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## MARKET STUDY

# RISING DIGITALIZATION, INDUSTRY 4.0, SMART CITIES AND THE OPPORTUNITIES ON THE LIFE SCIENCES MARKET IN TURKEY



OFFICIAL PROGRAMME

PARTNER

## **MARKET STUDY RISING DIGITALIZATION, INDUSTRY 4.0, SMART CITIES AND THE OPPORTUNITIES ON THE LIFE SCIENCES MARKET IN TURKEY**

Focus on the digitalization level and maturity of Turkey regarding Industry 4.0 and Smart Cities to understand investment opportunities in life sciences.

The evolution of human being has always been closely linked to knowledge legacy and preservation, from the first cave paintings to the invention of printing.

The means to preserve the knowledge or the information and to communicate it have evolved through history.

Among all of these technologies that deal with information storage and transmission, one characteristic of computer technology that sets it apart from earlier analog technologies is that it is digital.

The present market study aims at providing an overview of Turkey's environment by setting up its global technological position, analyzing the country's level of digitalization, especially for companies and the country's maturity toward Industry 4.0

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# Management Summary

The evolution of human being has always been closely linked to knowledge legacy and preservation, from the first cave paintings to the invention of printing.

The means to preserve the knowledge or the information and to communicate it have evolved through history. From the invention of the telephone, AM radio stations, and television to electronic computer; technological breakthroughs have revolutionized human communication and the spread of information.

Among all of these technologies that deal with information storage and transmission, one characteristic of computer technology that sets it apart from earlier analog technologies is that it is digital. Digital technology uses a system of discontinuous data or events and creates a universal model to represent information that is expressed in digits contrary to analog technology that uses light and sound waves. A digital world is in that sense a world united by one language, a world where people from across continents can share ideas with one another and work together to build projects and ideas.

In this context, the democratization of Internet in the 1990's plays an important role. More voluminous and accurate information is accumulated and generated, and distributed in a twinkling. This in turn allows the recipients of the information to use it for their own purposes, to create ideas and to redistribute more ideas. The Internet provides new ways of reaching out to customers and competing for market share. Over the past few years, social media has established itself as a powerful marketing tool. Information and Communication technologies (ICT) employed within companies help to streamline business processes and improve efficiency. The booming of connected devices throughout the world has created new ways for businesses to serve their customers.

Lately, the technological level is set even higher where all kinds of computers, equipment and appliances are interconnected and functioning as one unit. We can see telephones exchanging information with computers, and computers playing compressed audio data files or live audio data streams that play music over the Internet like radios. Some modern homes allow a person to control central lighting and air-conditioning through smart phones at distance. These are just some of the "smart" features of a digital world.

At a time of slowed growth and continued volatility, technological progress is a driving force behind economic growth, citizen engagement, and job creation. The digital and ICT revolutions that are twin revolutions are reshaping our world into a smarter one, where social relations, governance, company strategies, manufacturing processes, cities... are all concerned. In this new environment, the competitiveness of economies depends on their ability to leverage these new technologies.

With a young and connected population, Turkey is one of the fastest growing ICT market. It's all the more important for Turkey as an emerging hub to adapt fast toward the digital transformation and digital revolution to attract investments and keep pace with developed countries.

The present market study aims at providing an overview of Turkey's environment by setting up its global technological position, analyzing the country's level of digitalization, especially for companies and the country's maturity toward Industry 4.0. The study will especially focus on Smart Cities where Turkey is doing quite good by implementing digital technologies and finally emphasize the opportunities for Swiss companies, in the Life Sciences market for smart concepts and advanced digital technologies.

# Turkey's Environment

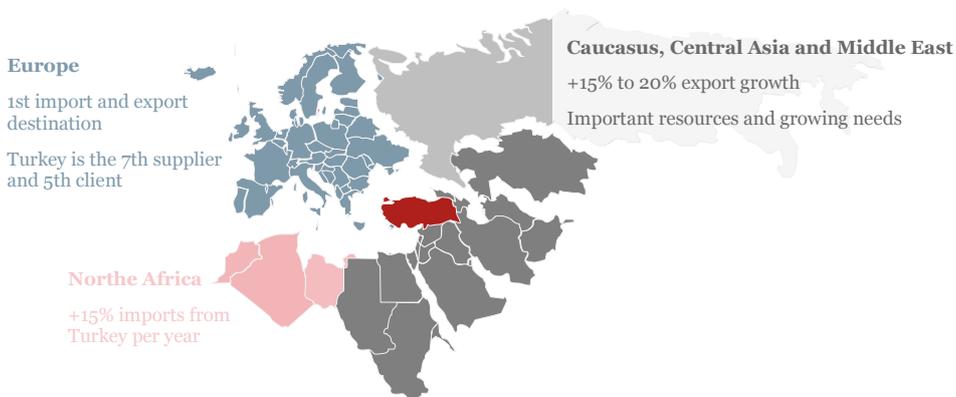
Lying at the junction of Europe, Asia and the Middle East, surrounded by the sea on three sides and 8 neighbor countries, Turkey is recognized as a regional hub for global business, both in terms of production and distribution.

Member of the OECD, NATO and the G20 and a candidate for EU since 1999, Turkey's proximity to European business ethics and participation in the global scene are major assets for investors. Additionally, Turkey has a Custom Union with the European Union since 1996 and several trade agreements with worldwide countries.

The workforce in Turkey is one of the youngest and largest in Europe. Education and training programs are following the ever-growing Turkish industry and recognized Universities are churning out highly qualified personnel who sustain innovation in the private and government sectors.

Finally, with a huge domestic market (approximately 80 million), doing business in Turkey enables investors/businesses to reach a fast growing regional market.

## Access to multiple markets at less than 5-hour flight distance



## REGIONAL PRODUCTION & DISTRIBUTION HUB



## ENERGY CORRIDOR

- 2 new LNG projects
- Turkish Stream with Russia
- Renewable energy incentives
- 3 nuclear plants

***Ernst & Young: "Turkey benefits from a unique strategic location; a young, dynamic and skilled workforce; and developed infrastructure and services. These factors provide investors with confidence in Turkey's business potential."***

## Country Profile

Area: 783,562 km<sup>2</sup>

Capital city: Ankara

Political system: Laic Democracy

Official Language: Turkish

Government: Unitary Constitutional Parliamentary Republic

Language: Turkish

Time zone: GMT +3

Population: 79.8 million

Median Age: 31

Density: 101 people/km<sup>2</sup>

Neighboring Countries: Bulgaria, Greece, Syria, Iraq, Azerbaijan, Armenia, Georgia

Major Cities (Population): Istanbul (14.3 million), Ankara (5.1 million), Izmir (4.1 million), Bursa (2.8 million), Antalya (2.2 million)



The Turkish economy has shown remarkable performance with its steady growth over the last decade, becoming the 17<sup>th</sup> largest economy in the world.

Turkey's performance since 2000 has been impressive and Turkey remains one of the most attractive investment destinations that recovered well from the global crisis of 2008/09 thanks to structural reforms. The economy registered average annual growths of 4% over 2002 to 2016 and 2,9% end of 2016.

Recently, slow growth in Europe and a deteriorating geopolitical environment in its neighborhood have negatively impacted exports, investment, and growth. The influx of 3 million Syrian refugees in 2015–16 created new social, economic, and political demands, particularly in urban centers.

The years 2015 and 2016 have brought series of challenges. Elections in June and November 2015, a cabinet reshuffle in May 2016, an attempted coup in July, and the consequent replacement of public officials have all affected the Government's reform momentum. At the same time, a series of terrorist attacks has weakened tourist arrivals and foreign investment. Private investments have been delayed, leading to slower economic growth.

However, the strong nationalist bound of Turkish citizens, the maximized efforts of business world and the accelerated reforms of the government to attract investors have paid and translated into a rather quick recovery of the market. The overall picture is positive even if there is slow down in 2016 compared to 2015. The real GDP decreased from USD 799 billion in 2015, to USD 717 billion in 2016 but the GDP per capita soared to USD 20,323 in 2016 from USD 19,917 in 2015. While the strongest GDP growth rate in Europe between 2005 and 2015 is 34% (Sweden), Turkey showed 80% spectacular growth. Despite the sudden degradation of Moody's notation in July and recent poor notation by Fitch, the Japan JCR maintained its notation as BBB- and Standards&Poor affirmed that Turkey is "stable".

The record FDI amount of 2015 couldn't be reached in 2016 but foreign investments kept coming in the past months. Right after the tempted coup, the Belgian Group La Lorraine opened its new plant in Turkey, Bombardier announced new technology transfers, PepsiCo announced a new plant, the group Shell recently announced new investments, and many multinational companies that have their hub in Turkey renewed their trust in the Turkish economy.

Despite the volatility of its market, the downward movement of the Turkish lira presented an opportunity for investors as well. Turkey has attracted many international funds in 2016. In December, The International



## Turkey's ICT market and global positioning offering development opportunities

Turkey's largely free-market economy is increasingly driven by its industry and service sectors. An ambitious privatization program has reduced the involvement of the State in strategic sectors such as banking, communication, and transport. In addition, an emerging cadre of middle-class entrepreneurs is adding dynamism to the economy and developing added-value innovation.

Even though Turkey lost one place in 2016 and ranked 70<sup>th</sup> among 175 countries regarding ICT Development Index (IDI), its ICT values are still higher than the global average and promising further development.

Source: OECD IDI 2016	Turkey	World	Europe
<b>IDI VALUE 2016</b>	<b>5.69</b>	<b>4.94</b>	<b>7.35</b>
Fixed telephone subscription per 100 inhabitants	14.99	14.34	37.50
Mobile cellular telephone subscriptions per 100 inhabitants	96.02	98.61	119.80
International internet bandwidth per Internet user (Bit/s)	59,034.36	61,030	165,322
Percentage of households with computer	55.58	45.63	79.80
Percentage of households with Internet access	69.54	49.03	79.80
<b>IDI ACCESS SUB-INDEX</b>	<b>6.20</b>	<b>5.58</b>	<b>7.81</b>
Percentage of individuals using the Internet	53.74	43.83	76.30
Fixed (wired)-broadband subscriptions per 100 inhabitants	12.39	11.21	29.20
Active mobile-broadband subscriptions per 100 inhabitants	50.94	44.17	72.80
<b>IDI USE SUB-INDEX</b>	<b>4.18</b>	<b>3.91</b>	<b>6.57</b>

The information and communication technologies (ICT) sector has become an essential part of the Turkish economy reaching TRY 83.1 billion in 2015 that is a growth of 18% compared with 2014. Currently, the telecommunication network covers 98% of the population. Turkey ranks 1<sup>st</sup> in Europe for mobile Internet usage and its data center market is one of the fastest growing in the EMEA region.

Many market leaders including Microsoft, Intel, Hewlett-Packard as well as others have already chosen Turkey as a regional hub. These companies chose Turkey as a hub not only because of geographical reasons, but also because of its demographic advantages.

The young Turkish population's motivation to work in the ICT sector will provide a quality workforce for investors. Indeed, the number of university students within the ICT field and the number of job offerings in this sector are increasing.

The Turkish government is focused on improving the ICT sector by 2023, with the goal of reaching an ICT sector size of USD 160 million and sector share of 8% of the GDP. Since the 1990s, 36 Technology Development Zones have been built and 14 more are under construction for a total of 2,209 companies. Turkey currently has 129 ICT related Research and Development centers and is still building more.

As an example, the FATIH project is the biggest public ICT project and was launched in 2012 with an investment of TRY 803 million, a sign of Turkey's dedication to ICT. Meaning "Movement of Increasing Opportunities and Improving Technology", the FATIH project brought the use of mobile technologies in schools and collection of data about students improvements in order to provide professional orientation.

Turkey is also growing within ICT sub-sectors. The software market reached TRY 9.7 billion and registered a 16.4% annual growth and the hardware market reached TRY 13 billion with 19.1% growth compared to 2014. The ICT services registered the most significant growth in 2015 with 25.1% reaching TRY 4.7 billion.



# Digitalization and Turkey

In order to understand digitalization we need to understand what digital means. Digital means made of digits, that is to say numbers. The digital technology, with its system of discontinuous data or events, creates a universal model to represent information with 0s and 1s. In this sense, digitization is a revolution that changed the form of information as we used to know in a material form.

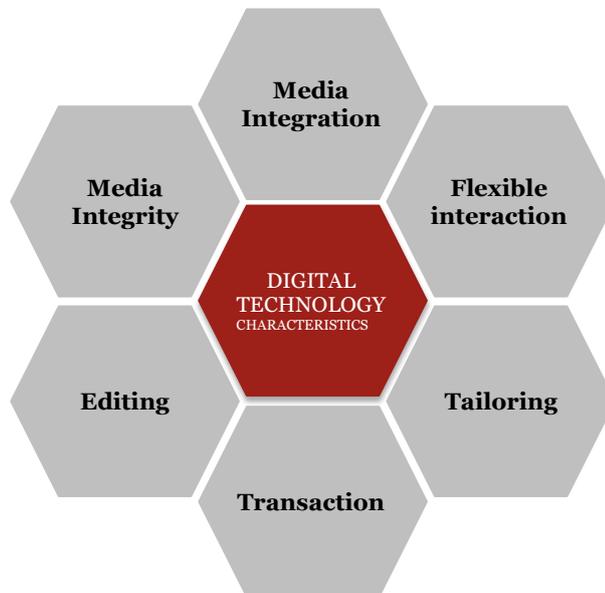
In the 70's, the process of converting an analog data into digits, made it possible to produce information that can be expressed in many different ways, on many different types of materials, and in many different systems. While digitized information is not limited to a specific set of materials, it mediates between the material and the immaterial.

6 characteristics are observed for digital technology. Thanks to digitization, data can be infinitely copied without being deteriorate, (media **integrity**) which gives us today the possibility to duplicate any media form from anywhere at the same quality. All media can be integrated from sound to image or text. This **integration** results in the multimedia concept. The digital domain **interacts flexibly** and can support a great variety of interactions such as one to one conferences, multiple channels broadcast and this can be at the same time in real time (online streaming for example). Software developed for digital communications are designed in a manner that users might **tailor** its use. **Transactions** are made possible with digital technologies, placing an order and paying has become very easy. Finally digital technologies allow the infinite **editing** where one can manipulate text, sounds and images very easily.

## From Digitization to Digitalization

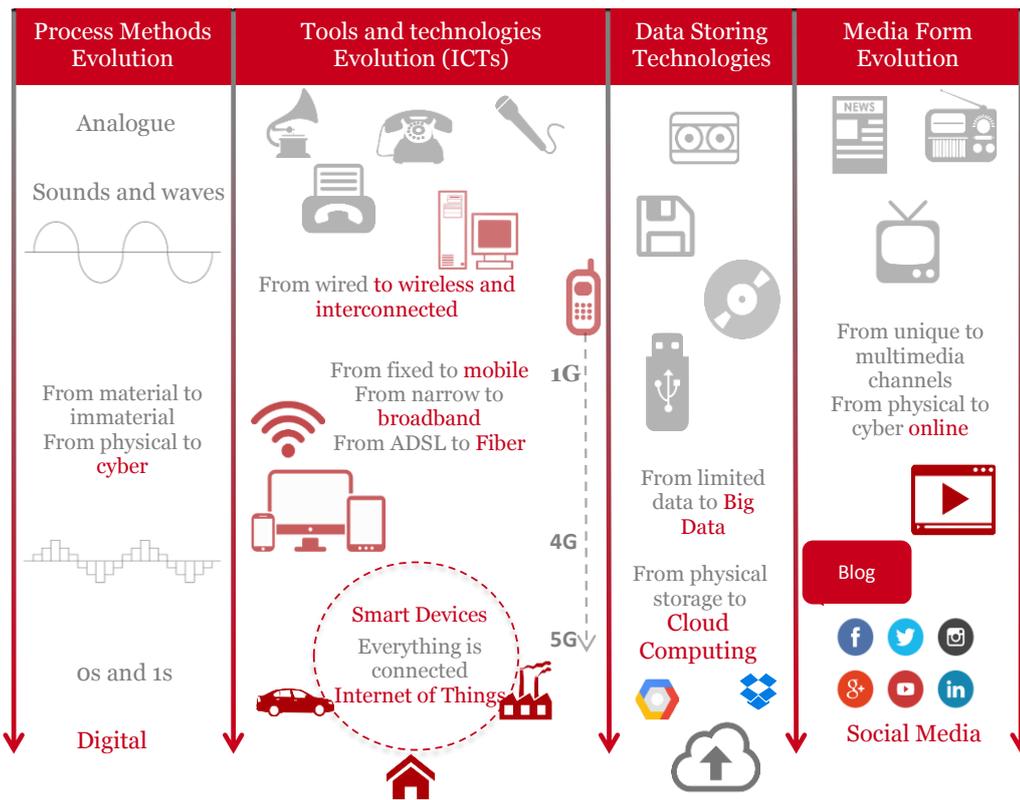
Digitization gains significance with the development of Information and Communication Technologies (ICTs) that is to say the tools that make it possible to collect, process and transmit data. The ICTs like computerized equipment, hardware, software, netwares... and recently mobile ICTs coupled with the democratization of Internet, which actually forms the backbone of nowadays global information network, digitization impacted on all media forms offering new possibilities of collecting, storing, processing and transmitting the information.

Therefore digital and ICT technologies can not be separated and they revolutionized both together the world of media and information. Thanks to these twin progresses, we can now access bigger amount of data in a shorter time and without geographical limits, from, to every part of the world.



If we look at the global picture from process method, tools, to the form of media we can see that Internet is undeniably the most important evolution within digital revolution.

*Evolution of technological advances from process methods to Media form*



This journey from analog to digital brings many new technologies and concepts into our world. Big Data, Cloud, IoT... There are particularly 4 digital technologies that step to the fore. The ACMS: Analytics, Cloud, Mobile and Social.



Greater volumes of information are available thanks to digital technologies (terabytes, petabytes, exabytes). **Analytics and Big Data** can collect and analyze huge amount of data in record time through specific software, platforms. Big Data is often characterized by 3Vs: the extreme **volume** of data, the wide **variety** of data types and the **velocity** at which the data must be processed. Analytics are a great tool for marketers who can precisely know the consumers and offer tailor-made services and products.



**Cloud Computing** as visible on the figure above is an immaterial storing place where one can access data and programs over the Internet instead of a computer's hard drive. Information is stocked on servers connected through Internet and accessible from every type of support (tablet, computer, phone...).



**Mobile technologies** are one of the most disruptive technologies from past years. No more specific place is required to be connected. Thanks to smart mobile devices using Internet it is now possible to work from home, stream online movies in the train or else... Coupled with the geolocalization function, mobile technology is an important tool for marketers.



**Social Media** is no secret anymore. Facebook, Twitter, Instagram, and Snapchat... all these supports allow creating and sharing contents. More than just sharing status or pictures, the critical role of social media has been observed during social revolutions such as the Arab Spring or the Ukrainian revolt. Moreover, social media is a heaven for marketers who can observe consumers and target them accordingly.

Another important and new concept that emerges from these digital technologies is the **Internet of Things**. As it is no longer mankind but in fact computers, machines, and increasingly “things” that collect, store, process and generate new information, thanks to a certain “intelligence” made possible with sensors, chips, sophisticated software, the concept of **Internet of Things often abbreviated as IoT** appeared. These smart machines make it possible not only to connect people to people thanks to **Mobile technologies** and **Social Media** but also machines to machines (M2M).

Considering that the digital technologies have penetrated our daily life and transformed the way we get informed (online news), the way we shop, we work, we interact with each other... we can understand now that this phenomenon is what we call digitalization.

The digital transformation was particularly triggered by the 4 ACMS technologies that we quoted previously. If technically, digitalization is the integration of digital technologies by digitizing everything that can be digitized, concretely digitalization is the use of all these innovative technologies to create values for people, governance and companies with the ultimate goal to facilitate our lives, make us smarter and progress.

***Digitalization means the use of digital, social, mobile and innovative technologies to create values for people, governance and companies...***

## From digitization to democratization

In order to fully understand digital transformation, it is important to quote the famous “Six Ds of Diamondis and Kotler” about Exponential Growth of digital technologies to summarize the steps of digital transformation. Indeed, if digitalization is now a common word of our language and spread so far, it means that it is accessible to many of us and that it is already democratized.

### The 6 Ds of Diamondis and Kotler

- |   |                          |  |
|---|--------------------------|--|
| 1 | <b>Digitization</b>      | During the first step of digital transformation, once something is digitized, it becomes an information-based technology and automatically enters exponential growth.  |
| 2 | <b>Deception</b>         | But in the early stages of this growth, it takes a while to get up to speed where growth patterns look deceptively linear. Exponential growth really takes off after it breaks the whole number barrier.   |
| 3 | <b>Disruption</b>        | The digital technology can be seen as hype. Then, often unexpectedly, the technology plays a role in disrupting established industries. Why buy CDs when you can stream online?  |
| 4 | <b>Demonetization</b>    | Slowly, the technology becomes cheaper and even free. Many technologies that were expensive in the 1990s now come for free. (I.e. download on Internet).   |
| 5 | <b>Dematerialization</b> | Several physical materials fit in one technology. People do not buy a camera, GPS device, and music player anymore because it is already available on their smartphone. Physical devices are dematerializing into digital applications.  |
| 6 | <b>Democratization</b>   | As a consequence, money is taken out of the equation as technologies become cheaper and cheaper. Existing business models evaporate as established revenue stream disappear. As technology becomes cheaper, access becomes available to anyone. Powerful technology is not only available for the wealthiest, but is democratized as large parts of the population gets their hands on it. |

The 6 Ds of Diamondis and Kotler shows that a digitized technology follows specific patterns to become finally accessible to the mass. It also shows us that beyond the benefits, digitalization implies challenges such as demonetization and disruption. It is not hard to understand that some people and especially small and medium size companies fear digitalization. For that reason, it is important to understand the advantages of digitalization and its challenges before entering this journey.

## Benefits of Digitalization

We already quoted some general benefits of digital technologies such as faster communication, the ability to access and process bigger amount of data from anywhere and all type of supports but concretely what are the benefits of adopting the digital transformation for all of us?



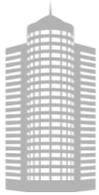
### For Citizens / Consumers

In the user point of view, digitalization is a huge time saving. Digital technologies make it possible to deal with many services at distance. Making an appointment with the doctor, choosing and ordering a gift for your friends, paying your invoices... all these are now possible through mobile phones and Internet. It is also money saving, no more postage cost or travel. Moreover, digital implicates citizens and consumers providing more feedback and transparency.



### Government

Because digital is faster, more convenient and mobile, it is becoming the preferred channel for citizens to access government services. Implementing digital in the payments, applications and registrations, complaints and resolution process is a must for governance authorities in the digital era. It is also an important time and cost saving for governance, allowing better efficiency, better storage of information. Digital also is very important to identify, track and avoid security issues for fraudulent payments, all other possible threats can be anticipated.



### Business and companies

It goes without saying that digitalization will save on paper. Thanks to automation systems that are more and more autonomous and the Internet of Things, companies can also save on employee cost. Less people but also less human mistake can be an advantage in adopting digitalization for business. Faster data and faster communication means also more time for value added ideas and activity and should result in an increase of productivity.

As there are no more geographical limits to influence, companies can also save time and money on travel. Thanks to developments in online business and sophisticated analytical tools, companies have more and more detailed information about their customers. Instead of marketing a general target, companies can provide hyper-personalized marketing, based on individual shopping patterns just by observing them online. Companies can even save on offices and focus simply on online sale.

## “Save Money Generate Money”

Beyond all that, not only do digital technologies save money, but also generate money. According to Google, using digital marketing tools can generate a turnover that is 2.8 times more important. Thanks to digitalization, companies can gain a lot of benefits from the production and processing of information, to decision-making processes and access to new markets. These advantages play a critical role in improving company performance and achieving company goals, and most importantly in increasing competitive power. Accenture also analyzed the financial benefits of adopting digitalization. The regression analysis on the correlation between digitalization Index and EBIT (Earnings before interest and tax) showed that for a 10 point increase in digital index, the margin can increase of an average 1.5%.

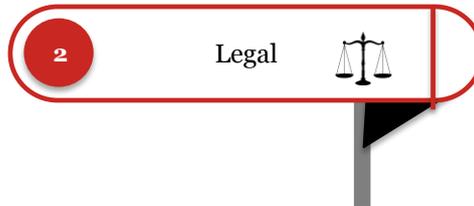
The companies that get ahead and embrace the digital transformation will uncover limitless possibilities to drive innovation, growth and jobs of the future.

## Challenges of Digitalization



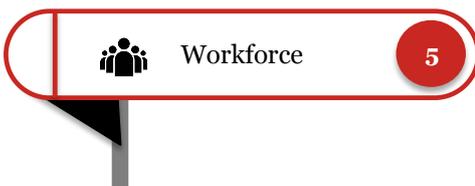
1 - Benefits always come with challenges. Adopting digital technologies in the first place needs investment before reaping the fruits. It's all the more important as this transformation can be fully disruptive and it is already predicted that many of the now 500 fortunes listed companies won't be on the list in 2025 if they do not adapt to digitalization. To keep up with new technologies, governments will have to invest in infrastructure and especially in fiber optic. As we know, technology isn't cheap, at least not at the beginning. It takes a time before innovative technologies become accessible to the mass, so it is important to calculate the return on investment and look at the global picture before entering in the digitalization path.

2 - With the online business development, the increasing number of online companies, new regulatory requirements demand action. Governments are racing to catch up with the speed at which the digital world is moving, leading to new and emerging laws on tax, privacy, data handling and more, with steep fines for failure to comply.



3 - Another issue born with the use of Internet is the security challenge. As we all know, Internet is an ocean of information about everything and considering that we all use it for transactions, to store our most personal data, it is vital to worry about security. Consumers are becoming increasingly aware that when they bring companies their business, they must also hand over their data. Firms that show themselves as untrustworthy data custodians will face a major loss of brand equity. Cyber crimes can be observed every day from simple movie download to bank accounts hacking. Improving cyber security is an important point for consumers, but also for companies and even more for governments in terms of internal security.

4 - Social media can be a heaven but also a nightmare for companies, as few bad comments from consumers can spread at the speed of lightning and damage their image. It's also the case for governments that are trying to control social media during contests or critical times. As it was observed in Turkey, the government first blocked or slowed down the use of Facebook and Twitter during terror attacks.



5 - As digital requires new competencies, another challenge that occurs during the transformation is to find the right educated people to deal with it. In that sense, the Z generation or C for connected have easier access to digital jobs. Companies that adopt digital technologies need the persons that understand these technologies. From social media management to IT departments, the digital transformation requires a change in the skills of employees.

## Digitalization in Turkey

The phenomenon of digitalization meaning the penetration of digital technologies in our lives is global. Indeed, Internet is connecting everyone from everywhere. However the level of penetration of digital technologies or else said the maturity of each country toward digital technologies isn't equal.

Turkey is one of the fastest growing markets when it comes to ICT and digital. Impressively, the country absorbs new technologies at a record speed.

To understand the level of digitalization of Turkey, it is important to look at several levels from consumers to governance, companies and industries.

First of all, Turkey has lately made important investments in information and communication infrastructure in order to facilitate the journey of digitalization. The move toward 4.5G, the improvement of fiber infrastructure, the increase of Internet speed have benefitted to the Turkish ICT market.

As a result of these recent developments in parallel with the government's policy that encourages investments in high technologies and innovation, ICT market registered an 18% growth and accounted for TRY 83.1 billion in 2015.

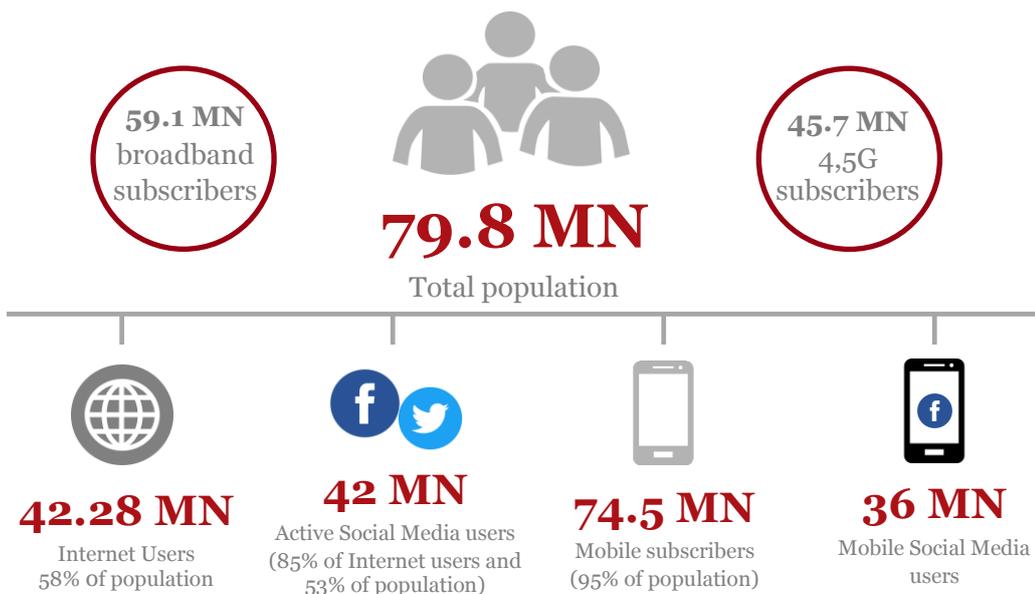
While the communication market stood for TRY 55.7 billion, the information technologies accounted for TRY 27.4 billion. The ICT market in Turkey represents now 2.9% of the country's GDP and employs around 113,000 people. Looking closer, the mobile communication market stands alone for TRY 38 billion.

The data center market registered spectacular growths as well of 60% in 2011 and 30% in 2012 reaching 29 public data centers nowadays. Following this, in 2013, USD 45 billion of investments were made in cloud computing.

## Digital Consumers of Turkey

Consumers are the main actors of the digital transformation. Indeed, their needs, their behavior are what matters to economic actors, especially companies that need to understand the consumers' change in order to readapt their strategies. Considering that consumption accounts for 70% of Turkey's GDP, the approach of consumers toward digital technologies is all the more vital to observe.

*Digital Picture of Turkey (Source: We are Social 2016)*



The phenomenon of digitalization in Turkey as in many countries is pulled by new consumers, in particular the “Generation C” (C for “connected”).

Surrounded by computers, smart devices, the Internet, mobile phones, instant messaging, social media, a new generation of connected consumers is born. All these electronic supports and new technologies have transformed the way people move, consume, work and simply live. The new consumers naturally expect to be always connected, to reach everything from everywhere in record time.

The fact that 59% of the Turkish population is aged under 35, plays an important role in the rapid development of digital technologies. Turkish consumers, and particularly Generation C, are already fully adapted to the digital environment. They are willing to share personal data, and are more likely to trust referrals from their closest friends than well-known brands.

Every year, We are Social is studying the level of Digitalization in different countries. Compared with 2015 data, the active Internet users number in Turkey has registered a 10% growth and the active social media users a 13% growth.

In Turkey, digitalization is still yet very related to mobile devices. In 2015 with an estimated value of approximately TRY 36 billion, the mobile economy contributed to 4.8% of total GDP. Based on these economic values created, mobile economy generated 584,000 jobs in 2015, 2.2% of total employment in Turkey. The improvement of infrastructure (fiber length reached 284,000 km), the higher speed of data transmission (6,5 Mbps, 4.5G) and the fact that mobile data costs to users are lower than other country levels, explain the high penetration rate of mobile technologies in Turkey (95%).

Some of the main characteristics describing digital consumers in Turkey can be summarized as below:

Firstly, Turks are addicted to their **smartphones** according to many surveys. Turkish consumers currently ascribe on average TRY 2,500 of benefits a year to owning a mobile phone. This is well above the TRY 600 they currently spend on devices and their operation each year. 94% of 13 million sold mobile phones in 2015 were smart phones.



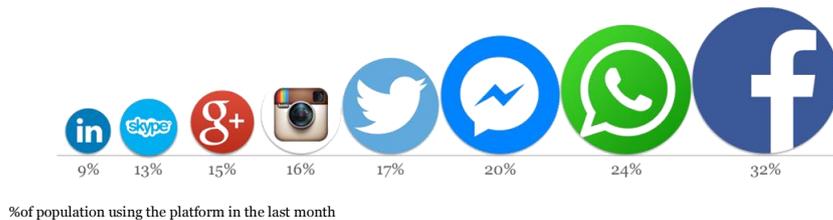
46% of Internet connections are made through smartphones VS 39% world average and Turks spent an average of 4.5 hours on Internet per day of which 2 hours and 35 minutes on mobile phone. They check at least 70 times their smartphone each day and 1 out of 4 person checks its mobile phone once awake.

A consumer survey shows that 2 to 3 out of 5 device owners would give up dining out (39%), watching their favorite TV show (50% of females) or watching their favorite football club matches (48% of males) for 3 months in order to retain access to their connected mobile devices. 4% have indicated they would even give up seeing their friends or family in person for video streaming.



Related to mobile addiction, **Social media and messaging** has become viral in Turkey. Whatsapp, Facebook Messenger, Snapchat, WeChat... 43% of the population is using messaging applications. Turks spent an average 2 hours and 32 minutes on social media.

Use of social media in Turkey (%of active user\*) (Source: We are Social 2016)



**Turkey's global rank in Whatsapp and Instagram use**  
4<sup>th</sup> top country 5<sup>th</sup> top country



**Online payment** is another characteristic of the Turkish consumer using digital technologies. The amount that consumers spent through phone orders and online shopping via credit cards increased by 23% in the first nine months of 2016, compared to the same period of 2015 and reached TRY 83 billion (USD 28 billion).

In contrast, the amount of phone orders and payments, along with online shopping via credit cards, totaled USD 92 billion in 2015, with a 324.3 million total number of transactions. 50% of mobile payments are made through smartphones, ranking Turkey the 4<sup>th</sup> country worldwide in mobile payments.

Related to consumers hunger for digital technologies, 2016 was characterized with new digital technologies that accelerated the penetration of latest innovative advances.



Even though Pokémon GO is not yet officially playable in Turkey, the game met a huge success and millions of people found a way to crack it. This shows that **mapping and augmented reality technologies** can reach new heights.

**360-degree camera and virtual/augmented reality** goes now far beyond 3D glasses with more sophisticated tools that allow users to visualize non-existing objects thanks to applications on their mobile phones.



In 2016, **IoT (Internet of Things)** has gone from a hype term to being a part of our everyday business operations. Sensors have become commonplace and are involved in almost everything. Everyone, particularly retail firms in Turkey, has developed applications that can track their customers' behaviors. Mobile applications have caused shopping lovers to stick at their smartphones to watch for discounts and opportunities. The world is not either digital or physical; it's now "digical".



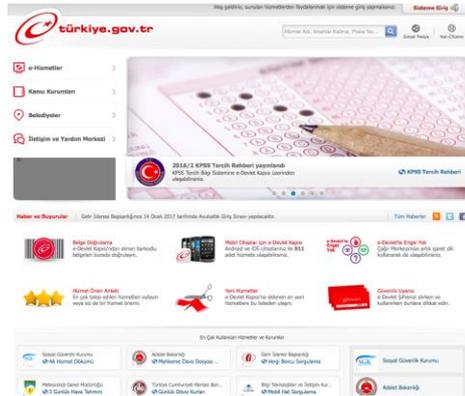
**Virtual assistant:** Another example of "digical" was the apparition of virtual assistants on online services. Banks, public administration started using the virtual assistance that allows instant messaging between the user and the service provider. The virtual assistant can assist you through simple written exchange or with webcam.

### Digitalization of administration

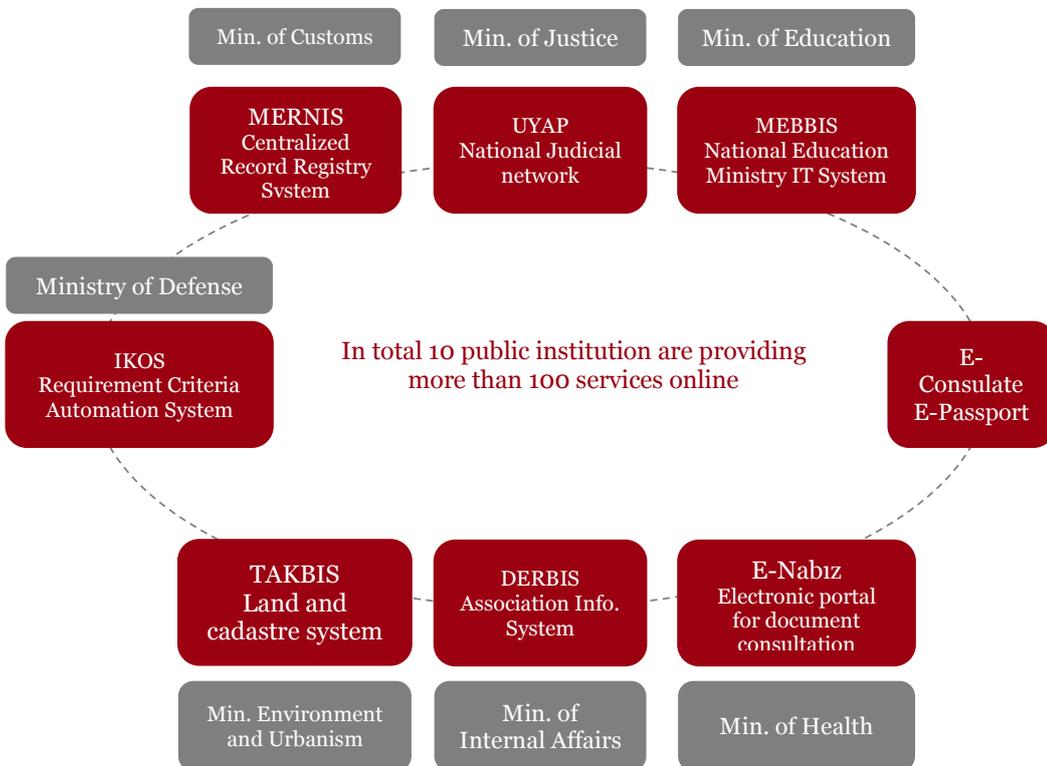
In 2007, Turkish public sector started the digital transformation by setting up an electronic information management system (EBYS). The first and truly use of big data and artificial intelligence approach in public administration was set. Almost every Ministry in Turkey has now a digitalized information system where users can connect and reach needed information.

Centralized around one platform called E-government, it is now possible to be informed about your taxes, your social contribution, obtain an official paper such as a death or birth certificate, schedule an appointment for visa...

Most important, every citizen can communicate directly with the Prime Ministry Offices through the BIMER communication platform or access each municipality website and deal with local issues.



Turkish Public Information Sharing System



## Digitalization of business

The digitalization of business has started earlier than the digitalization of administration in Turkey, late in the 90's with first the appearance of online shopping platforms. Extended to online transactions and increasing international trade, it became vital for Turkey to set the legal framework for digitalization.

Beginning of the 2000 was characterized by huge reforms in the commercial code. Indeed, digital technologies and supports were recognized legally as equal to traditional documents.

### Legal framework for digitalization of companies Evolution of the Turkish Commerce Code



In January 2004, **E-signature** has got the same legally binding power as handwritten signature according to the Turkish Code of Obligations and the Civil procedure Law. The electronic signature can only be issued using an electronic certificate by using the public key infrastructure and published by an authorized certificate service provider and at least an EAL4+ security level encryption device. In Turkey, e-signature is widely used in public services: Patent Institute, Public procurement Agency, E-government applications, banks...



The Turkish Commercial Code (TCC) introduced the **Registered e-mail (KEP) system** in 2006. It entered in force in 2014. For legal transactions where parties have to be notified, **e-mail and e-notification** can be legally used. Warnings and notifications from a registered email address can be sent for example to cancel a contract, for objections, bills, confirmation letters, letters of application...with a very large scope. The notification Law of 2011 was modified adding the possibility about e-notification. Then in 2013 the Regulation on Electronic Notification was issued. Coupled with e-signature and registered e-mail system, that allowed a functional e-notification system in Turkey, a secure e-notification has been made possible for public institutions using these 3 E-Systems



**Online Meetings:** The new TCC allows limited and joint stock companies to hold their general assembly, board of directors and board of managers electronically. Attending meetings, submitting motions, voting online have the same legal consequences as when done physically.



**Websites:** The new TCC emphasizes the principle of public disclosure and transparency. According to these principles companies have to establish a **website** and publish information according to the TCC. The obligation to maintain a website is regulated by the Regulation of Websites of Companies. It is mandatory only for companies that are specified by the Council of Ministers as subject to independent audit. Some information as the Central Registration System Number, commercial title, center, capital and names of managers shall be present on the websites but financial tables and statements aren't compulsory.

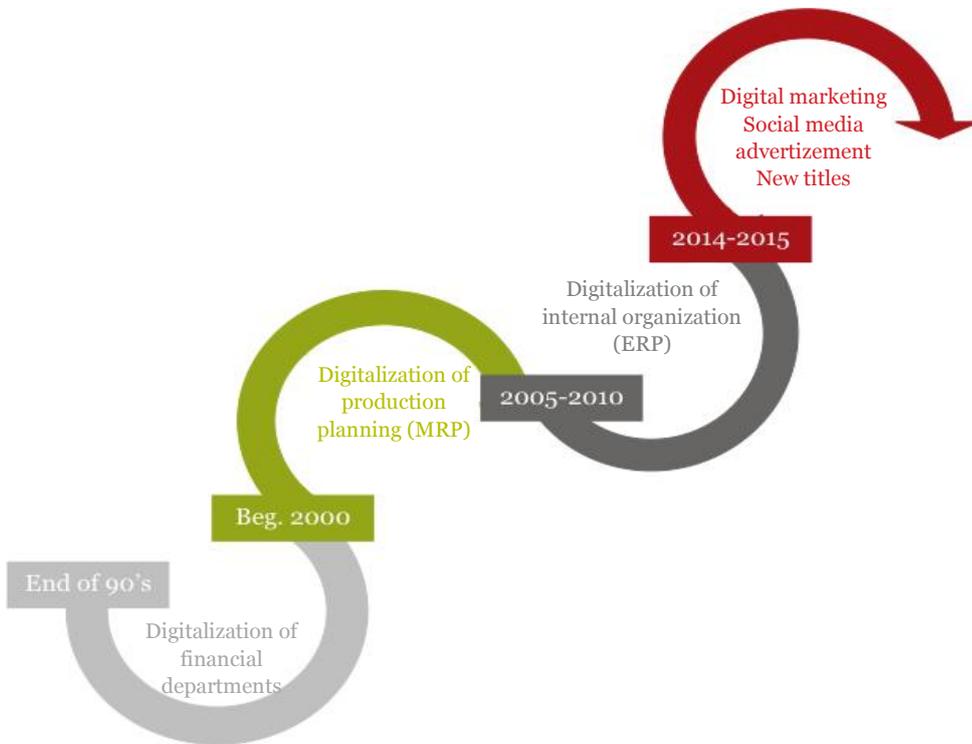


**Digital records:** In the same way, there have been modifications in the commercial and tax legislation regarding electronic documents, records, bills and commercial books. All merchants have to keep commercial books in accordance with the provisions of the TCC. They can keep their books either physically or electronically. Specific type of companies are required to keep electronic books and use electronic bills such as companies having mineral oil license or importing and selling specific type of goods... Electronic bills have the same effect as paper bills. Companies obliged to KEP electronic books have to use electronic bills. Beneficiaries can access a website designated for e-bills and activate their certificate of financial seal. A list of e-bills users is published on the website. Taxpayers including companies are obliged to make statements to tax offices as part of their tax obligation. Those obligations can be carried out online by taxpayers themselves or through authorized institutions such as independent accountants and financial advisors and sworn financial advisors. Each taxpayer is given a user code and password to enter the system. Once statement is submitted the program does a calculation of data and requires approval of the taxpayer or intermediary institution.

Thanks to the legal acknowledgment of using digital technologies in business, Turkey has set an important context for the companies so that they can fully adopt digitalization.

The journey of Turkish companies toward digitalization can be summarized in 4 major waves. Companies started first digitalizing their financial departments end of the 90's and nowadays IT departments are mainly linked to finance departments. Secondly manufacturing companies started digitalizing their production planning with the use of MRP (Manufacturing Resource Planning). In the mid 2000's the democratization of ERP (Enterprise Resources Planning) improved companies internal organization. Finally the 4<sup>th</sup> wave that occurred in 2015-2016 spread e-work to vertical and horizontal organization, and the use of digital technologies increased to communicate with consumers, suppliers, partners etc. Few companies also started dedicating specific departments for digital marketing or social media communication opening the door for new skilled employment.

*Waves of digitalization for companies in Turkey (Source: Capital Survey)*



Actually, if one searches about digitalization on the Internet, he or she will mainly find results about the digitalization of companies. Why is it an important focus? Well, economics decides what resources are made available, how they are produced and who gets them. Business exists because the functioning of a robust economy is essential to the goal of allocating resources properly. Businesses are often key players in preventing economies from becoming stagnant or crashed. So companies play an important role in the development of a country and in the creation of value for the economy. It's important for this reason to understand how the companies really integrate digitalization in their strategy, how mature they are for the next steps of digitalization and its challenges.

***Thomas Groot, digital Director at the AA: “Digital is at the heart of businesses and in my view it’s a reflection of the fact that customer behavior is changing. The digital age has accelerated that change and therefore businesses need to be fast at changing themselves to meet that customer behavior”***

### Level of digitalization of Turkish companies

To understand the maturity of Turkish companies toward digitalization, many different surveys were conducted on companies' approach to digital technologies, their rate of digitalization and readiness. In order to evaluate the digitalization of companies, it is important to look at the full activity around 3 major axes:

- 1- The business model: Is there a digital strategy?
- 2- Customer experience: Is the company offering digital services?
- 3- Internal organization and competences: Are the operations digital?

In 2013, a survey made by DELL EMC with global companies showed for example that the top business priorities for Turkish companies by adopting ICTs and digital technologies was to make process more efficient, followed by data management and innovation. More than 80% of interrogated companies seemed aware of concepts such as big data, cloud and acknowledged the importance of using these technologies but for a main reason that is to improve their organization.

In 2014, Vodafone Turkey and TÜSİAD (Association of Turkish Industrials and Entrepreneurs) started an online survey called "I am ready for Tomorrow" in order to evaluate the digital score of companies. From their size to their activity, companies answered to different questions.

As a result in 2014, Vodafone declared that 53% of Turkish companies were digitalized.

More recently, in 2015, Accenture with the support of Vodafone and Turkish Information and Technology Foundation (TBV), realized a detailed survey with 104 Turkish companies from 17 different sectors in order to evaluate the digital index of Turkish companies regarding the 3 main dimensions: digital strategy, digital services and digital operations, based on a total of 91 criteria. The survey showed that the priorities in 2015 are quiet similar to 2013.

Turkish companies have better score in Operational Competences (63%) than in digital services (54%), meaning that they focus more on internal organization and process than services to customers (which is overall the same with 20 other countries) because digitalization is still more **a mean to increase productivity and decrease cost for deciders than finding new customers or new sources of growth.**

As a result of the study, the digitalization Index of companies was set to 60% in 2015.

The digital Index studies are now set every year and the goal for 2016 is to achieve a 75% digitalization score.

Another research "Strategy, not Technology, drives Digital Transformation" made by Deloitte and GfK with Turkish CEO's of 55 companies from September 2015 to January 2016, showed the different factors that are impacting on companies digitalization process, why it is important for them and their level of maturity regarding digital transformation.

### Turkey scores 60% in digitalization index and aims at 75% in 2016

Top Business priorities in ICT adoption



Major findings show that companies understand the need of digitalization and have already implemented digital technologies in their processes but their approach remains siloed.

- Digitalization in Turkey isn't yet approached as a whole picture, generally "siloed" at different operations level
- The results of digitalization expected vary upon sectors, as the customers' expectations are different. For B2C companies the results are directly linked to final customer.
- In Telecom and Finances digitalization is more a priority and stands for an important part of investments.
- Whatever the sector, digitalization is an important issue for high level managers and this shows that an important change is ongoing.

As a result of these researches, Turkey is on the right way and is registering important improvements year by year. Still digitalization remains siloed and not yet approached as a whole strategy by companies. Also, depending on their size and sector, digitalization level can vary. If we consider that 95% of companies are SMEs, it is still very promising to reach average scores of 60%.



**There is a correlation between the digital maturity and digital strategy of companies.**

*Turkish companies understand the need to have a digital strategy and they evaluate their maturity regarding the strategy they have. The more the strategy is clear and comprehensible, the more mature is the company in its process.*



**Turkish companies are still at the very beginning as they are not yet encouraging or seeing digitalization as a source of innovation and new revenues but focus on internal aspects**

*Companies adopt digitalization for productivity increase and to respond quicker to customers.*



**Major external factors taken into consideration during digitalization are macroeconomics, qualified taskforce and regulation issues**



**Digitalization is seen as creating value mainly in operational efficiency, and data analytics**



**The head of companies are encouraging the digital change and the process is 90% lead by high-level managers (CEO or CMOs).**

*New departments and titles have appeared such as Digital Communication and Marketing Specialist, Chief Digital Officer (CDO), Data base Manager... In almost 40% of the companies, there is a technology unit undertaking the digital process. 20% are planning to have such a unit. 70% of companies have already a person that corresponds to a CDO.*

### Initiatives for SMEs

The pillar institution of innovation and R&D in Turkey (TÜBİTAK) emphasized the importance of adopting digital transformation for SMEs in order to be more competitive and export value added products. Accordingly, 5 NGOs and the Association of Electronic Device Manufacturers (ECID) drew a road map in 2015. TBV, TÜBİSAD, TBD, TESİD and ECID created the Turkish Digital Platform that is also supported by Türk Telekom leading the participation of Turkey and Turkish companies in many programs.

- **Going Local Project:** European Digital Agenda Compliance Project
- **INTOUCH-ICT:** New non-routine skills via mobile game-based learning funded by Leonardo Da Vinci program. Among 4 different countries, Turkey was also chosen for a learning lab.
- **PaaSport project of EU:** A Semantically Enhanced Marketplace of Interoperable Platform as a Service Offerings for the Deployment and Migration of Business Applications of SMEs, to help the common use of PaaS solutions in cloud IT for SME's (in 12 countries).

Field Code Changed

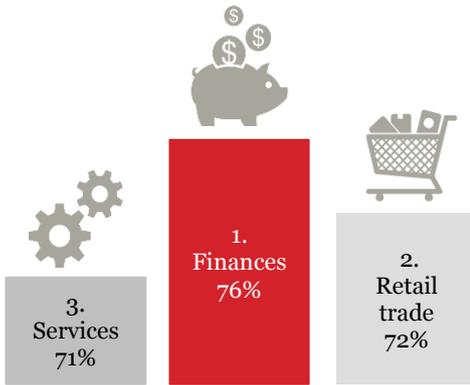
### Leaders of digitalization

The companies who implement digital technologies in all their activity and think digital succeed better and become the leaders of digital transformation.

The survey made by Accenture in 2015 puts forward the most digitalized sectors and companies in Turkey according to the 3 main dimensions: digital strategy, digital services and digital operation.

Based on different criteria, the most digitalized sectors are financial services, retail trade, general services and automotive scoring more than 70%. Finances alone are leading with 76%.

Leader sectors in digitalization



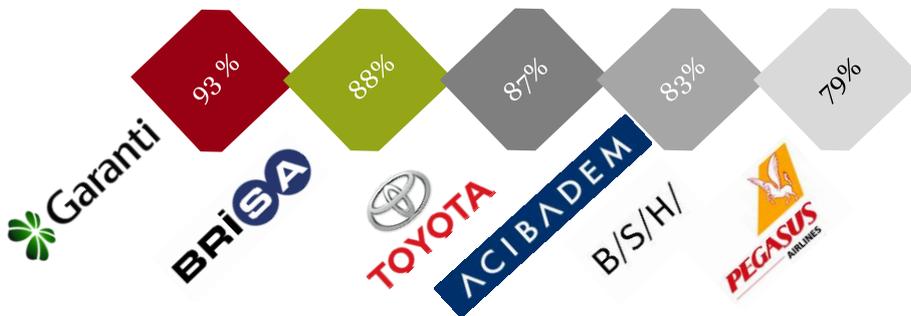
Digitalization score per sector

≥70%	Financial Services Retail trade Services Automotive
60-70%	Other manufacturing Transport and Storage Wholesale trade Insurance
50-60%	Wholesale of ICT equipment Food manufacturing Electronic and optic manufacturing
<50%	Non-metallic mineral products manuf. Metal industry Construction Chemicals manufacturing

For MasterCard, Turkish banking sector is in fact a pioneer in digitalization and was the first to adopt innovations such as EMV Chip technology, NFC (Near Field Communication), contactless smart card, company based loyalty programs...

In the same sector, all companies doesn't score the same, sometimes competitor or not. The leader of digitalization in Turkey is the Garanti Bank for consecutive years, followed by two companies active in automotive industry. These leaders have all in common a digitalization road map in line with the corporate strategy and they all set performance objectives to their employees. They score an average of 70% in digital services and in operational competences.

Leader Turkish companies in digital scoring



Telecommunications, Banking, Insurance and Retail Trade are leading sectors in terms of investment in digitalization. The 4 sectors all together stand for 55% of investments in digitalization VS 16% of average rate for all other sectors.

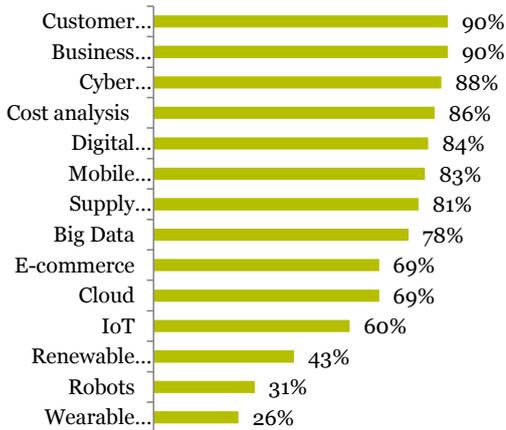
All levels of maturity considered, the most invested fields in 2015 were Business Analytics, Customer experience and Cyber Security.

Less invested fields are Renewable energy, Robots and Wearable technologies. Considering the investment plans for 2016-2018 period, these 3 fields are still non-prioritized.

While digital beginners mainly invest in Customer experience, Supply chain management and Cyber security (12% each field), developing and digitally mature companies have almost equally divided their investments (7-8-9%) except for Robots and Wearable technologies that are the less invested fields for all companies.

Overall, Turkish companies have an operational approach but are investing in all fields of digital technologies. The coming years will be even more important for new digital technologies as the planned investments show it.

*Repartition of digital investments in 2015 in % of companies by field*



*Repartition of digital investments planned for 2016-2018 in % of companies*



(Source: Deloitte)

Globally, Turkish sectors and companies are in the process of digitalization. The transformation has started for directly concerned sectors as banking, telecommunications, and retail services...

Even if the approach remains siloed, it is believed that Turkish companies will rapidly catch up the speed. Anyway they will have to. Not only because they have to follow and keep up the consumers' trends, but if they want to remain competitive and not disappear, they have to invest in this journey and think digital.

Successful digitalization for a company means digitalization of its activity but not only sales channels or communication but its "whole" activity. Because adapting is far beyond just creating a new website or creating an e-commerce platform but implies that destructive technologies are embedded in the company's DNA. As digital permeates every part of a business, it cannot be siloed. From manufacturing methods to customer expectations and distribution channels, digitalization forces a company to change almost everything in its business processes, requires companies rethinking their strategies, operations and human resources.

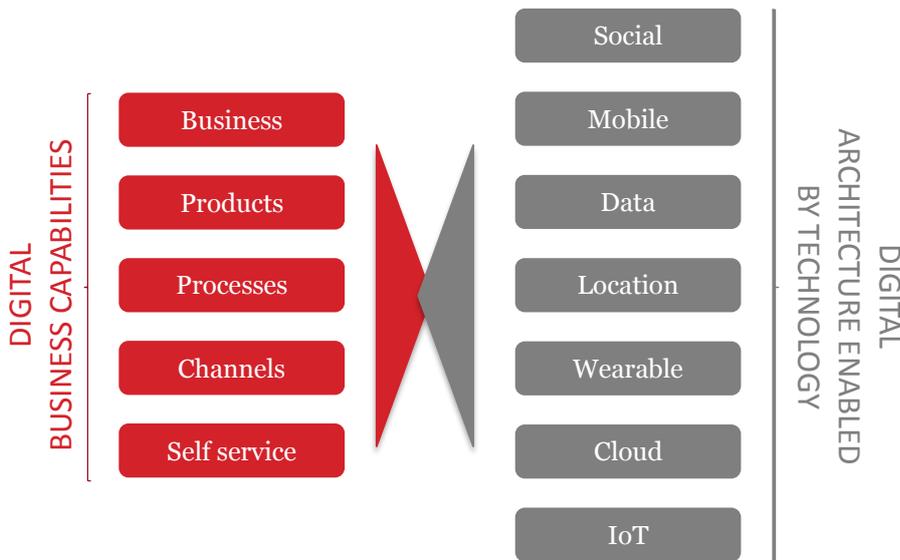
In order to reach more consumers, companies need to manage a bigger amount of data and to stay in the spotlight and beat the competitors; they need to have adequate equipment, adequate strategy and qualified people able to use these new digital technologies, so companies have to invest in this journey.

We live now in an Idea Economy where success is defined by the ability to turn ideas into value faster than your competition.

***“Winners in the digital age do much more than tick o a checklist of technology capabilities. The ability to understand changing customer needs and behaviors is, of course, vital but companies should also evolve their corporate culture to not only take advantage of emerging technologies, but also, critically, embrace the new business strategies that those technologies drive” Accenture***

**“A digital business uses technology to innovate, capture, create new sources of growth and value”**

*Digital Model for companies*



For manufacturing companies, it is even more strategic and critical that they get digital. The digitalization of the manufacturing industry has led to an industrial revolution itself that is called the Industry 4.0. The next part will focus on Industry 4.0 and try to define where is Turkey.



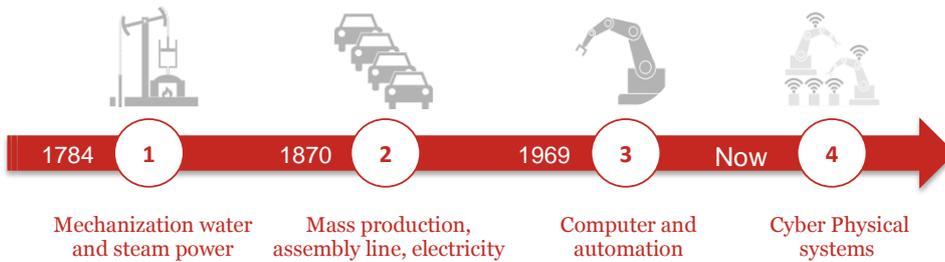
# Industry 4.0: Where is Turkey?

## Digitalization of Industry: the 4<sup>th</sup> revolution

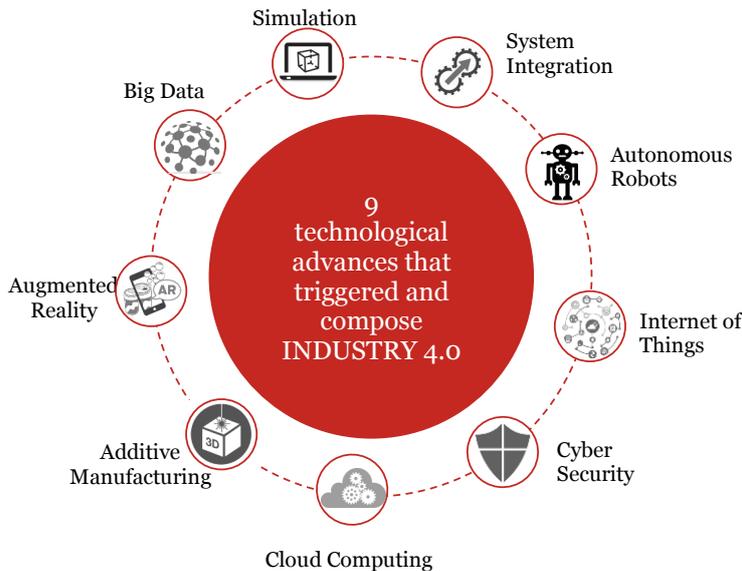
As an effect of digital technologies invading all domain of life especially business activities, the manufacturing industry is obviously concerned and even more profoundly. Under the influence of ICT and digital advances, the industry is going through a 4<sup>th</sup> revolution called Industry 4.0.

Indeed, since the late 18<sup>th</sup> century, industry has seen three main waves: steam-powered machines, the introduction of electricity in production and increasingly widespread robot automation movement after 1970's.

Industrial revolutions timeline



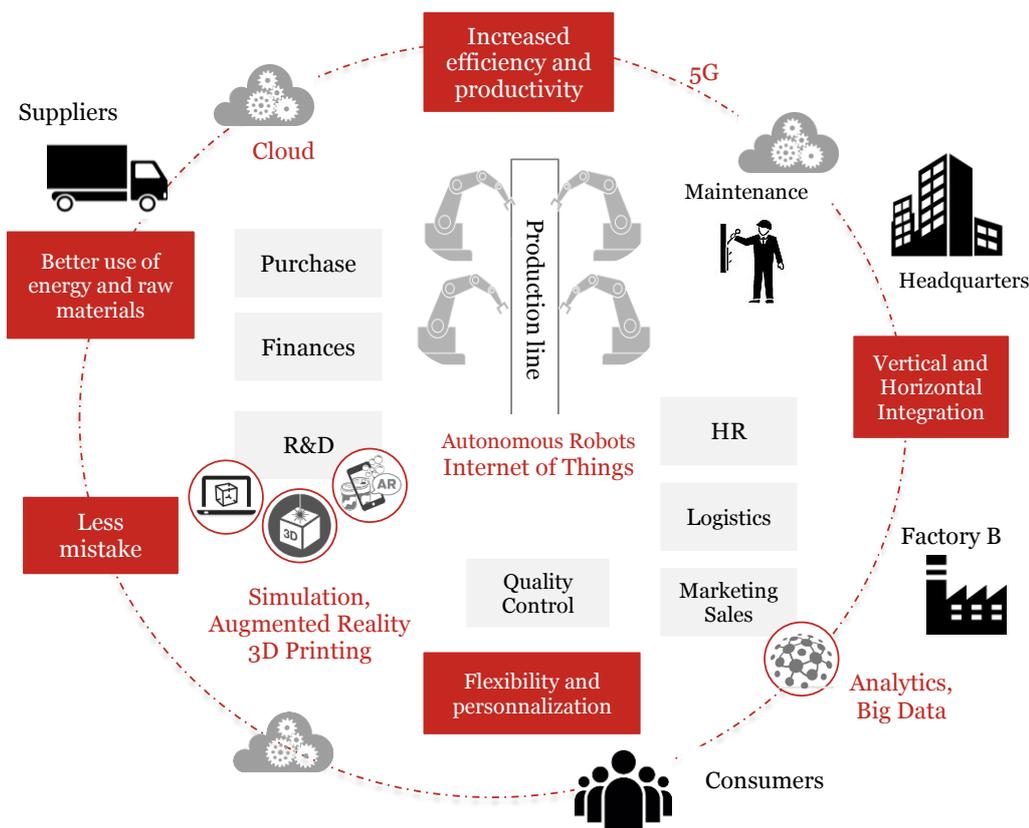
Today, we are going through another revolution triggered by digital combined with hardware technologies, especially 9 that have played a critical role. Apart from the major technologies brought by digital transformation such as Big data, Iot, Cloud... there are here new concepts such as Simulation, Augmented reality, Additive manufacturing (3D printing) and Autonomous Robots that are specific to manufacturing industry.



The spread of digital technologies and the democratization of advanced solutions such as autonomous robots or even 3D printing that can create a prototype from a design on computer have changed the landscape of manufacturing industry, enabling the rise of “smart” factories. These smart factories are flexible production facilities with the potential to fulfill custom, single-unit orders at a unit cost comparable to mass production, with an integration of not only the plants and equipment themselves but also the materials they process and parts they produce. All the digital elements combined, it is possible to reduce mistakes before production – using simulation, 3D, AR and during production by using IoT, Cloud to collect real-time information (using integrated sensors, for example), process this information, and share it back and forth continuously. This empowers such systems and their corresponding processes to run themselves. The result: increased productivity and plants where people merely monitors and intervenes when necessary.

In that sense, the 4<sup>th</sup> industrial revolution implies “integrated production”: the real and virtual worlds are converging, and IT is becoming an inseparable element of traditional industrial systems. When they come together in a single network such as the Internet, automated and autonomous processes emerge.

*Illustration of a smart factory using digital technologies*



***The 4<sup>th</sup> industrial revolution focuses on the business related developments, changes in business models, and impacts on the entire industrial sector as a result of digitization and the Internet of Things.***

The word “Industry 4.0” was put forward by Germany in 2011 at the first place and the name was officially given in 2013. Indeed, Germany played an important role in the process of Industry 4.0, as it is the first country that adopted advanced technologies in manufacturing and opened the gate to other industrialized countries looking to regain their competitiveness. According to a detailed study conducted by BCG in 2015, widespread application of Industry 4.0 in Germany will have a significant economic impact in the next 15 years. It is estimated to achieve a cost saving up to EUR 90 to 150 billion equivalent to 15-25% of the conversion costs associated with production. Acatech, the National Academy of Science and Engineering in Germany, estimates that Industry 4.0 will help businesses boost productivity by around 30%.

But Industry 4.0 goes far beyond increased productivity and automation, it is a journey just like digitalization, that creates its own higher value-added economy, fundamentally changes the established value chain by integrating all links, and, most importantly, creates an increased demand for skilled labor. Its effects are expected to be disruptive and long-term, and many believe those developments to bear the potential to completely transform existing value chains into entirely new ways of doing business.

To catch up with developed countries such as Germany, US, Finland and UK that have already started their journey, emerging economies like Turkey have to observe and learn quickly to get on track if they want to remain competitive and become high value added products suppliers.

## Turkey's industrial level of maturity

Industry stands for almost 30% of Turkey's GDP and the country has set important goals to increase local production in many different sectors. As the concerns rise about catching Industry 4.0, some organizations and research companies started the assessment work of Turkey's readiness and level of maturity toward Industry 4.0. Indeed, it is important for Turkey to dress up the actual picture and act accordingly.

### General Picture

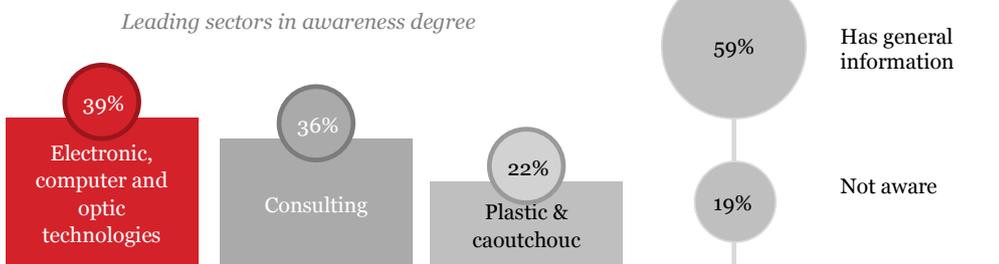
The recent (2016) TÜBİTAK's study made with 1,000 companies that applied for R&D support showed that the maturity in Turkey is more **between Industry 2.0 and 3.0**. The lack of investment in R&D in Turkey is one of the reasons why Turkey is still late on Industry 4.0.

As a result of the study, it was observed that the industrial maturity level is higher in material, computers, electronic and optic industry, automotive and white appliances.

This was evaluated based on the awareness degree of the interrogated companies and their investment plans.

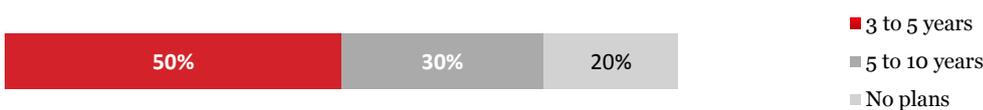
22% of the interrogated companies declared being fully informed and aware of Industry 4.0. 59% of them have general information about it whereas 19% are not aware at all.

Sectors like electronics, software and consumables are generally the most conscious about Industry 4.0. Within computer, electronic and optic technologies the awareness rate is around 39%, for consulting companies it is around 36% while it decreases to 22% in plastic and rubber industry.



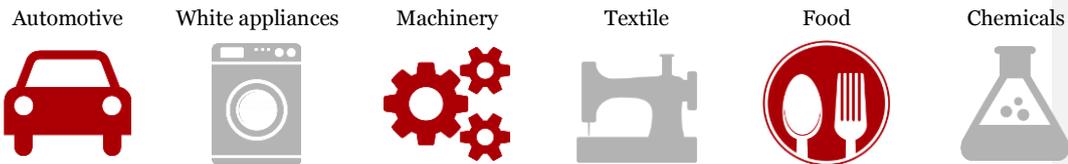
50% of the interrogated companies are planning to invest in Industry 4.0 technologies within the coming 3 to 5 years. 20% still do not have any strategy regarding Industry 4.0 and the remaining 30% plan it in 5-10 years. The technologies that companies consider the most value adding are automation and control systems, advanced robotics, additive manufacturing.

### Investment plans of companies for short and middle term



### Leading sectors

Another survey realized in March 2016, by TÜSİAD (Turkish Industrials and Entrepreneurs Association) and BCG's (The Boston Consulting Group) showed the examples of Industry 4.0 applications existing in Turkey for 6 pilot sectors based on their share in the Turkish economy.



As a result of the study, Industry 4.0 is already a reality for big Turkish manufacturers.

Industry 4.0 applications	Sector	Examples of use
		Integrated quality management Horizontal data integration Integrated design data
		Virtual factory and product design
		Flexible manufacturing
		Automated guided vehicle
		Self optimizing process

Discussions with industry representatives have shown that awareness of Industry 4.0 opportunities is very high in these sectors and many leader companies have already begun to move forward in terms of applications, even though there are various levels of maturity. Another important and common finding was that this journey could only succeed if all stakeholders contribute and holistic policies are established. A long-term, comprehensive approach should be developed to address the structural limitations Turkey faces, such as the workforce, scale, and investment.

## Success Stories

There are pioneer companies in Industry 4.0 applications. 2 of them that are active in white goods are great examples of smart factories.


*White Appliances*

<p><b>3<sup>d</sup></b> in market share in Europe <b>4<sup>th</sup></b> on 500 biggest Industries in Turkey</p>	<p><b>78<sup>th</sup></b> in global Patent application R&amp;D center in Technopark in ODTÜ University</p>	<p>Active in more than <b>100</b> countries <b>15</b> plants in <b>6</b> countries</p>
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□□□□□□□□ 4.0 applications in plant

3D printing	RFID	Data Analytics	Management software (TeamCenter, PLM, MES)	Simulation	Sensors	Automated robots	Data Security	Cloud
								

Arçelik is using **3D printing** for 20 years to make its prototypes and has developed projects for service and maintenance parts. Beside Team Center and PLM product management, Arçelik has developed **MES (Manufacturing Execution System)** software. There are many Horizon 2020 projects that Arçelik has funded with **augmented reality**. In this context, it was decided to implement the project "Virtual Acquisition of Industrial Equipment" at Çayıröva plant. The company also runs projects to develop workstations for people and **robots** working together.


*Electronics, White appliances, IT*

<p><b>2<sup>d</sup></b> biggest TV producer in Europe <b>1<sup>st</sup></b> electronic exporter of Turkey</p>	<p><b>8</b> R&amp;D centers <b>1,200</b> R&amp;D employees Among the <b>3</b> biggest investors in R&amp;D in Turkey and 1,000 worldwide</p>	<p>Active in more than <b>152</b> countries</p>
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**Mega Plant Vestel City**  
Production center of 1 million m2, 76,000 products / day



Vestel's factory in Manisa, which claims to be the biggest domestic electronics manufacturer with its consumer electronics, white goods, information technology and digital fan products, is one of the most important smart factory examples in Turkey. The plant is capable of producing 76,000 products a day and is Europe's largest production complex on a single site. One of the features that make Vestel City a smart factory class is its 'flexible production' capability. According to this, in Vestel City, many different customers can produce in many different models and respond to all the needs of the customer in a short time. In addition, every phase of production from the design at Vestel City plants is under digital control. Industrial designs can be instantly tested, and the test phase provided by digital technologies increases efficiency.

## Use of Industry 4.0 technologies

### Big Data



Telecommunication companies, banks, online retail companies are the first ones to use big data in Turkey. A survey made by EMC on the importance given to Big Data by Turkish companies showed that 84% consider big data as a tool that enables better decision making, 81% think it affects success, 50% think it affects competitiveness and 77% agree that it prevents from cyber attacks. Only 11% of companies don't plan to use big data technology.

### Augmented Reality (AR)



AR applications are limited to specific industries such as gaming, amusement (3D cinema), and advertising. It started in Turkey in 2015. Some construction companies use it to promote real estate projects and online shopping platforms to make shopping experience look real. The Pokémon Go fury shows though the opportunity in Turkey. Thus, Blippar opened its office in Istanbul in 2014 (10<sup>th</sup> office of the group) and one University Lab was created to work on AR.

### Additive Manufacturing



Mostly known as 3D printing, additive manufacturing is also quiet new (2015) in Turkey. Automotive industry, defense and aeronautics, white appliances started using 3D printing. Small and medium enterprises working for these sectors, in molding, plastic industry, medical also do use it but outsource for cost reasons. Turkey stands for 1.2% of the world additive manufacturing use for now.

### Cloud Computing



Companies already use cloud computing for corporate and analytic applications but the quantity of data remains low. There are 29 Data Centers: 25 with Tier II and III level. USD 45 billion of investments was made in 2013 for cloud Technologies, especially by the banking sector.

### Simulation



Simulation is mostly used in high tech value added and strategic industries such as defense, medical, automotive for manufacturing trials but the focus remains on training. In healthcare, a simulation center for nurses and doctors is available in Istanbul to teach about medical techniques.

### Internet of Things (IoT)



Only a minority of sensors and machines are connected through a network and use data analysis. It's mainly a vertical integration. But IoT is very popular in retail sector where vendors use it in complementarity with geolocalization and mobile applications to better target their customers.

### Cyber Security



Accenture survey with 99 Turkish companies showed that 88% use Advanced IPS/IDS/UTM for internet security, 12% use only firewall, 84% use solution for DDoS (Distributed Denial of Service) – 16% use nothing. The use of Blockchain applications is increasing as well, especially in finances.

### System integration



For now, ICT aren't totally integrated in the whole value chain. Vertical integration within companies has started but is not yet complete. As an example, design departments aren't connected to manufacturing or after sales. Horizontally, the integration is still premature that is to say, manufacturers, suppliers, consumers aren't yet fully connected.

### Autonomous robots



Robots are commonly used in industries with serial production but the new generation robots that are autonomous interconnected are new. The investment for robots is quiet low in 2015 and very few companies plan to invest in it in the coming years.

### **Are Turkish SME's ready for Industry 4.0?**

It's an important question if we consider that 99% of more than 1.7 million Turkish companies are SME's and that big companies source intermediate goods and don't always internalize all the production. In a way, the success of big companies is based on SMEs adaptation to Industry 4.0 as well.

However, SMEs aren't yet so enthusiastic about dematerialization that comes with all these new technologies. Plus, investment is logical if companies can produce in sufficient amount to gain back their investment. Considering that business in Turkey is approached at very short and middle term, SMEs aren't ready yet. However there are many examples of SMEs trying to adapt and conscious about the importance to transform their business and those will not be deceived by the quick returns on investment. If we look at the applications for Innovation Competitions, 60% are from SMEs.

Industry 4.0 implies a whole integration; innovation and R&D have to become a reality in every layer. On that point, the government, biggest industries, Non Governmental Organizations, R&D Institutions will have to help SMEs get through this journey by implementing common training and development programs and maybe incentives, as the bigger challenge for SMEs is to have the sufficient budget. SMEs have to be implicated in this process from the start and particularly in R&D projects otherwise the integration will never be complete and many SMEs will disappear. There are promising facts for Turkey's fast adaptation but a fully implementation of Industry 4.0 should take 30 years according to Siemens Turkey General manager and Digital Plant Manager.

### Turkish Government's approach and initiatives for Industry 4.0

Industry 4.0 is new in Turkey. The concept arrived in Turkey in 2015 and examples started with the automotive industry. In December 2015, the Public sector clearly gave the signal of Industry 4.0. and implemented the base with projects, guidelines and made campaigns around it, and events multiplied in 2016.



The Turkish government is focusing on the production of local technology for many years and pushing companies to invest offering several incentives.

The Tenth Development Plan of the National Policy (2014-2018) identifies four strategic pillars that are in line with the technological increase and policy measures that intend to prevent Turkey's deindustrialization:

The 4 pillars of National policy toward Industry 4.0



Policies for increased industrialization

- The use of public infrastructure investments for promoting strategic investment involving critical technologies
- The use of public procurements for improving the innovation and green production capacity of domestic firms
- The improvement of export capacity in smart building technologies, public transportation and signaling systems
- The efficient use of country loan and guarantee programs for increasing the exports of capital goods
- Subsidizing the acquisition of foreign companies

**EVENTS**

**Hackatons**

**garanti <hackathon/>**

**Technology Prices**

**Industry 4.0 Forum  
Last in May 2016**

**Industry 4.0 Conference  
Last in October 2016**

**Innovation Weeks  
Last in December 2016**

Apart from legal support, the government provides direct support for R&D through ERDB or through incentives and sets important targets for 2023, the centenary of Turkish Republic. The efforts put in R&D and innovation paid partially as Turkey moved from 58<sup>th</sup> country in innovation ranking in 2014 to 42<sup>th</sup> in 2015.

The National Science, Technology, and Innovation Strategy (2011-2016), the Industrial Policy Strategy (2015-2018) and the Decrees of Supreme Council of Science and Technology (SCST) emphasize many targets for the transition of Turkish industry for increasing international competitiveness in technology production:

- Developing an implementation and monitoring model for smart manufacturing in coordination with all stakeholders
- Increasing goal-oriented R&D efforts in critical and pioneering technology areas (cyber-physical systems, AI/sensor/robotics, IoT, big data, cyber security, cloud techs, etc.)
- Designing support mechanisms for manufacturing infrastructures to develop critical and pioneering technologies.

Some of the initiatives for Industry 4.0 are summarized below:

- TÜBİTAK, (Scientific and Technological Research Council of Turkey) TEYDEB (Direction of Technology and Innovation Support Programs) launches calls and give subsidies for Industry 4.0 projects. Recent calls occurred in Advanced Manufacturing Technologies, Multilayer additive manufacturing, Rapid prototyping and 3D printing technologies, CAD/CAM, simulation & modeling software, Robotics and mechatronics, Flexible manufacturing, Internet of Things, Sensors and sensing systems, Virtualization, M2M communication, Cloud computing that are all related to Industry 4.0.
- TÜBİTAK' Horizon 2020 Program with European Commission: EUR 80 billion budget for Universities, R&D Centers, SMEs, and independent researchers...
- The Ministry of Science, Industry and Technology has started the Industry 4.0 platform and will prepare a road map until next spring.
- Machinery Exporters Union prepared a guide for Turkish manufacturers in partnership with German VDMA at the WIN Automation Fair occasion.
- MÜSİAD (Association of Independent Entrepreneurs and Industrials) also supports SMEs and collaboration between private and public sectors.
- Istanbul Municipality has announced the creation of a new organized industrial zone with the support of the Ministry of Sciences, Industry and Technology dedicated to Smart Industry (Deliklikaya DESB). The zone's infrastructure works have been finalized in September 2016 allowing smart building, smart energy projects. The zone is set up on an area of 2.3 million m<sup>2</sup> and will be the first example in Turkey.
- The Ministry of Science, Industry and Technology is cooperating with Microsoft for educational programs about Internet of Things.



### Importance of Industry 4.0 for Turkey, benefits and advantages

Industry stands for ¼ of Turkey's GDP and is an important development axe in Turkey's politics. The country has made significant progress with the development of key industries like automotive, food, chemicals, and metallurgy.

The rapid export growth in the last decade, the strong banking sector, the well developed and large domestic market and the generous public incentives aimed to increase private RDI, export share of high-tech industries, as well as to improve research commercialization and entrepreneurship helped Turkey to position itself as a regional hub and strong economy.

Turkey's position in the global value chain hangs on logistical advantage and labor cost, where the country scores 98, which is higher than its region but lower than western countries and that gives Turkey a competitive edge. In fact, production costs in Turkey are 23% lower than in Germany and 2% lower than the USA. But it is critical that Turkey not only stays abreast of these developments but also takes its place among the leading economies by implementing Industry 4.0.

Whereas advanced economies see Smart Industry developments as an opportunity to increase their competitiveness (for example for reshoring purposes), for emerging economies such as Turkey Smart Industry provides an opportunity to increase the share of high technology products in the total volume of production.

*Turkey's manufacturing cost index (BCG, 2014)*



The Turkish government aims to transform their economy into a knowledge economy based on the development of high tech products with a high added value. Considering the current share of high added value technology products in export is only 4% (USD 3.8 billion VS USD 23.5 billion imports) and Turkey's export value by kilogram is around USD 1.40, it's all the more important for Turkey to achieve its goal of moving from an emerging market to the next level.

The risk for Turkey not to adapt to Industry 4.0 is to remain an outsourcing low cost country and not be able to go further than middle technology. It will be dependent on import of high value products and export low cost products, which will tremendously impact on the balance trade deficit. Furthermore, Turkey might lose its first export market Germany that will jump to the next level and Turkey will only sell to emerging markets and less developed countries. In order to achieve this transformation, Turkey have to be aware of its lacks and challenges such as the need for higher skilled labor force, the premature de-industrialization risk the low export share of high-tech products. To face these challenges and accelerate its industrial development, Turkey has to invest time and money.

Compared with countries that have implemented Industry 4.0, it is actually possible to quantify the needed investment and benefits for Turkey as the results of conversion to Industry 4.0. If Turkey invests in technology and its workforce, Industry 4.0 will benefit to productivity and growth.

**Investment:** Based on current prices and the size of the economy, it is estimated that approximately TRY 10-15 billion (about 1 to 1.5 % of manufacturing revenues) must be invested per year to integrate Industry 4.0 technologies into the manufacturing process over the next ten years.

**Employment:** The structure of the workforce needs to change. Industry 4.0 requires a highly educated workforce, whereas currently vocational education levels are quite low. Despite the predicted low skilled job loss, 5% absolute increase in employment is expected. Higher-skilled labor force structure is expected to prepare a stronger know-how base for Turkey.

**Productivity:** If Industry 4.0 is successfully implemented in an economy of the present size, manufacturing sectors in Turkey have the potential to achieve **benefits of up to TRY 50 billion** and efficiency savings are expected to be around 4-7% with an expected productivity growth of between 5-15%.

**Growth:** Turkey will gain a competitive advantage that can lead up to 3% of yearly additional growth of industrial production, thereby adding 1% to Turkey's GDP, which translates to about TRY 150-200 billion additional revenue. Turkish producers are required to invest about EUR 3 to 5 billion per year over the next ten years. According to Siemens, a growth of even 5-8% can be expected.

Turkey is a young country with an internalized technology and a growing workforce, on the threshold of an opportunity to achieve a huge transformation that will change its role in the global economy. It is urgent and imperative that all stakeholders focus and work within the framework of a joint national plan and objective to join the Industry 4.0 (r)evolution that will be a fundamental factor and opportunity to enhance the development and competitiveness of Turkish industry and allowing the country to take its place among the leading nations.

***Ali Akurgal, Manager of Akurgal Consulting: “If companies don’t move on Industry 4.0 they will disappear just like small retail stores disappeared for big chain supermarkets.”***



# Smart Cities in Turkey

Smart City concept emerged as a result of digitalization and overall Industry 4.0, democratization of energy, all fueled by disruptive technologies and social innovations giving birth to new socio-economic paradigms such as connectivity, augmented personal experience, platform economy and data gathering. As a matter of fact, digitalization and progress made in information and communication technologies transformed daily lives. These new innovative technologies bring solutions to some problems but also give birth to new questions and challenges. How can we do better by integrating all these technologies in our daily life, how can we improve our comfort and create sustainable lifestyles.

## Definition of Smart City

After several terms like Intelligent City, Knowledge City, Sustainable City, Talented City, Wired City, Digital City or Eco-city, Smart City is the most commonly used and actually designates the third generation of City according to the company Aiguasol where the approach has changed from top to down to bottom-up.

The concept of Smart City remains complex with many different definitions. Some define a smart city based on human, some based on technology. Here are some commonly used definitions:

“Smart cities exist on the intersection of digital technology, disruptive innovation and urban environments. They are an exciting place to work and live and the breeding ground for new ideas.” Deloitte  
A city is smart when investments in human and social capital, traditional infrastructure and disruptive technologies fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.

“A city that uses its resources more efficiently, investing in information and communication technologies, saving cost and with this saving improving life and services quality, protecting the environment and implementing sustainable and

innovative governance” (Faruk Eczacıbaşı – President of TBV).

“Cities where ICTs are used to improve life, work and sustainability” (Council of Smart Cities)

“Cities that combine traditional services with digital and telecommunication technologies to improve efficiency and productivity of people and companies.” European Union



### **Human based definition**

*“A smart city is made of digital and human systems efficiently integrated in order to provide its citizens with sustainable, high welfare and participant future”  
British Standards*



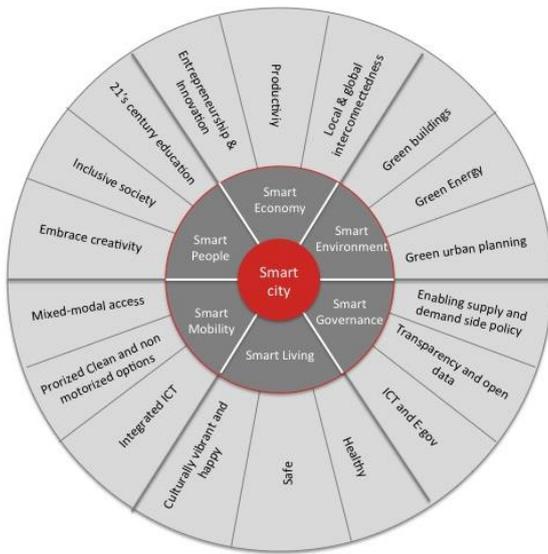
### **Technology based definition**

*“A smart city uses data obtained from inter-connected, metering smart engines to make real time or future oriented decisions”*

Fueled by the new technologies that brings Industry 4.0 such as Social media, Internet of Things, Cloud computing, drones, big data, artificial intelligence, gamification... smart cities emerge all over the world with different type of examples in different type of field.

However, in order to call a city smart, it should achieve certain criteria. 6 criteria generally accepted are composing a smart city: Smart people, smart building, smart governance, smart mobility, smart environment and smart living. These 6 criteria are emphasized in Boyd Cohen’s Smart City wheel.

Smart City Wheel of Boyd Cohen

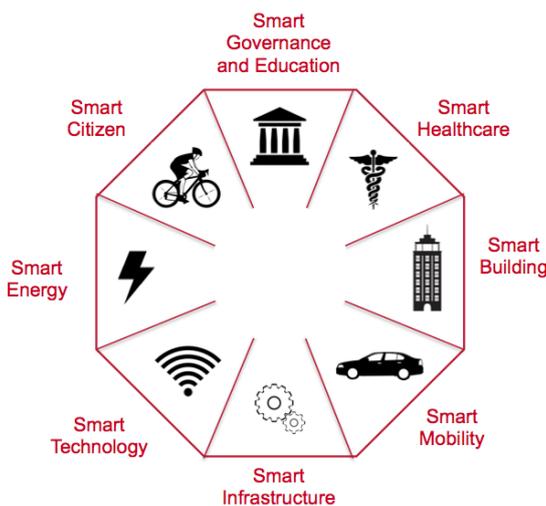


According to Cohen's analyze, a smart city need to gather 6 smart concepts around all actors:

- Smart Economy including Entrepreneurship and Innovation, Productivity, Local and global interconnectedness
- Smart Environment providing efficient use of energy with green buildings, green energy and green urban planning
- Smart Governance that enables transparency and open data to citizens, uses ICT and e-government systems and enables supply and demand policies
- Smart People that are highly educated, embrace creativity and create an inclusive society
- Smart Mobility that integrates ICT and prioritize clean technologies using mixed modal access
- Smart living that includes safety, health and culture.

Frost and Sullivan was the first private consultancy group to study Smart Cities worldwide and put forward 8 main concepts (F&S quasar) of a smart city. The concepts might be named differently but overall, a smart city is a sum of smart use in all field of daily life from mobility to building involving all actors from citizens to governors.

Frost and Sullivan's Smart City Quasar



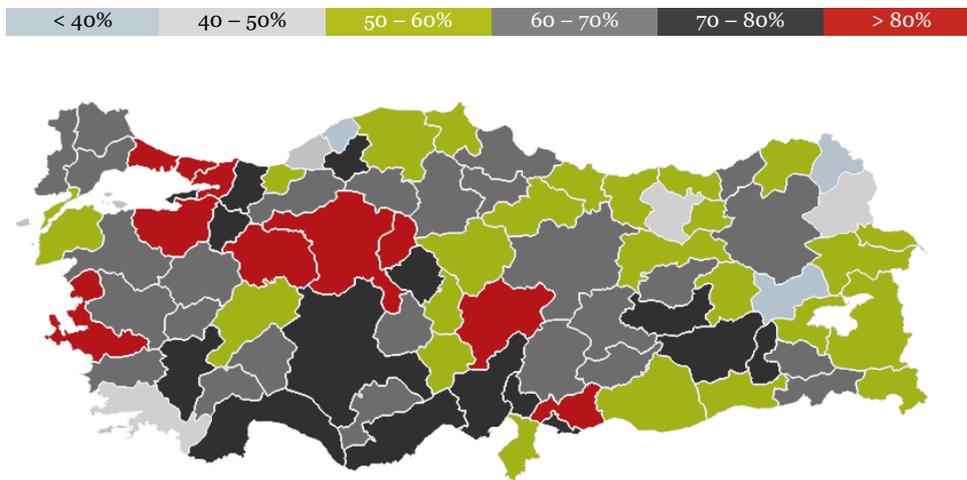
**Boyd Cohen: "A smart city is one that exploits technology and innovation to make efficient use of resources and reduce the size of the ecological footprint. This idea is here to stay. The term has a technological origin, but it is also a question of being innovative. What services can be offered to citizens to increase their quality of life? Technology is just one aspect. A high-tech city is not necessarily a smart city. Many urban planners have realized that cities are about people not technology"**

### The rise of smart cities in Turkey

Turkey's rapid urbanization has transformed the country demographically and economically. Urban population has grown from 25% (1950s) to 75% (today). According to World Bank, by 2030, 80% of the Turkish population is expected to live in cities.

Urban growth has shifted from mega/primate cities to its secondary cities over the last ten years. 25 cities with more than a million populations have emerged and Istanbul remains the "mega-city" with more than 17 million inhabitants concentrating 20% of the total country's population.

Urbanization rate per city, 2015



This rapid transformation brings challenges and problems such as infrastructure, transportation, and health complexes with the need for more efficient governance policies, better use of energies and resources.

Moreover, in 2012, Turkey has launched the Urban Transformation program that aims at rehabilitating and rebuilding all unsecure buildings and infrastructures regarding seismic risk. The program started in almost every city of Turkey and lead to significant changes in urban landscape.

3 major critical issues are important for Turkey to manage its rapid transformation of cities:

- 1 **Better Planning of cities limits**, coordination between national and municipal policies especially for energy and earthquake issues
- 2 **Better connection**: plan the new buildings, work places with a transport and mobility focus
- 3 **Financing**: Plan long term budget, use efficiently the incentives

Spatial concentration of population in Turkey



## Approach and initiatives

Considering the above-mentioned challenges, the Ministry of Development has designed a hybrid top-down/bottom-up approach within the Information Society Strategy in order to facilitate the development of smart cities in Turkey.

**Top-Down:** A national level smart cities program aiming to develop a national smart cities strategy framing the smart applications to be implemented in cities, targets and financing instruments would be used to implement these applications. So national level financing would be provided for the local authorities in order to motivate local authorities to implement smart city application within their cities.

**Bottom-Up:** In order to benefit from the creativity potential of the private sector and universities, local development agencies of the different regions in Turkey, which are operating under the Ministry of Development, would finance smart city projects for private sectors and universities. These projects would use public sector information in order to provide solutions for societal challenges in particular in the fields of health, transport, housing, energy, disaster and water management. Local applications should be developed within the concept of open data.

The government enabled specific policies for Smart Cities and the framework for Regulation was completed in April 2016 by the Ministry of Environment and Urbanization.

- **Letting Markets Work:** Policies that enabled labor markets to work facilitated agglomeration economies that generated jobs for incoming poor, rural migrants
- **The Metropolitan Regime:** The Metropolitan Municipality Law (1984) provided a local administrative regime that could facilitate inter-jurisdictional coordination, allowing planning and investments to operate at the scale and pace of growing city economic footprints
- **Strong Regulatory Framework for Municipal Budgeting:** Maintaining a hard budget constraint on local governments and utilities has instilled fiscal discipline at the local level, generated strong local revenue surplus, budget predictability, and stable local government finances.
- **Equality of Opportunity for Education:** Building human capital is a critical element for smart cities.

Initiatives are being developed with many private companies and Institutes. Turkey's important telecommunication companies (Türk Telekom, Turkcell, Avea...), IT companies and Institutes (Novusens, Innova, Turkish ICT Foundation) take part in this process to accelerate the process of smart cities.

The Turkish ICT Foundation (TBV) and the company Novusens have launched a project to become a referential for Smart City Strategy in Turkey. The first step was completed assessing the current approach of municipalities toward smart city concept.

### Important Associations and organizations

#### Smart City Institute

Established by Novusens, the Institute started "Smart Cities Readiness Assessment of Turkey Project", working with several government agencies and NGOs.

[www.akillisehirenstitusu.com](http://www.akillisehirenstitusu.com)

#### Green Building Institute

develops pilot projects with government and universities, conducts lobbying activities to increase public awareness about the necessity of green building, and encourages the building industry to develop sustainability.

[www.cedbik.org](http://www.cedbik.org)

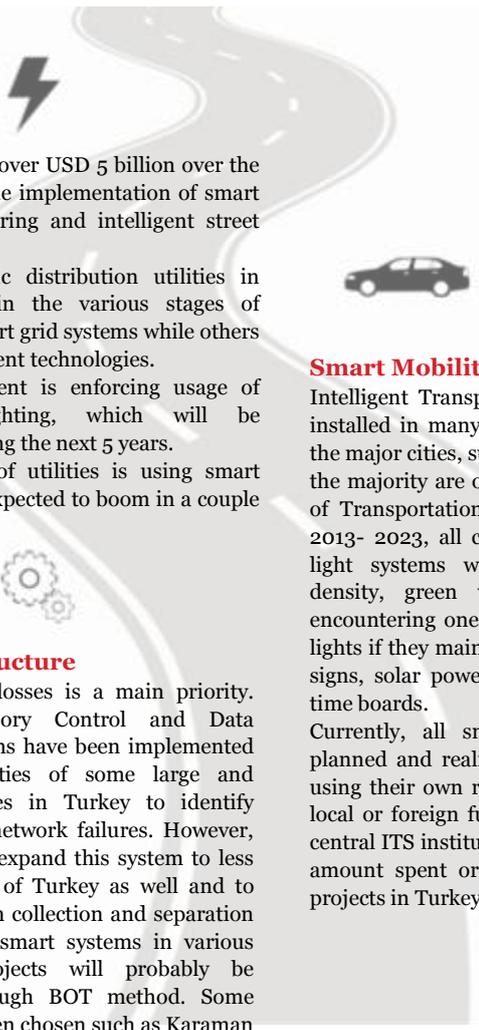
#### Turkish Information and Communication Foundation

TBV contributes to build the infrastructure for Turkey's transformation into an information society, and conducts economic and social studies by carrying out scientific researches.

[www.tbv.org.tr/en](http://www.tbv.org.tr/en)

Field Code Changed

Identified as the three main focuses for cities, transport, infrastructure and energy are at the heart of smart city initiatives of the Turkish government.



### Smart Energy

Turkey will spend over USD 5 billion over the next 5 years for the implementation of smart grids, smart metering and intelligent street lighting.

Out of 21 electric distribution utilities in Turkey, 13 are in the various stages of implementing smart grid systems while others are studying different technologies.

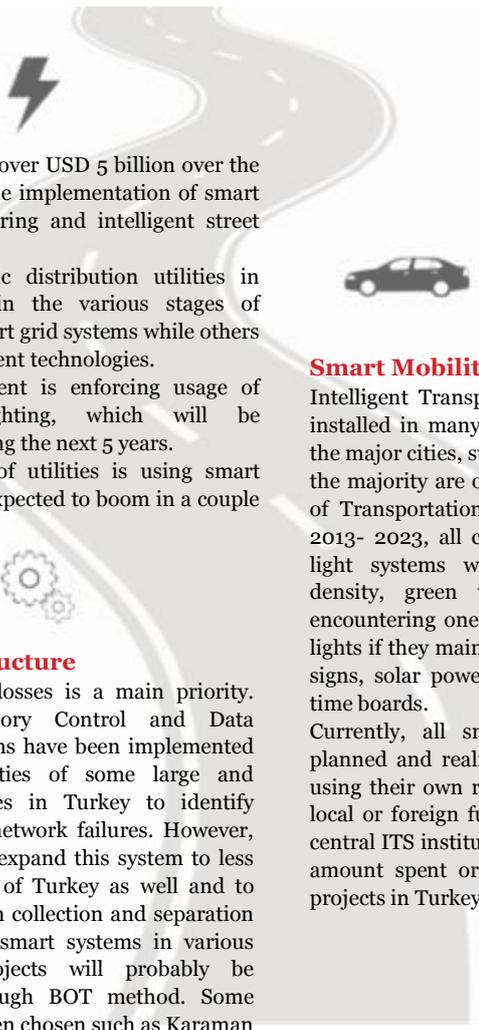
Turkish Government is enforcing usage of LED street lighting, which will be implemented during the next 5 years.

Limited number of utilities is using smart meters, which is expected to boom in a couple of years' time.

### Smart Mobility

Intelligent Transportation Systems (ITS) are being installed in many cities of Turkey. However except the major cities, such as Istanbul, Izmir, and Ankara, the majority are only in initial phases. The Ministry of Transportation has stated in their Action Plan 2013- 2023, all cities will implement smart traffic light systems working according to the traffic density, green wave system where cars after encountering one red light will pass through green lights if they maintain a specific speed, digital traffic signs, solar powered bus stops with digital arrival time boards.

Currently, all smart transportation projects are planned and realized by local municipalities, some using their own resources, whereas some use other local or foreign funding resources. Since there's no central ITS institution, it is not possible to get a total amount spent or planned to be spent for all the projects in Turkey.



### Smart Infrastructure

Preventing water losses is a main priority. SCADA (Supervisory Control and Data Acquisition) systems have been implemented by water authorities of some large and industrialized cities in Turkey to identify water losses and network failures. However, there is a need to expand this system to less developed regions of Turkey as well and to develop projects on collection and separation of waste through smart systems in various cities. These projects will probably be implemented through BOT method. Some pilot cities have been chosen such as Karaman to initiate smart waste collection.

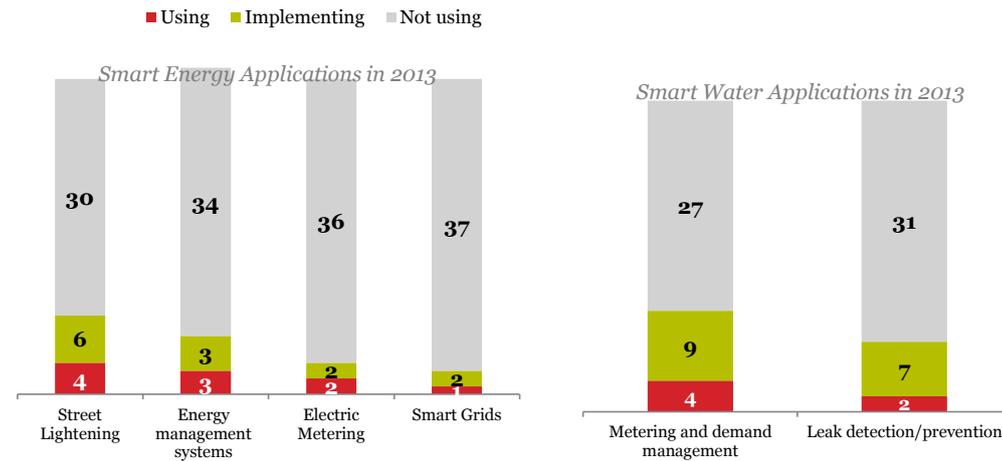
### Level of maturity

Smart City projects in Turkey are fewer in number than those in European countries and in the US. But according to Frost & Sullivan, there are 8 cities classified as “sustainable”: Istanbul, Bursa, Ankara, Eskişehir, Izmir, Denizli, Antalya and Adana. Among the 26 global smart cities projected for 2025, at least one city from Turkey is expected to be present.

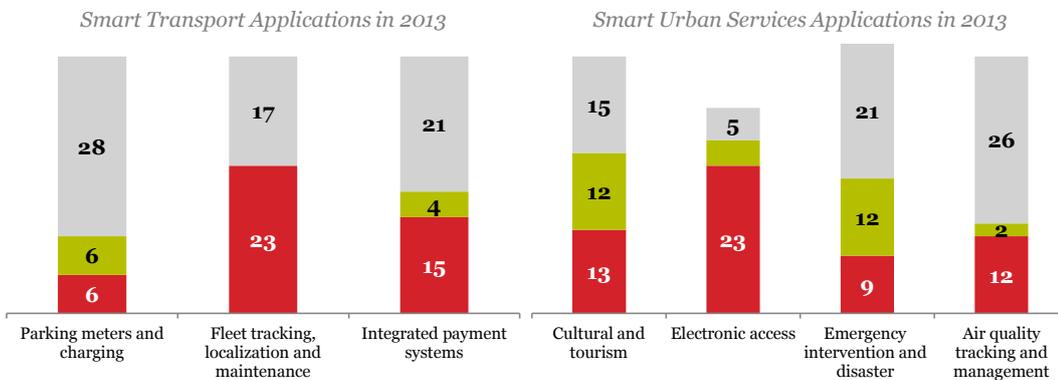
The first application of Smart City started in 2000 in the city of Yalova with the “Information Valley Project” for an eco-technological valley. Istanbul started smart projects in districts implementing Google Earth / 3D street visioning technologies and Augmented Reality for buildings.

In 2013, a national survey made with 40 big city municipalities to understand the smart city applications use showed that all cities were concerned by smart systems for energy, water, transport and urban services but the use was quiet low.

In the energy field, there were few municipalities using and implementing smart systems such as metering, street lightening or smart grids. Regarding smart water applications used by municipalities, there were only 4 municipalities among 40 using metering systems and only 2 using smart leak detection/ prevention systems.



In 2013, the concern was mostly on transport and urban services. 23 municipalities among 40 were using smart fleet tracking and localization systems and 15 municipalities were using integrated payment systems. In urban services, the electronic access to services was widely used.



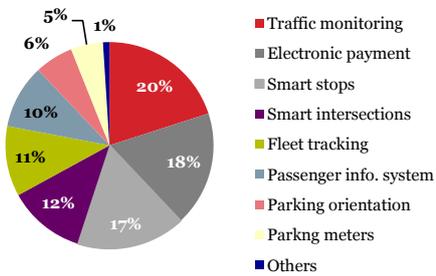
Today, the penetration of smart applications is much higher. In 2015, the results of the survey conducted by the Turkish Information and Telecommunications Foundation (TBV) and Novusens with 25 big municipalities (cities of more than 1 million inhabitants), 4 water management authorities and district municipalities showed that the main concerns are still on transport but followed by water and energy. Payment systems and geographical information system (GIS) are increasing as well.

Repartition of smart city applications by field, 2015

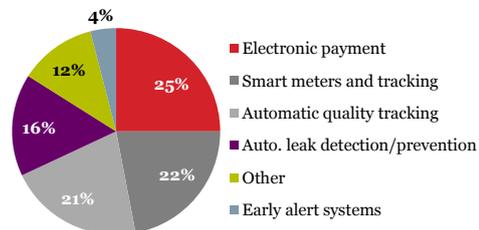


Repartition by type of smart city application use in municipalities, 2015

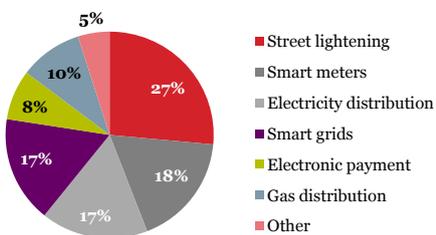
Transport applications



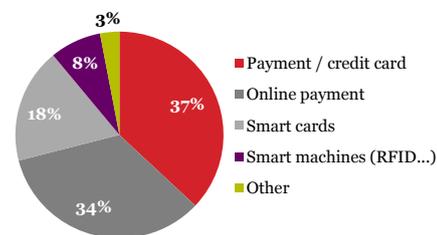
Water applications



Energy applications

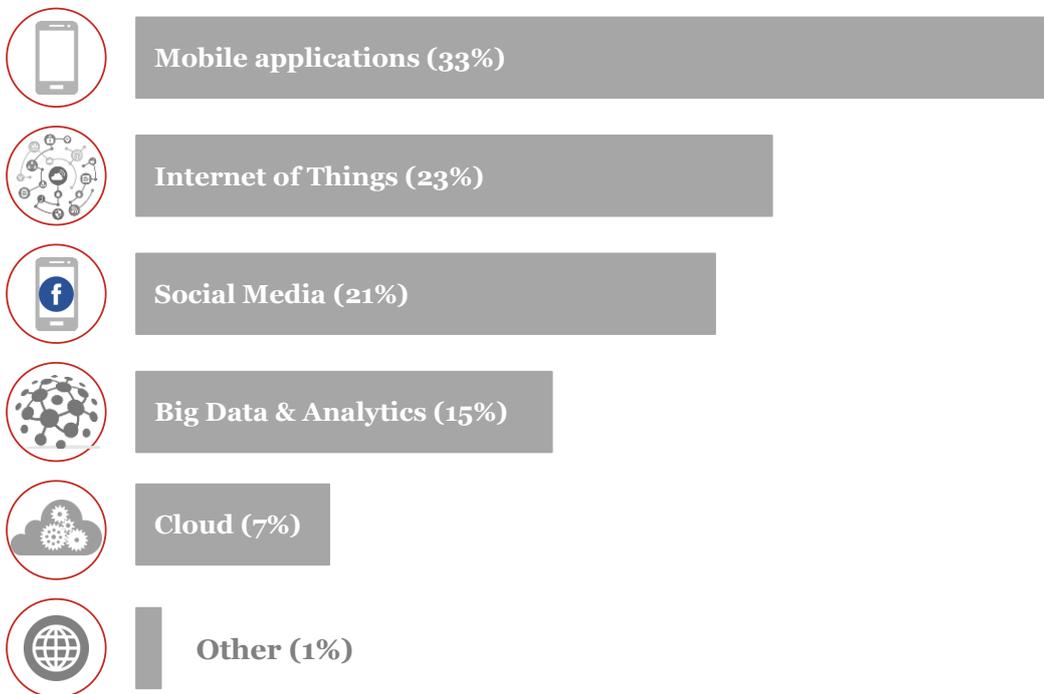


Payment systems



The study also analyzed the penetration of most important digital technologies such as cloud, big data or IoT within municipalities. Electronic channels and e-government are the most popular application within municipalities. Smart applications for energy and water management are on their way with SCADA and GIS applications in particular by electric utilities and water and sewage administrations in major cities. Smart metering is yet in very early stages and the lack of GIS infrastructure is still a challenge.

*Repartition of Smart technologies used in City Applications, 2015*



Municipalities have progressed very fast in 2 years regarding the integration of smart digital technologies in their management of transport, energy and services. Still, they have a siloed approach, not all smart technologies are used in an integrated manner. Most of them use mobile technologies followed by IoT (sensors, electronic circuits, thermostats, parkmeters, gas detectors) and social media. Big data and cloud computing are still very less implemented.

Indeed, there are few barriers refraining cities from fully adapting to the smart systems. The challenges for Turkish cities mainly consist in the lack of funding and qualified human resources. 60% of expenses are made from the municipality budget, which is quiet limiting when it comes to higher added value systems. Also, there is still a lack of cooperation between public and private sectors, NGOs, R&D Institutes and Universities. Everyone is aware of the transformation and pushes toward it but without a real synergy and innovative governance the journey might be longer and harder.

## Featured cities

Depending on the population, size of the city and level of industrialization, the use of technology is very diverse in the 81 Turkish cities. Istanbul, Ankara, Izmir and Eskişehir are some featured examples of cities where various smart technologies are already implemented and in use.



### ISTANBUL

As the most populated city and economic capital, Istanbul gathers many achievements and projects of smart city.

The city is part of the CitySDK (Smart City Service Development Kit and its application Pilots) project, funded by the EU ICT Policy Support Program as part of the Competitiveness and Innovation Framework Program (CIP) and led by Forum Virium Helsinki. The U.S. Trade & Development Agency (USTDA) has awarded a grant to the Istanbul Metropolitan Municipality (IMM). The grant provides technical assistance to improve city operations, enhance crisis and disaster management, and provide efficient and reliable public services for the citizens of Istanbul. The project will focus on procuring advanced IT solutions and developing a cloud-based environment capable of aggregating big data from existing municipal databases. Talking Roads & Talking Vehicles project, is another EU project performed by the Turkish private companies Koc Sistem and Otokar where IMM takes part.



- ✓ Intelligent signalization system
- ✓ Smart signalization, supervision system



- ✓ Smart bus/tram stops in 750 different points
- ✓ MobIETT application enabling passengers to access the information of the smart stops
- ✓ E-payment card



- ✓ Special info points at bus stops for disabled people and special card for blind citizens



- ✓ Electronic enforcement system
- ✓ Partnership with SSM and ISBAK for Big Data and Cyber-Security



- ✓ Pedestrian Electronic Detection System



- ✓ Smart bicycle renting system



- ✓ Traffic congestion and emergency management center (Connected vehicles)



- ✓ Parking automation with unmanned payment points



- ✓ Special division for Smart Cities in its organization
- ✓ Turkish Smart Cities Technology Center
- ✓ Living Lab Center in Başakşehir district

Among Istanbul future plans and targets, the major topics can be listed as below:

- ✓ **Geographic Information System (GIS) Geospatial Analytics:** IMM seeks to better utilize existing and planned GIS technology to reduce costs, improve city services, and support disaster and crisis awareness, management and mitigation.
- ✓ **Browse, Search and Discovery Portal System:** IMM seeks to further develop an online portal to provide government and citizen access to the comprehensive data stored in the planned cloud based environment.
- ✓ **Disaster Management:** IMM seeks to implement data collection and analysis tools that would enable first responders to efficiently communicate and respond to crisis situations that may arise in Istanbul.
- ✓ **Citizen 360:** Due to the increased citizen engagement, IMM seeks to develop improved systems for understanding citizen needs and, in turn, developing additional citizen IT services. A Citizen 360 Initiative will enhance citizen digital interaction with municipal services.

IBM and Vodafone are cooperating with IMM Transportation Corp to make a smart transportation project.

The cities of Izmir, Ankara and Eskişehir are following Istanbul in terms of smart applications with implementation in mobility, water management, etc.



IZMIR

Izmir has a SCADA system, which is centrally managing the water distribution system.

The WizmirNET project, Izmir Municipality provides internet in the open areas. Izmir Municipality has activated the Trunked Radio System, which even works in the times of disaster and emergency. The city has a very advanced transportation system that is mentioned in the smart mobility section and the city has plans to do more investments in this sector. Izmir has most advanced ITS system in the country. Full Adaptive Traffic Management System to include: full adaptive intersections, online traffic density maps for passengers/drivers, traffic lights specified for disabled people including talking lights, enforcement system to trackspeed/parking/lights etc. A project, funded by World Bank, is continuing to be installed and e-payment cards to be used in all transportation modes, including ferries, busses, train, and metros.



ESKİŞEHİR

Eskişehir is known as the little Amsterdam of Turkey and is one of the first examples of city where sustainable solutions were adopted. The city was chosen for a European Example of Living Lab project and obtained EUR 5 million subvention from the Smart City Innovation program plus EUR 21.5 million EUR from the EU. The project includes a Smart Tracking portal for buildings energy, renovation of buildings, 4 electric bus, 7 hybrids, LED street armatures, solar panels for heat and water and organic waste transformation systems, 6,2 km roads for smart bicycles (150 for collective use), solar charge stations, heat pumps with solar energy, full participative system.



ANKARA

Ankara has smart bus stops, on-line traffic density map, and online tracking system for fire department vehicles. Ankara's mayor was elected "Best Social media User in the World" two consecutive years and Ankara was chosen as a pilot city for Smart city applications.

The city offers Ego Cep which is a mobile application that prevents from waiting in bus stations and informs citizens directly by SMS as well as smart stations, smart traffic cameras, etc.

Ankara has implemented SCADA systems for water management, 360 degree tours are available on the municipality website, as well as e-payment systems, other cultural applications.

Besides these major cities where applications are much more advanced, the city of Kocaeli is very promising as its municipality was selected “best digital user” by the Association of Digital Research. The Association is indeed doing an analysis since 2015 on the use of existing digital technologies by 81 municipalities and 240 mayors in Turkey, based on 68 criteria such as the availability of a website, mobile applications, social media communication, updated info, content management... to evaluate the score and grade of each city in the effective use of digital technologies.

**The mayor of Antalya was chosen “best user of digital technologies with a score of 79 points and Kocaeli was selected the “best digital municipality” with 76.5 points.**

Smart systems have been developed in many other cities as well, some examples of applications are:

- ✓ **Shared bicycle** systems are visible in Antalya, Erzincan, Kocaeli and Yalova.
- ✓ **E-card** is widely used in most cities. The Turk Telekom Group in the city of Karaman has launched Akilli KentTT (smart urban card). Innova undertook the overall management of the integrated project and offered support services. It also provided the sensors, Internet of Things (IOT) components, infrastructure, kiosks, touchscreens, data center and operations center.
- ✓ **Intelligent Transport systems** are utilized partially in Konya (dynamic intersections at certain ones, information system on traffic density using cameras only without any sensors and with intersection control mechanism that is capable of controlling the traffic light with emergency vehicles being able to change the light, intelligent public transportation system), Mardin (smart bus stops, smart intersections, tracking systems for busses in planning phase), Kahramanmaraş (mobile park meter system), Gaziantep (smart bus stops, systems to enable smart phones to inform passengers/drivers, systems to enable disabled people to use transportation systems alone), Sakarya (tracking system for busses), Yalova (smart bus stops), Kars (smart bus stops, information system for disabled passengers, both in planning phase), Edirne (enforcement system under planning phase to track and send bills automatically drivers not obeying traffic rules), Manisa (payment system for public transportation using smart phones).

The rising consciousness about improved city management is visible in Turkey even though the execution is siloed as observed in all fields using digital technologies. In order to facilitate the implementation of digital technologies in cities, Turkey has developed Living labs where many applications are tested before getting implemented in big cities such as Istanbul. The events in parallel multiplied in 2015 and 2016 where the government and economic actors are willing to involve citizens in the journey of Smart City. Recently, Istanbul Municipality has set up an e-mail address and a call center specially focusing on smart city topics and ideas where citizens can share ideas and their daily concerns about the city.

One of the most important topic about city and daily life which is emphasized in the quasar of Frost & Sullivan’s and Boyd Cohen’s Smart City Wheel, is undeniably health. Smart healthcare applications are increasing as well and as a major topic, it will be focused on the next part.

COMING EVENTS AROUND SMART CITY			
<p><b>Antalya City Expo March 2017</b></p> 	<p><b>International Istanbul Smart Grid and Cities Congress April 2017</b></p> 	<p><b>Smart Grid Congress and Fair Istanbul April 2017</b></p> 	<p><b>International Smart Cities Conference Ankara, May 2017</b></p> 

## Opportunities for Swiss SMEs in smart cities

As seen, the rapid growth and urbanization in Turkey raises many concerns in the cities management. As an example, Turkey needs to build over 600,000 houses yearly, for a total of 7.5 million by 2023 and many transport and energy infrastructures to cope with the demand.

In order to comply with security requirements, technological expectations and to make energy savings which is an important issue, Turkey has started huge investments for technological and scientific R&D activities and production for Smart Electricity, Gas, Water Grids and Systems, Smart Transportation Systems and Smart Cities – with the country's global objective being to plan and implement cost-effective and productive facilities for energy consumption.

All applications offer opportunities as Turkey is at the very beginning of this journey but the current focus of municipalities remains energy and transport :

- Traffic management (smart lights, cameras, interconnected platforms...)
- Big data and cloud platforms (centralized platforms for all applications...)
- Water loss prevention
- Gas
- Waste management
- Eco green buildings
- Safety and security of citizens (cyber security, face recognition...)
- Disabled people
- Health and education

Examples of ongoing projects which require smart solutions :

- Antalya Municipality has signed a global smart city transformation contract including free Wi-fi spots, intelligent traffic lightnings, solar energy use, disabled people friendly applications, smart traffic cameras...
- Ankara has started trials for smart lightnings in one industrial area. The lightning includes an alarm system that is linked to the fire station and can detect and pre alert the arrival of emergency vehicles. The idea is to cover the whole city after different trials.
- Istanbul has many different projects going on: Electronic Traffic Control (plate recognition, speed calculation...), applications for disabled people (especially for transport and city tours), eco-buildings and new residential areas, some connected waste collection vehicles have been tested in Başakşehir district...
- Hatay municipality has joined the Horizon 2020 STEP project to develop and pilot test a cloud eParticipation SaaS platform (step.green), enhanced with web / social media mining, gamification, machine translation, and visualisation features, which will promote the societal and political participation of young people in the decision-making process on environmental issues.
- Akıllı Kent TT project of Türk Telekom that is an integrated platform for smart applications form waste collection to e-governance has been implemented in Karaman and Türk Telekom is trying to promote it through other cities

To access these opportunities, Swiss SMEs should go through local partners as the smart city projects are treated by municipalities with public tenders often won by big Turkish integrators such as Türk telekom, TürkSat in collaboration with well known telecommunication, electronics or even defense companies. Turkish companies are quiet experienced and competitive on the software part but lack of hardware knowledge where Made in Europe equipment is meeting international requirements and better quality.

Partnerships (commercial or through merger and acquisition) with local software developing companies are the best solution to enter the Turkish market.



## Smart concepts in Life Sciences market

The life sciences comprise the fields of science that involve the scientific study of living organisms as well as related considerations like bioethics. While biology remains the centerpiece of the life sciences, technological advances in molecular biology and biotechnology have led to a burgeoning of specializations and interdisciplinary fields. From healthcare, medical devices, biotech to pharmaceuticals, life sciences include all industries related to health improvement.

Focusing on human life sciences, Turkey is one of the most growing and promising industries. Over the next two decades, as the current young population of Turkey ages, a sharp rise in healthcare demand as almost 80% is expected. Demand for higher-quality healthcare services in line with the advancement in economic welfare will almost triple healthcare spending per capita in Turkey by 2023, hitting USD 2,000.

Turkey has many generic-drug manufacturers, local and multinational pharmaceutical companies and medical device producers, which combine to create an active and expanding healthcare market. These local manufacturing capabilities for generic and name brand drugs are a powerful incentive for foreign companies to move production to Turkey, while local brands are also increasing production. Turkey's large population, important research hospitals, incentives for investment and geographical proximity to fast-developing markets are some of the strengths that make Turkey well placed to be a global pharmaceutical, healthcare and life sciences hub.



The life sciences and healthcare sectors are therefore considered industries of strategic importance by the Turkish government and specifically approached in the development plans. The “Healthcare Transformation Program” introduced in 2004 by the Ministry of Health marked the first significant improvement in Turkey's healthcare system. The Ministry of Health and the Ministry of Development also developed a joint long-term strategic plan for the pharmaceuticals industry, supporting and encouraging the further development of life sciences with legislation providing incentives for R&D projects with the goal to make the country a global life science R&D and production hub. Indeed, the Turkish Government aims at making Turkey one of the world's top ten economies in health services by 2023 by increasing research and development expenditures to 3% of GDP and by increasing exports to USD 500 billion. To achieve these goals, the government launched several projects of manufacturing infrastructure through the establishment of special pharmaceutical zones, PPP healthcare projects, “Free Health Zones” and “Big City Hospitals” in 31 cities – the first one opened in the city of Mersin in February and 18 other projects are ongoing.

Therefore, the modernization and digitalization of life sciences in Turkey is important to catch up with global advanced countries and preserve its position of high quality service provider in the region.

## Turkish Pharmaceutical market

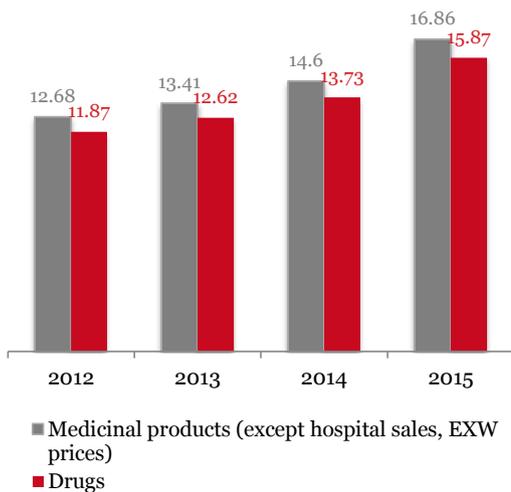
Turkey ranks 6<sup>th</sup> largest pharmaceutical market in Europe and 14<sup>th</sup> largest in the world registering steady growths since 2012. In 2014, the consumption of pharmaceuticals per capita rose by 14% from was TRY 187.9 to TRY 214.2 in 2015, an average of 24.7 boxes per person.

The Turkish pharmaceutical industry is highly fragmented and intensely competitive. The sector consists of over 300 local companies, most of which produce generics, and employs around 30,000 people.

Turkey has the potential to be a pharmaceutical manufacturing hub thanks to its young workforce, large number of skilled science and engineering graduates, and comparatively low wages. Additionally, its geographic position provides strategic access to markets in Central/Eastern Europe, North Africa and the Middle East.

Yet, Turkey remains reliant on imports for both innovative medicines and active pharmaceutical ingredients (APIs). To address this trade imbalance, the government is promoting local production and R&D in several areas, such as biologics, where it is willing to provide subsidies and investment incentives.

Total Sales Value in TRY billion (Source: IEIS)



The pharmaceuticals reached a size of TRY 16.8 billion in 2015 (~USD 7.6 USD), growing by 15.5% over 2014. The medicinal products market grew by 6.7% in units and 15.15% in value and the drug market rose by 15.6% in value and 6.8% in volume. Turkey ranked 29<sup>th</sup> worldwide and 2<sup>d</sup> in Central/Eastern Europe region in 2015.

Growth is mainly driven by increasing public insurance, modernization of life sciences industry, increasing chronic diseases and increasing health awareness.

The pharmaceutical market is projected to grow at a CAGR of 9.1% until 2018. According to IMS Health Report, Turkey is one of the top 20 “pharmerging” countries expected to rank 17<sup>th</sup> in 2019.

### 2015 Snapshot



**Total**  
\$ 7,6 B (1.1% of GDP)

\$97 per capita  
\$2.8 B Generic  
\$4.1 B Patented  
\$8 B OTC

**27.8% Growth**  
between 2009-2015



**11,500 products**



**30,000 people**  
employed



**300 pharmaceutical**  
**entities**

**70 manufacturing facilities**  
12 are owned by  
multinationals  
**12 raw material producing**  
facilities 3 of which are  
owned by multinational  
companies.  
**116 foreign entities in**  
**total**



**Exports**  
\$939 M in 2015  
to 170 countries

**Imports**  
\$4.6 B  
**Rate of export meeting**  
**imports: 20.3%.**

## Turkish Healthcare market

A rapidly growing young population is one of the key factors driving demand for healthcare in Turkey. Turkey's current population over 65 accounts for 7.5% and is expected to expand. The reforms engaged in Healthcare have been very effective, as within the first six years of the project, Turkish life expectancy rose from 71.8 to 74.3 years and the number of primary care facilities increased by 230%.

Besides, Turkey has become one of the most popular medical tourism destinations. The number of healthcare tourists visiting Turkey reached 746,000 and the revenue they brought accounted for USD 5.8 billion in 2015.

In order to satisfy the growing demand and improve healthcare services, an ambitious Health program was set by the Ministry of Health that is planning to open organized health zones, which will include hospitals, rehabilitation centers, thermal tourism facilities, nursing houses, health techno-cities, and R&D centers and will be spending an estimated USD 200 billion for Healthcare PPP Program.

The ambitious healthcare public private partnership (PPP) program makes Turkey the 2<sup>nd</sup> most attractive market globally for PPP projects in the medium to long term. Investments in the healthcare sector are expected to continue as the government strives to increase the number of hospital beds per 10,000 people to 32 in 2023 from the current level of 26.5, meaning +90,000 beds.

The strategic objectives of the program, along with rapid economic growth will ensure that Turkey's life sciences market progresses faster than mature markets in the U.S., Japan and Europe.

According to the Economist Intelligence Unit forecasts, the healthcare sector in Turkey is set to boom as spending per capita is increasing at an average CAGR of 5.6%, while most developed countries are experiencing relatively lower growth rates.

### 2015 Snapshot



#### Healthcare Expenditure

\$39.4 B (5.5% of GDP)

77% Public

\$780 per capita



#### Investment

\$200 B till 2023



#### Projects

34 PPP projects with 18  
"Big City Hospitals"



#### Medical Tourism

746,000 medical tourists

\$5.8 B income



### Preventive healthcare

Preventive healthcare consists of the measures taken to prevent diseases instead of disease treatment. There are two types of diseases: Communicable diseases that are infectious; they spread from one person to another or from an animal to a person, and Non-Communicable diseases that are chronic diseases and are not passed from person to person or animal to person. Last century faced health struggle against the communicable diseases in global scale.

There are several health prevention projects in Turkey. Currently, prevention is the main target of the Ministry of Health and every regulatory effect is taken to promote healthy lifestyle habits. Local municipalities are trying to implement health promotion project and the health insurance covers rehabilitation with a small reimbursement.

### Turkey's Medical devices technology (MedTech) market

Together with the pharmaceutical industry, the medical devices industry is one of the major elements of the Turkish health sector. Although medical devices industry is quiet young in Turkey, it expands very fast regarding the population needs and especially medical tourism.

More than 1,000 companies, mainly SMEs, are active in the production of medical devices that can be divided into 4 main categories: Diagnostic Imaging (21%), Consumables (20%), Orthopedic and Implants (18%) and Dental Products (6%). These main categories are followed by hardware and software for hospital information systems, surgical tools, tubing sets for cardiovascular surgery, stone breaking devices, surgery lightening, anesthesia devices, monitors, surgery aspirators, oxygen devices and air sterilization. The biggest health care cluster in Turkey is located in Samsun. The Samsun Health Care Cluster has 44 manufacturers among Turkey's 183 biggest medical equipment manufacturing companies and provides the international market of medical equipment. This Health Care Cluster in Samsun is globally known as the third center for medical equipment clusters following Germany and Pakistan.

The market in 2015 was estimated at USD 4 billion and the registered number of medical devices produced in Turkey was around 1.5 million, yet covering only 8-10% of the consumption with an average 28 medical devices per 1 million people. Although Turkey's exports of medical devices rose after 2012 by 37.5% making Turkey the 18<sup>th</sup> in Europe and 38<sup>th</sup> worldwide, Turkey still imports 85% of its advanced medical devices, mostly from countries like the U.S., Germany, China and Japan as Turkey's current focus is mostly on low value added products and R&D in MedTech remains very low, ≈0.9% of GDP ranking Turkey 20<sup>th</sup> country with USD 0.74 added value. That is why medical technologies are an important axe of development in Turkey's health politics that intend to increase local production and increase the export of high value added devices in order to balance the deficit trade balance.

**2015 Snapshot**



**Size of the market \$ 4 B**  
**0.9% of GDP**  
**0.74 added value**

**1.5 million products**

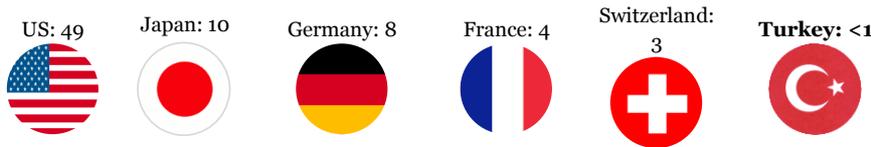


**1,000 companies**  
**183 big manufacturer**



**85% Imported**

Country's market share in world medical devices industry (% , 2016)



#### Success Story

Robogait is a Robot Assisted Walking Therapy Device to regain and develop walking ability. It was developed by the Turkish company BAMA Teknoloji and is exported to Europe. The R&D of this product was mainly done at the Middle East Technical University (ODTÜ) Technopolis and manufactured at OSTIM industrial park in Ankara.

As part of the tenth development plan and Vision 2023, Turkey's Health Ministry created TITCK Turkish Medical Devices Institution in March 2012 to encourage the pharmaceutical and medical devices industries to develop innovative and value added products.

Recently, Turkey has launched the "Industrial Partnership Program" for the local manufacturing of high technology medical devices such as MR, tomography, monitors, ultrasound and digital imaging devices. The purchases for ongoing projects of the Ministry of Health are evaluated at USD 2.5 billion of which 2 billion only concern advanced devices and the rest middle and low added value hospital equipment. There is a will for local production increase that offers opportunities for technology transfers with 7 years of purchase warranty.

## Development of Biotechnologies in Turkey

1928

Although Turkey has been researching and investing in biotechnology since the first appearance of biotechs in the programs of the Scientific and Technological Research Council of Turkey (TÜBİTAK) in 1982, the country ranked 47<sup>th</sup> in 2014 and 45<sup>th</sup> in 2015 among 54 countries regarding innovation in biotechnologies with an index of 11.4. In terms of patent number, Turkey's share is very low as well, around 0.03% and the share of biotechnology in R&D expenses is around 18%. Local manufacturing in biotechnology stands for only 0.1% meaning Turkey is highly dependent of imports.

2009

But Turkey has recently concentrated its attention on biotechnology beginning of 2000's. In 2009, the project of the first Biomedical Techno-valley in Istanbul Çatalca area was announced. In 2013, Turkish Technology Development Foundation (TTGV) and the Ministry of Science, Industry and Technology (MoSIT) have prepared the Strategy and Action Plan for Biotechnologies of Turkey 2014-2018 in line with the 10<sup>th</sup> Development plan, TÜBİTAK Vision 2003-2023 focusing on the importance of R&D and domestic biotechnology development.

2013

From 2013, TÜBİTAK, MoSIT, Ministry of Agriculture and the Small and Medium Enterprises Development Organization (KOSGEB) multiplied incentives and subventions for biotechnology programs. The supports can cover as much as 50% of expenditures related to R&D and focuses largely on the production of biosimilars and bio-betters as the Turkish government aims to transform Turkey into a global hub for biotechnology post 2020.

2015

In March 2015, the joint Technology Transfer Accelerator Turkey (TTA Turkey) fund with the support of the European Investment Fund (EIF) and TUBITAK went into life. As a university-industry-government collaboration to support biosimilars, the KAMAG (TUBITAK 1007) initiative was launched with the government offering grants to companies that develop biosimilars. In parallel, Bogaziçi University, Ege University and Dokuz Eylül University are leading industrial PhD programs focused on biotech and pharmaceuticals and have opened lab technician education certificate programs. One of the strongest, Turkish Economic Think-tank (TEPAV) has a dedicated team developing strategies to accelerate life sciences, especially biotech industries.

There are over 140 biotechnical companies in Turkey, with 56 of them serving the health sector. A large number of these companies focus on diagnostic methods and equipment rather than R&D. As an example of success story, the leading Turkish pharmaceuticals manufacturer, Abdi Ibrahim, established its biotechnological pharmaceutical manufacturing facility (AbdiBio) at a cost of USD 100 million in 2016 producing biologics for cancer, diabetes, rheumatism, CNS, blood, GI, dermatological, and immunological diseases.



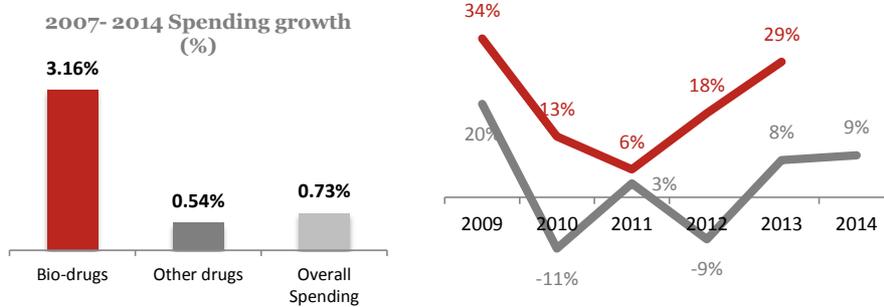
The biggest Turkish biotech cluster is located in Izmir as well as 2 major universities, Ege and Dokuz Eylül, each with approximately 60,000 students, focused on the health and life sciences industries. Each has complementary technoparks (ideEGE and DEPART), hospitals, and labs for pharmaceutical Sciences, Research Center (FABAL), Biotechnology and Bioengineering Research and Application Center (BIOMER), Electronics and Materials Production and Application Center (EMUM), Drug Development and Pharmacokinetics Research and Application Center (ARGEFAR), and International Biomedicine and Genome Institute (IBG). Under the Izmir Biotech Cluster initiative, they offer a biotech startup end-to-end product development as well as testing and certification. This cluster has many collaborative partners outside of Izmir, such as Inovita, ISEK, and Technopark Istanbul in Istanbul.

### Success Story

Created in 2009, the company VSY is manufacturing lens for cataracts surgery and won consecutively the technology award, the innovation award in 2015 and 2016. VSY's exports stands for half of total biotechnology exports of Turkey with USD 675,000 per 1kg export value.

In the last 5 years, the biotechnologies market registered important developments, especially on 5 areas.

**1- Biopharmaceuticals** is the area in which the Turkish pharmaceutical manufacturers have placed the greatest emphasis in their R&D. They heavily invested in developing ventures by partnering with companies primarily from the APAC region. The market registered a +19.4% growth between 2014-2015 reaching TRY 2.57 billion and is expected to grow at a CAGR of 15% till 2018. Biosimilar drugs were developed after 2009 however in 2015, they constituted 3% in value of all biotechnical drugs. There are currently 183 reference biotechnological drugs ( $\approx 17\%$  of the prescription drugs and  $\approx 11\%$  of total pharma market) and 38 biosimilar drugs circulating in the Turkish pharmaceutical market, only 13 of them (34% of the total) are being produced in Turkey. Biosimilar drugs experienced a significant 59% rise in the last two years, rounding up to TRY 73.6 million in revenue.



**2 - Oncology** drugs received the largest share in 2014 (52%) from biotechnology drug spending. Oncology is an important research field for Turkish scientists. The Turkish Association for Cancer Research and Control (TACRC) founded in 1947 promotes the awareness of cancer and therapies. The association works on cancer control, early detection, tobacco control, patient support and supports cancer research and supports educational activities at national and international level. At the moment, Turkey is far behind other developed European countries in oncology research. Especially the exploration of new molecules, identification of the clinical controlled trials and phase studies. Currently there are 7 national cancer control projects in Turkey:

- Tobacco and Alcohol Control Program
- Healthy Eating and Active Life Program, Diabetes program
- Turkey Excess Salt Consumption Reduction Program
- Health Effects of Electromagnetic Field Monitoring Project
- Strategic Action Plan for Asbestos
- Radon Mapping and Control Program
- Carcinogenic Substances Report



**3 - Stem cells** are cells with the potential to develop into many different cell types in the body during early life and growth. Until 2005, Turkey had legislation prohibiting the use of embryos for research. After 2005, the government decided to develop regulations but the government blocked again the human embryonic stem cell research. The break-through in 2006, by the discovery of the iPSCs resulted in a new, innovative way to do stem cell research. Currently, stem cell research is a new and small field in Turkey. There are 20-30 people clinically based working in the field of stem cell biology. Besides the clinical based research, there are 10 basic scientists, almost all of them located in Istanbul.

**4 - Genomics** is relatively new in Turkey but highly emphasized in R&D and university programs. The only publicly funded research entity of Turkey is the Genetic Engineering and Biotechnology Institute (GEBİ), department of TÜBİTAK. GEBİ is working on sequencing and proteomics. Turkey is a member of the European Molecular Biology Organization (EMBO) and benefits from its economic support and programs. The genomics industry overlaps the pharmaceutical industry with the shift to personalized medicine.

The high-ranked universities that conduct genomics research are:

- Izmir Dokuz Eylül; they established the Izmir Biomedicine and Genome Centre Istanbul
- Boğaziçi University; they conducted the human genome project in Turkey
- Koç University
- Istanbul University; Whole Genome Sequencing Laboratory
- Bilgi University
- Sabancı University
- Bilkent University
- Hacettepe University; Center for Bio banking and Genomics
- Middle East Technical University; Bio Informatics Program, Genomic Disease Modeling for Personalized Medicine
- Gazi University Hospital



**5 - Biomaterials and biomedical engineering:** There is a lot of knowledge in the field of biomaterials and biomedical engineering in Turkey. This sector is closely related to the sectors oncology, genetics, biotechnology and medical devices. Research in the biomaterials and biomedical engineering in Turkey has become competitive with the international labs in this field. In 2010, Turkey established a Centre of Excellence in Biomaterials and Tissue Engineering, BIOMATEN, with a grant support of the Ministry of Development. BIOMATEN established then the Biomaterials and Tissue Engineering Application and Research Centre. Located in Ankara on the ODTÜ (Middle-East Technical University), the center has both members from knowledge institutions as well as the industry, and is experienced with the translation of research into industry. It is collaboration between the Department of Biological Sciences, Chemistry, Mechanical Engineering, Metallurgical and Material Engineering, Engineering Sciences, and Biotechnology of METU University, and has the advisory committees from OSTİM (Middle East Industry and Commerce Center), SEİS (Health Industry Employers Association of Turkey), and two Non-governmental organizations from the medical sector and GATA (Gulhane Military Medical Academy). It has an international collaboration with professors all over the world and the Biomaterials and Tissue Engineering Society of Turkey, established in 2008, is one of the non-governmental organizations that support the centers. The Biomaterials and Biomedical Engineering industry is becoming a large industry in Turkey. Companies are investing in research and collaborate with Turkish universities. They produce biomaterials and industrialize these products for hospitals. These companies are located in OSTİM, an industrial zone in Ankara. They industrialize and patented together with BIOMATEN a wound dressing material called Neoderm. Research of biomaterials mainly consists of high-tech and innovative end products and this result in a positive mentality for future research plans. The policy of the Ministry of Development is pushing them for research. The program science for science does not have sufficient resources so the Ministry is using this budget for suitable companies. There are several high-ranked universities that conduct research in the field of biomaterials:

- Istanbul Yeditepe University
- Istanbul Technical University
- Kocaeli University
- Acibadem University Ankara
- Middle East Technical University
- Hacettepe University

### Digitalization of Life Sciences in Turkey

The influence of digital technologies is visible in Turkish life sciences, especially with the concept of “Digital hospitals” that has emerged. Thanks to the implementation of Industry 4.0 technologies into life sciences field, healthcare services become more accessible, fully connected and integrated.

Turkey may not be very advanced in producing high value added life sciences technologies but is already using technologies in all fields of life sciences. As part of its goals, Turkey has put several efforts in the digitalization of health services starting with e-health information systems and web applications.

**E-health system** was an important part of The Health Transformation Program to ensure standardization of data used in healthcare, to create an Electronic Health Record for citizens, for data analysis in the healthcare to support managers, to speed up the flow of information among stakeholders and to save resources and increase the efficiency in the healthcare system.

The Turkish E-health includes several systems that are accessible from smart mobile devices.

- Consultation Information Management System (MBYS)
- Public Health Information System (HSBS)
- Electronic Document Management System (EBYS)
- Centralized Hospital Appointment System MHRS
- Core Resources Management System (KDS) developed by Oracle,
- E-prescription system of the Social Security Institution (MEDULA)
- Other web applications such as Doctors Data Bank, Organ Information System, Green Card System...



**Digital hospitals:** As part of the process of digital hospitals transformation within the measures taken by Ministry of Health, Turkey follows the Electronic Medical Record Adoption Model (EMRAM) of the HIMSS Association (Healthcare Information and Management Systems). Composed of 7 stages, the EMRAM criteria evaluate the use of paperless technologies, integration of horizontal and vertical information systems in healthcare within and between hospitals, continuity of patients’ information and service quality. The American Hospital in Turkey was one of the pioneers in the use of electronic data storing with the PaperWork software in 2002. Acibadem Hospital is also a success example that developed its own software for pharmaceutical products management with a device: A Store.

In 2014, the Turkish Ministry of Science, Industry and Technology asked for the evaluation of 143 hospitals regarding EMRAM criteria of the HIMSS Association. As a result 9 hospitals were qualified at stage 5, 28 in stage 4 and others in stage 1,2 and 3, but non in stage 7 or 8.

Since then, the hospital of Izmir Tire was approved stage 7 in April 2016, the first in Turkey and 4<sup>th</sup> in Europe. Today, 17 hospitals are classified in level 6.

Cumulative capabilities by stage of the EMR Adoption Model (HIMSS)	
<b>Stage 7</b>	Complete EMR, CDD transactions to share data, Data warehousing, Data continuity with ED, ambulatory, OP
<b>Stage 6</b>	Physician documentation (structured templates), full CDSS (variance & compliance), closed loop medication administration
<b>Stage 5</b>	Full R-PACS
<b>Stage 4</b>	CPOE, Clinical Decision Support (protocols)
<b>Stage 3</b>	Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside radiology
<b>Stage 2</b>	CDR, Controlled Medical vocabulary, CDS, may have document imaging, HIE capable
<b>Stage 1</b>	Ancillaries – Lab, Rad, Pharmacy – all installed
<b>Stage 0</b>	All three ancillaries not installed

**Example of technologies:** From mobile applications to automated robots, the Turkish Life Sciences sector is already using many of the innovative digital technologies. In recent years, Turkey has seen many locally developed digital health solutions in particular with universities. There is a great potential of development in the coming years considering the size of the market.

Pilot hospitals have started the use of **IPad or tablets**. As an example the Kayseri Research and Education Hospital adopted BIRIM's digital hospital model. The « Mobile Medical Assistant » is a special tablet for medical purpose that will record patients data and connect to the Centralized system of the hospital. It also allows seeing patients' MR, radio, ultrasound... without using any paper.



A **QR code** project to help diabetic patients calculate the nutritional value of the product they purchase was developed by students of Trakya University's pharmaceutical faculty. The project was chosen 1<sup>st</sup> in the service category of the competition "Sen Bul Diyabet Kolaylaşsın" (Find it, make diabetes easier) organized by Sanofi and the Turkish Diabetes Foundation. Regarding diabetes, the Koç University also developed an **Online Diabetes Educational program** for children.

**Alz-e-med** is an example of mobile health developed in Turkey by BYG Group in collaboration with Gazi University under the E-Medical Patient Care Project. This application is an e-medical patient care system, developed with mobile technology infrastructure, web based software architecture, and user friendly interfaces for Alzheimer patients' caregivers. It provides first step health-care service at patients' home for maintaining the good physical-physiological conditions of the patients.



In the same way, **EvdeBakicim** is another example of mobile application. The mobile platform enables people to appoint medical personal for elderly people at home after several qualification steps. The application was first developed for baby nursing services.



**LONGI** is another example of success in Turkey. After 1.5 year of research and development, the application using Chatbot technology is designed as a life coach.

**Simulation technologies** in health are very focused on training. The first modern simulation center SIMMERK was built in Istanbul in 2007. The center now provides training for doctors and nurses in different fields such as anesthesia, gastroscopy, colonoscopy, etc. Few medical universities have also implemented simulation centers in order to provide trainings but it's still very less developed.

In the field of **3D printing**, there are 2 Turkish companies like IKIZIN and 3DÖRTGEN that are developing 3D implant printers. The Robohand, a 3D printer of prostheses and mechanical hands developed in US is also distributed in Turkey since 2012. The Military Medical Academy of Gülhane (GATA) is widely using 3D printing technologies in its Medical Design and manufacturing Center (METÜM) for biomedical products for cancer cure, defective tissue loss surgery, implants, prosthesis and orthosis, models for training, prototype for R&D. GATA is collaborating with defense companies such as Aselsan, the Ministry of Health, Michigan State University and ODTÜ University in Ankara. Sabancı University Nanotechnology Research and Application Center is also using 3D printers for tissue bio printing – example of coroner aorta. Pharma companies are using for testing medicines on 3D printed tissue

### Challenges to enter the Turkish Life Sciences market

Turkey holds great potential, as well as motivation for life sciences growth. The government has set very ambitious goals and is working to implement the required legislation. Nevertheless, there are still major challenges that Turkey needs to overcome and foreign companies willing to enter the market have to be aware of the main problematic issues that they can face during export and commercialization of their products in Turkey.

**1 – Approval process:** Companies willing to introduce new drugs into the Turkish market have to register their products with the authorization of the Ministry of Health, which can be time and energy consuming (500 days). It is strongly advised to have a local partner dealing with the registration process that can divide this time by 2.

**2 – GMP requirements:** As part of the registration process, an inspection at the production site is compulsory to check the Good Manufacturing Practices (GMP). This procedure may take a very long time as well. In 2010, Turkey began requiring plants inspection for U.S. and EU companies as well before being issued GMP certificates and receiving marketing approval for their products.

**3 – Pricing and reimbursement:** The pharmaceuticals and medical devices are subject to the same pricing and reimbursement policy that remains problematic in Turkey. The pharmaceutical industry is mainly focusing on generics instead of original pharmaceuticals and the government is trying to cut back on the medical devices expenses by choosing the most inexpensive devices to reimburse. This results in a low added value production and high amount of imported products.

**4 – Patenting regulation:** Patent protection in the life sciences market is a relatively new concept in Turkey. Turkey lacks an effective patent linkage system for resolving related disputes, and lacks of legal content for copyrighting, bio-banks, and consumption coding. For more innovation and investment, the strengthening of IP protection is inevitable. As Turkey is a signatory to the European Patent Convention, improvements are expected.

**5 – Localization:** The government's special support for domestic production has led to increasing localization. The incentives such as preferential reimbursement arrangements for domestically produced products have lead many foreign manufacturers to localize their production in Turkey and to powerful merger & acquisitions.

**6 – Transparency:** Finally, transparency remains problematic throughout Turkey's regulatory system. For example, in February 2016, Turkey released a draft patent law with wide-ranging implications, including further restrictive patentability requirements for second usage and vague and concerning language on compulsory licensing to satisfy domestic demand.

The health reforms of the Turkish government have brought numerous positive developments to the healthcare sector. However there is a need for more focus on how to ensure sustainability instead of a cost-oriented approach. Still, the continued involvement of multinational firms in the market is a positive indicator of its potential. More emphasis shall be given to R&D and innovation. The Ministry of Science, Industry and Technology is aiming to increase the R&D budget, emphasizing the importance of university-industry cooperation and offers to cover 85% of the costs arising from these cooperation's. R&D financing and State-funded research should therefore increase offering consequently opportunities for foreign investors.

## Opportunities for Swiss companies in Life Sciences

Turkey's big hospital projects, its will to become a quality medical tourism destination, its position as a hub to the Middle East and Asia are all factors that make Turkey a very attractive country for investors who are already flocking to Turkey to capitalize on its encouraging policies and advantageous market. The Life sciences market offers many different opportunities and collaboration possibilities for foreign companies, especially European investors.

1

### Pharmaceuticals

Turkish pharmaceutical industry being mainly focused on generics, original drugs remain highly imported offering export opportunities for foreign drug manufacturers. But due to the complicated reimbursement policies and long registering procedures mentioned above, companies willing to target the Turkish market and around might take advantage of outsourcing opportunities instead. There are many opportunities on OTC products exports as well where regulation is still unclear.

2

### Medical Devices

The healthcare expenditures have increased tremendously in the last 10 years, with an increasing demand of medical supplies and medical technology. Compared with the OECD countries, Turkey has still less medical device per person and Turkish companies are more focused on low value added products. Therefore, export possibilities exist for foreign companies. For Swiss companies willing to export medical devices in Turkey, opportunities of partnerships with local companies are high and are an easier way to enter the market with already known and active companies. Turkey recognizes CE (European Conformity) and is part of the Horizon 2020 program of the EU, which enables R&D collaboration within the field of medical devices.

3

### Biotechnologies

Turkey does not want to import products from international companies anymore and is increasing researches in the field of biotechnologies. Turkey offers low cost clinical studies and production when compared to countries such as the United States and some Western European countries. The quality of the student programs and knowledge within some universities is very high. The sub-sectors genomics, oncology and stem cell biology are developing rapidly. Currently there are several European knowledge institutions collaborating with Turkish universities. Over the last decades, biomaterials represent a challenging field, which shows opportunities for companies to invest large amounts of money in the development of new products. Thanks to new policies and the government funding, this sub-sector is very attractive for international companies.

4

### E-health

Turkey stimulates R&D in e-health by funding a large amount of research projects. The sector is facing challenges that can be changed into opportunities for foreign companies willing to be part of the improvement such as the development of software, mobile health applications, software security and healthcare information technology policies and ethics. The government is open to high-tech and innovative e-health information system and is interested in advice and help with the policymaking, law and ethics for new applications. There are several opportunities in knowledge transfer through a technology matchmaking or one to one business.

5

### Preventive Health

Preventive healthcare offers opportunities for Swiss companies and institutions, as the shift to non-communicable diseases is currently ongoing in Turkey. To prevent a high prevalence of chronic diseases in the future the Ministry of Health is focusing more on preventive healthcare. In that sense, Turkey is actively taking part in 3 Joint program initiatives of the European Union: "A healthy diet for healthy life", "JPI on Antimicrobial resistance" and "EU Joint Program on Neurodegenerative Disease research".

Overall, there are important opportunities in the R&D in Turkey. Collaboration between universities and companies in Turkey shows great potential for international investors. The translation of research into the industry is often integrated in technoparks at the universities or in the Technology Development Zones. Both areas show great advantages like exemption from several taxes and governmental support. Turkey also shows great interest in knowledge and business collaboration. Companies and universities show an active research mentality that results in collaboration in several research projects. In 2014 Turkey became a partner to Horizon 2020 projects. Besides Horizon 2020, Turkey takes part in many other EU programs.

Other opportunities for Swiss companies are to outsource their production in Turkey. Thanks to the low production prices and to a strategic hub location, Turkey offers lots of advantages. There is an easy access to export countries and the production of high added value products in Turkey may result in an increased added value within Turkish companies.

Within the years, the Turkish government became more interested in R&D and clearly aims to become a global leader in the Life Sciences and Health sector. To accomplish this aim, the government started a finance program which finances 75% of fundamental approved research. This program is open for all technological areas.

An example of the opportunities and the pro-active behavior of the Turkish government are the new projects to develop 'smart hospitals', which will use the same energy source for heating, cooling and lighting systems.

This shows opportunities for 'smart' medical devices and other added value products for foreign companies through partnerships with local companies (know-how transfer, export partnership, outsourcing, M&A...).

**Do not miss the coming events in Life Sciences to discover the Turkish market and its actors**

4<sup>th</sup> Health ICT Summit in March 2017  
WOW Istanbul

CPhI in March 2017  
IFM Istanbul



Discover  
the potential

## Conclusion

Turkey is a resilient economy despite internal and external shocks and offers many assets for investors. With a fast penetration of digital technologies in the last few years, Turkish population ranks among the first users of social media and mobile technologies in the world. This young, highly connected and consuming population eager for new products, makes Turkey an attractive domestic market for companies willing to sell innovative products and target young and curious consumers with improving income level.

Furthermore Turkey has become a regional hub for distributing and producing goods where many giant multinational firms are already implemented for decades. Despite an important decrease in cultural tourism in 2016, Turkey keeps attracting foreign professionals taking part in important international trade fairs and also medical tourists thanks to its competitive high quality level healthcare services.

Thanks to an affordable and qualified work skill and its will to become a high added value products exporter, Turkey offers many opportunities of outsourcing and technology transfers as well. The Turkish government is very proactive and highly involved in the economy in order to facilitate broader development and entail higher public and private investment, skilled job creation and for this purpose takes several sectorial reforms and offers many incentives per sector of activity.

As a candidate for the European Union, Turkey is also part of several subsidy and development programs allowing research and development cooperation for European companies in several fields.

As an industrialized and fast emerging country, Turkey is indeed trying to catch up with highly developed countries especially for innovative high value added products and is therefore investing in R&D. Turkey has set a route map until 2023, the centenary of the Republic to improve its infrastructures and boost strategic sectors.

In this context, foreign investors are more than welcome to bring their knowledge into the market and collaboration opportunities are high on many sectors especially 4 strategic ones that are transports, defense, healthcare and new technologies and information systems. Digital and smart technologies are as a consequence a must do and must have for the country's future welfare and sustainable growth.

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