted a survey with 2090 senior business executives in 20 countries in 2018. The results and details of this survey provide a significant information on the development of innovation across the world.

Innovation and Digital Transformation Champions

Which countries are leading in innovation?

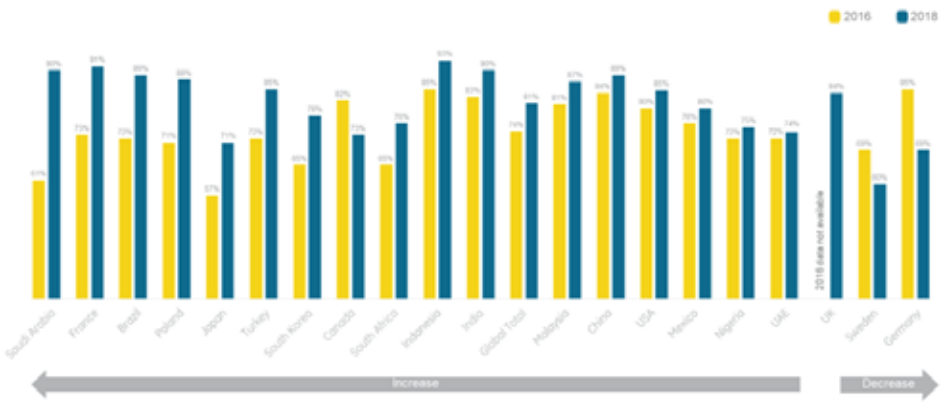


According to the survey conducted by GE, developed countries like USA, Japan, China and Germany took place in the list of leading countries in digital transformation and innovation. It is not a coincidence that these countries play an active role in the world trade.

With National Network for Manufacturing Innovation (NNMI) program, USA prepared its Digital Strategy while Germany created an Industry 4.0 platform consisting of the leading companies of the industry for digital transformation in 2012 and published its 2025 Digital Strategy. While Japan prepared its strategy with Society 5.0 concept, China prepared its "Made in China 2015" strategy and specified their targets specifically and clearly and have come a long way.

Turkey's Perspective on Digital Skills

How much do you center digital skills on the focus of your organization and company?

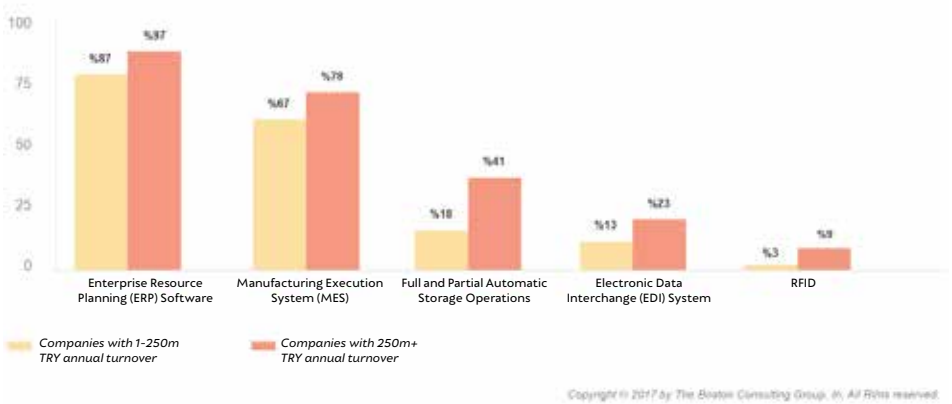


In the answer given to the question of "How much does your company focus on digital competencies", it was pointed out that the companies more focused on digital competencies in 2018 compared to 2016. As seen in this survey, it is easily pointed out that the awareness about Industry 4.0 and Digital transformation has increased in Turkey during the recent years.

Since Germany has already focused on its route map for Industry 4.0 and has come a long way, it seems to slow down in this regard. And it is seen that the other countries more focused on the digital competencies like our country in time. The result of this survey is that digital transformation process in the world proceeds by gaining speed.

Digital Transformation in Turkey?

Graphic 9: Usage rates of automation technologies



Let's see the usage rates of automation technologies in Turkey:

Even though the application usage rates of medium and major scaled companies like MES, Storage Automation, EDI and RFID are low and inadequate, these rates are much lower for the minor scaled companies. Another significant point here is the effectiveness level of the usage of such applications. Many firms continue to conduct their order and supply process via instruments such as e-mail and phone instead of professional applications.

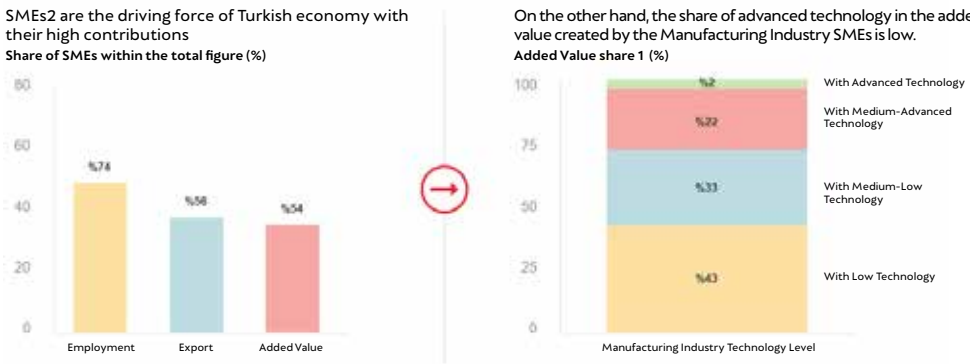
"Digital Transformation Roadmap" published by the Ministry of Industry and Technology draws attention with its 6 components from education to technology. They are:

- Human - Development of education and training infrastructure and training of qualified workforce
- Technology - Improvement of technology and innovation competency
- Infrastructure - Fortification of data communication and network
- Suppliers - Supporting national technology suppliers and manufacturers
- Users - Supporting the digital transformation of technology users
- Governance - Fortification of corporate governance

It is of crucial importance to assess and support such fields with actions when planning the digital transformation.

Digital Transformation in Turkey?

Graphic 6: Basic indications on SMEs in Turkey (2014)



1. Added Value with Factor, 2. SME Companies that employ less than 25 workers and whose annual income does not exceed 40 million TL *Resource: TUIK*

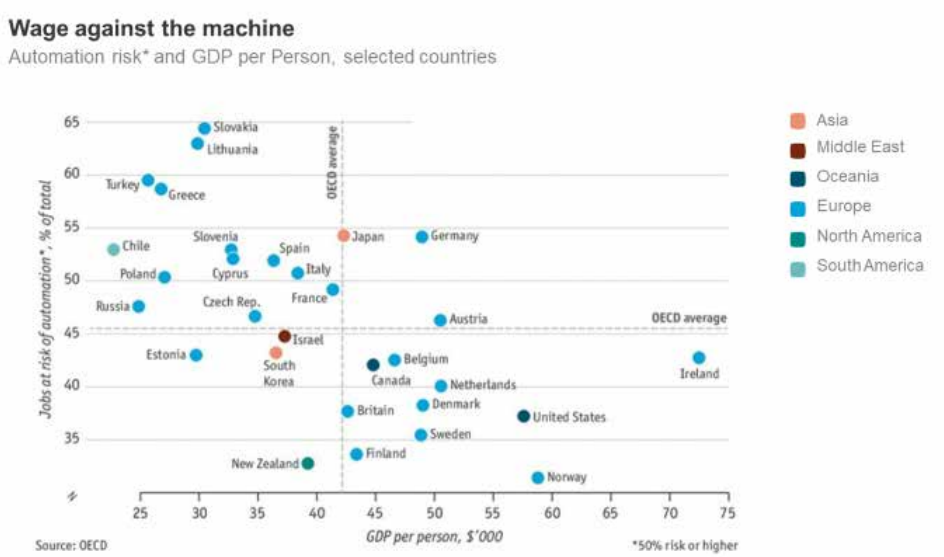
TUIK data put forwards the situations of SMEs in Turkey regarding their distribution in manufacturing.

SMEs serve as the locomotive of the economy with the high employment rate, export and added value that they provide. They provide nearly 74% of employment, 56% of export and 54% of added value in Turkish economy.

On the other hand, the added value that they create in the manufacturing industry is very low. Nearly 43% of this added value is low-tech. However, 33% is medium-low-tech, 33% is medium-high tech while only 2% is high-tech.

Risk of Turkey is high against the automation

Ratio of businesses under the risk of automation (%)



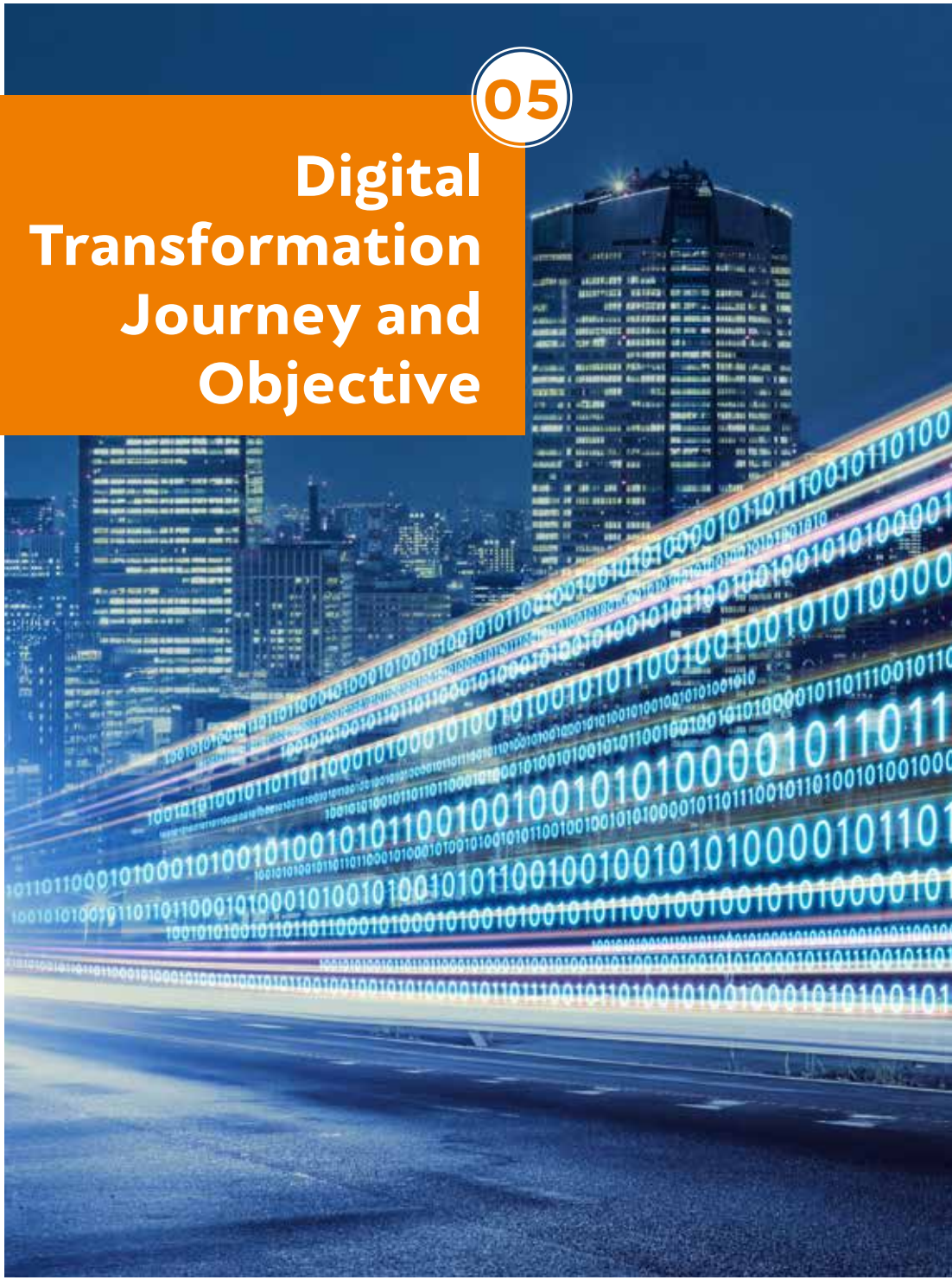
Some of the professions have risk against automation in Turkey. The sectors that use low technology and manufacture with high level of labor force face with a serious risk of labor force loss with the automation.

This risk might be divided into two groups:

- Many operational tasks are automated and can be performed by robots and digital applications thanks to digital transformation and Industry 4.0 applications. And it will lead to labor force loss.
- It is the loss of competitiveness of industrial companies operating in our country against the businesses that have completed their digital transformation and accordingly produce cheaper, more different and higher quality and faster products. As the result, businesses face with the risk of ending their operations.

05

Digital Transformation Journey and Objective



Digital transformation is a long journey. Organizations and firms should consider and plan the transformation as a long-term process. It is of crucial importance for employees to obtain the digital competencies in time and adopt the transformation as a part of their daily activities.

Journey of Digital Transformation

Where do you want to be?

Where are you now?

The Route towards the Target

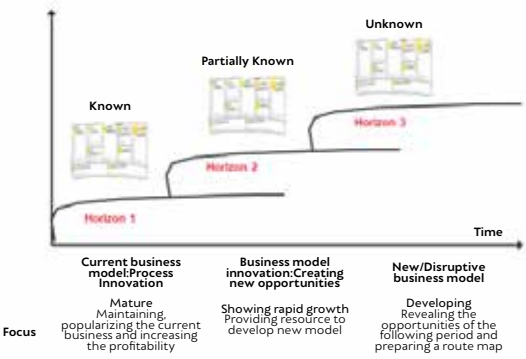
The following three questions should be answered when stepping into digital transformation journey:

1. Where do you want to be? Specify your target destination that you would like to arrive at the end of this journey.
2. Where are you now? Be aware of the point you are now compared to your target.
3. What is the path you should follow in this journey? You should realize a well-thought plan and specify the activities that you should do in order to meet your target before the journey.

Digital transformation is no longer an alternative but an obligation for industrial firms now. It is a strong assumption that firms that cannot catch up on time will fall behind the era and competition and disappear from the market.

You should determine your target in a clear way when stepping into the digital transformation journey. Then, specify how much you are away from your target for the time being. The last step is to create a well-thought project plan to meet your target. Your plan should include all details from the point you will start to the destination point you would like to arrive. Good intention and a target are not enough to succeed. Unplanned action or unrealistic plan will not lead you to your target.

Planning the Future and Priorities when Transforming



- Horizon 1: Today
- Horizon 2: Tomorrow (1-2 Years)
- Horizon 3: Following (1-3 Years)

Ecosystem establishment

Resource: 3 Horizons of Growth-Baghai, Cole White

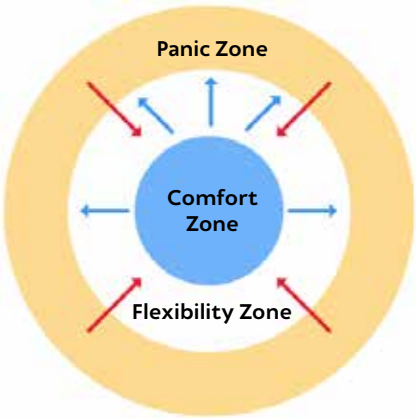
The establishment of ecosystem consists of three horizons for the transformation journey.

Horizon 1: You are recommended to maintain and sustain your current business and grow by increasing your profitability when making prospective plans. In order to sustain your future operations, you should continue your current operations by finding new markets and customers.

Horizon 2: You should grow by realizing innovations in your business model in the following 2 years and you should provide fund for this aim. Have a rapid growth by developing new business models and accordingly increasing your profitability by providing fund in this phase. You should use any opportunity provided by digitalization in the creation of new business models.

Horizon 3: To catch numerous opportunities of disruptive business models starting from today and prepare the route map for the future period. Disruptive business models help create an entirely new marketplace by creating a new niche in the market or by creating, restructuring or optimizing a product/service. Firms that especially focus on human and create customized innovative products will be able to take their parts in the ecosystem in this phase. You can realize many enterprises even with your competitors in the ecosystem.

Planning the Future and Priorities when Transforming



- Flexibility Zone
- All is well!
- In fine fettle!
- We don't think it is necessary for now.
- We will wait for others to try first.
- Some tried but could not succeed.

  Why bother?

Digital transformation is not a choice but a requirement. Companies that are unwilling to leave their comfort zone will put forward various excuses to not step into the digital transformation journey. They will face with major risks to maintain their existence in the near future. They should leave their comfort zone with a well-designed transformation plan and take step towards their target without losing any time.

The excuses of those who want to stick to their comfort zones might be listed as: being satisfied with their business operations, not assuming to be affected by the transformation since they do not foresee it, waiting others to go through the transformation because of fear of failure, accepting the bad examples and considering the transformation process only as a cost.

On the other hand, those who are intended to go through the transformation process but do not act in line with tangible and realistic plans or acting without adequate preparations might panic and lose their current businesses.

You are recommended to complete your preparations and step into the digital transformation journey without losing any seconds in order to take your part in the future ecosystem

Will robots replace us?

Elon Musk's Neuralink implant will "merge" humans with AI - Dezeen
https://www.dezeen.com/2019/07/22/elon-musk-neuralink-implant-ai-technology/
10 hours ago - Tesla founder Elon Musk has launched tech startup **Neuralink** to build implants that connect human brains with computer interfaces via artificial intelligence. The approaching technology would see groups of minuscule, flexible electrode "threads" implanted into the human brain by a ...

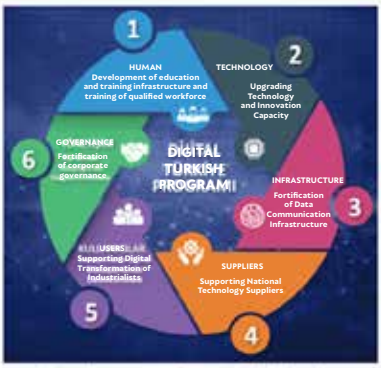
18.7.2019

Robots are used in the industry for a long time. Their usage rates are expected to increase significantly in the near future. All activities requiring muscle force in the industry are left to robots, and the human factor will also decrease in many sectors with artificial intelligence applications. Elon Musk claims that robots that operates with artificial Intelligence will take over the world in the near future. And in order to prevent it, he aims to combine human and artificial intelligence by affixing an implant into the human brain by investment in Neuralink technology.

It will be the most important approach for our organizations to comprehend the ongoing transformation and make strategic plans that will enable them to adapt to it, to transform them into realistic and fruitful projects, and to manage the possible labor market changes in the long run.

Industry 4.0: Turkey

TURKISH INDUSTRIAL REVOLUTION "DIGITAL TURKEY" ROUTE MAP



https://www.sanayi.gov.tr/tsddtyh.pdf

Titles

- Digital Transformation of Manufacturing Industry
- Country Policies: Germany, UK, USA, China, European Community
- Current Situation in Turkey
- Route Map
  - Human
  - Technology
  - Infrastructure
  - Suppliers
  - Users
  - Governance

You can access to the digital transformation plan in Turkey prepared by the Ministry of Science and Technology via https://www.sanayi.gov.tr/tsddtyh.pdf

Result

Digital transformation is no longer an alternative in the manufacturing industry; on the contrary, it is an obligation to be applied with its all components in order to keep the competitive capacity in the manufacturing. With the digitalization and Industry 4.0 technologies, it is aimed to increase the efficiency and quality in the production, improve customer experience and maximize competitive capacity. Additionally, it will be possible to create new business models where digital competencies are frequently used with the digitalization. In order to meet these targets, facilities are required to prepare their digital transformation route maps and plan the projects by which they will implement their route map. While the world is going through a rapid transformation with the digitalization, facilities that can catch up with this transformation will manage to continue their path by growing; however, those which fall behind this transformation will face with serious risks in maintaining their operations.