

The Opportunities of Industry 4.0 Technologies

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ABSTRACT

The world is starting a new industrial revolution through Industry 4.0. The power and impact of developing technologies are increasing with the ever-spreading data communication and expanding information network. This new age will have an effect to change the business life, the life cycle of products, service areas, business models, machine safety and even socio-economic standards. The recent design and developments in sensor network technologies and machine to machine communications paved the way for Internet of Things (IoT) which is one of the most essential technologies of Industry 4.0. As the ability to collect data from various IoT applications increase, the concept of big data come into place. Many companies aim to analyze data to better serve their customers. The sensor technologies also heavily used in smart cities where we begin to see the expansion of smart houses, smart appliances and smart gadgets within these smart houses. Many of the developers are starting to incorporate smart designs from the ground up, creating a fully smart environment in which the house adapts itself to the needs of its occupants.

Keywords: Industry 4.0 technologies, IoT, sensor networks, smart cities

1. INTRODUCTION

Industry 4.0 is the promotion of existing industry through digitalization and computerization. In this context, machines will be able to understand their environment and communicate with each other through the Internet of Things (IoT). Industry 4.0 will combine intelligent product manufacturing processes with embedded product technology, launch a new technology, and this technology will turn into business models and supply chains. Industry 4.0 is not only a technological revolution, but also a new process that takes place in many areas from health to education. With the digital transformation and Industry 4.0, the connection between people, objects and systems at the new level will be widespread and effective.

Due to this infrastructure, self-organized, real-time cross-organizational value-value chain networks will be formed. These networks have the ability to optimize themselves according to various criteria such as cost, accessibility and resource utilization [13]. The automation of the processes is essential to increase efficiency and reduce costs. It is clear that the use of IoT in companies that refer to better customer service, new revenue flows, changes in business models and innovation.

2. INDUSTRY 4.0

Industry 4.0 is used to describe the next industrial revolution. This revolution, also known as Internet of Things (IoT) or Industrial Internet of things (IIoT) demonstrates the technological change of today's production through the smart factory vision. In order to create a factory that is able to manage more complex systems than today, innovations in the fields of informatics, embedded systems, production, automation technology and mechanical engineering prepare the development of this new process [11].

Industry 4.0 is the digital transformation of industrial markets (industrial transformation) with smart production. Industry 4.0 represents the fourth industrial revolution in logistics and supply chain (Logistics 4.0), chemical industry, energy (Energy 4.0), transportation, public services, oil and gas, mining and metals and other segments [16]. Cyber-physical systems is also very important which includes smart machines and productions facilities which can function almost autonomously. This in turn clears the path for engineering, manufacturing, and supply chain management [4].

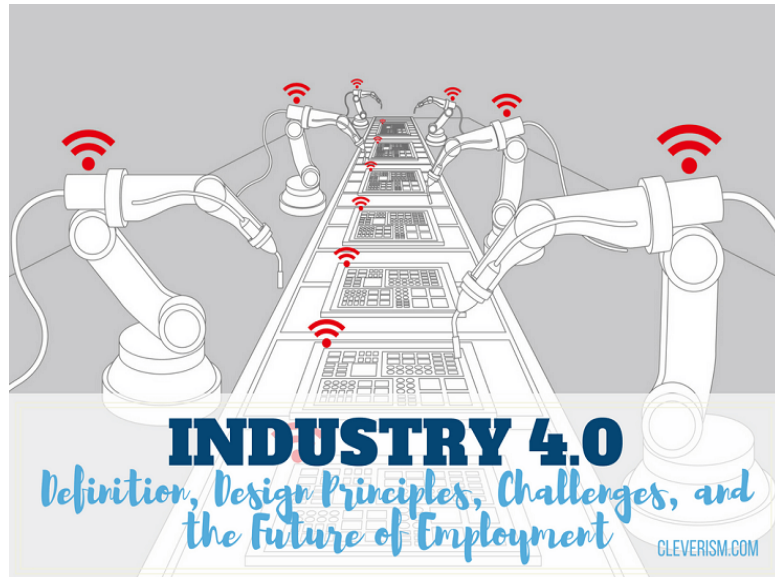


Figure 1: Industry 4.0 [4].

Source: ©Shutterstock.com | chombosan, <https://www.cleverism.com/industry-4-0/>

3. INTERNET OF THINGS & SMART CITIES

As estimated by many companies, The Internet of Things (IoT) is expected to connect about 30 billion smart things (objects) within the next couple years. The types of applications and scenarios are endless. Here are few scenarios to consider [6]. The first scenario starts with you having a difficult workday and decided to take a shower. While showering you are thinking about having a nice cold ice cream. As you are reaching out to get your ice cream, a wireless speaker states your current weight (coming from the bio-monitoring sensor fitted in the bathroom) and recommends you think about eating more healthier food choices from the fridge. In the second scenario, you start a pleasant weekend with a good night sleep. You get into the mood for walking but since you are not regular at walking, you are not familiar with the parks around your apartment. Luckily, your mobile app provides you sufficient information about the close by parks that you can walk. In addition to the park information, the app also provides you the all the registered user who are also walking along the path you choose. Another common scenario is the fact we can easily turn off our lamps, oven or other objects that we forget to turn off when we leave home with our mobile phone. In this context, the concept of smart home has emerged with the Internet of Objects, in which all the item in a home connected with each other, creating (big data). As you can see from the example scenarios, IoT connects devices in many application areas. Intelligent sensors play a crucial role in the distribution of data, as a key activator for many new applications. In addition to sensors, radio frequency identification (RFID) tags and readers are also frequently used in IoT applications [5].

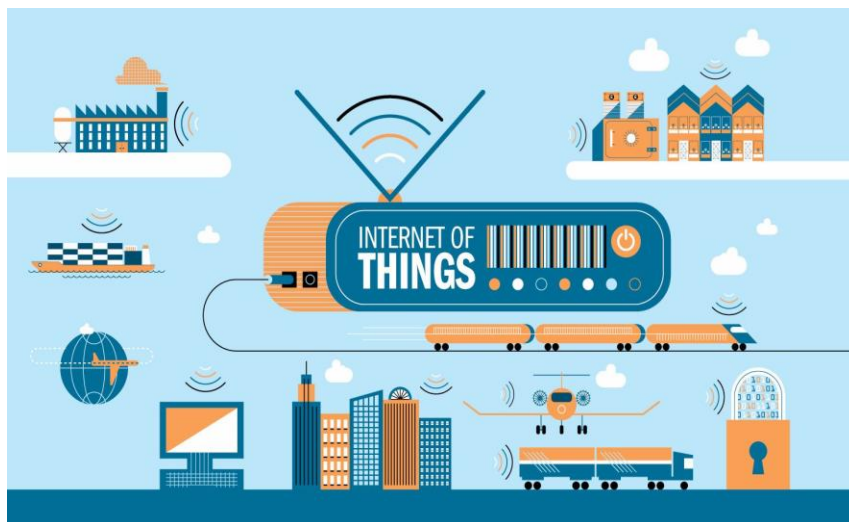


Figure 2: IoT scenarios [6]

Source: <http://inxee.com/blog/internet-of-things-what-makes-the-weirdest-of-thoughts-turn-into-reality/>

Management of IoT

One of the biggest challenges in IoT is to manage all the devices connected to each other. In the past, a person would have a desktop at home and at work and those machines provided the connectivity to the outside world. Nowadays, people have desktop/laptop computers, smart phones, tablets and so on. Most of the devices at home or in the office are somehow connected to each other and online. As the number of connected devices increase, the managing of these devices becomes an important issue. Managing IoT devices are not quite the same things as managing typical IT networks with routers, switches, etc. The devices in IoT differ significantly from one domain to another. Managing small sensor embedded in various home appliances such as smart fridge, smart kettle to sensors on cars to wind turbines in which all are getting connected. Industrial IoT (IIoT) is another concept powering industrial IoT things. In order to successfully manage these IoT devices, the companies need to consider the Internet not as the Internet of People (IoP) but the IoT. Here are the main differences between the things and people [8]:

- *A lot more things than people:* there are significantly more things connected to Internet than people in the world. By 2022, it is expected that we will have 1 trillion networked sensors.
- *Things can tell you more than people:* people used to go around with a personal digital assistant and collect information from the machines and sensors in the past. There days on the other hand, each IoT devices have far more sensors than in the past. For instance, a typical Smartphone has more than ten sensors including GPS, accelerometer, gyroscope, microphone, magnetometer, proximity sensor, ambient light sensor, touch screen sensors, etc. Industrial things such as wind turbines may include various sensors in the range of hundreds.
- *Things can talk constantly:* people do not nearly enter data into data collection systems compared to embedded sensors in the smart IoT devices. For instance, a utility grid power sensor can send data 60 times per second.
- *Things can be programmed:* the programmability aspect of the IoT devices are far more beneficial than one can easily admit.



Figure 3: Management of IoT [8].

Source: <https://www.itproportal.com/features/in-a-world-of-connected-things-organizations-need-thing-management-and-a-new-kind-of-internet/>

How a digital marketplace creates value

As we are collecting enormous amount of data in the ranges of gigabytes, terabytes and even petabytes, most businesses do not know how to efficiently analyze the data and monetize it. McKinsey research concludes that many companies indeed underutilize much of the IoT data [1]. One possibility is to offer the collected data to third parties in which the companies find it as acceptable practice, the consumers might differ in their opinion. Digital marketplaces are defined as platforms connecting providers and consumers of data sets as well as data streams. They need to ensure consistency, quality and security. Essentially, the data suppliers allow the marketplace to license their information on their behalf based on the predetermined terms. The consumers can potentially provide their data back to the marketplace.

Third parties can give value-added solutions through offering real-time analytics in which the companies can quickly make decisions and act upon those decisions. The six essential components of the data marketplace that can assist companies with their collected data are as follows [1]:

- *Building an ecosystem:* through assembling a great number of third-party entities
- *Opening up new monetization opportunities:* through services in which the companies can decide on the pricing based on the available customer data and market trends
- *Enabling crowdsourcing:* crowdsourcing allows collection and sharing of data and possible monetizing it through consumer incentives
- *Supporting interoperability:* interoperability is at most important when it comes to connecting various IoT devices and naturally, the collected data needs to make sense across different devices. The definition of meta-data formats is essential.
- *Creating a central point of discoverability:* having a central platform that the customers have access to satisfy their data needs is crucial
- *Achieving consistent data quality:* through predetermined terms and conditions, consistently high quality data can be delivered

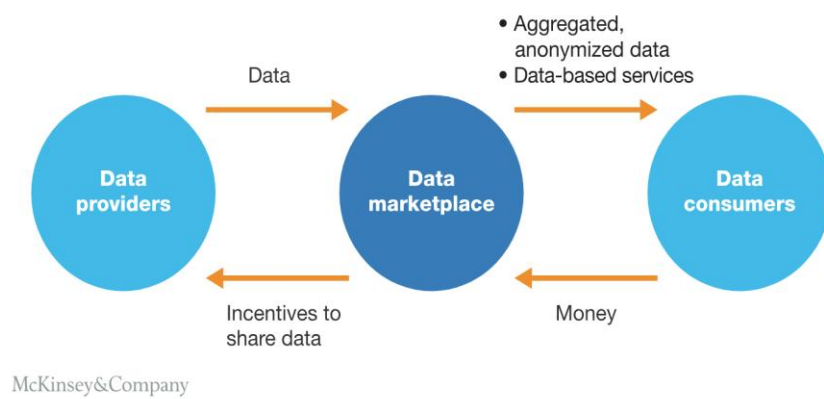


Figure 4: Aggregated data can be incentive for providers to share the data [1].

Kaynak: <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/creating-a-successful-internet-of-things-data-marketplace>

4. SMART CITIES

The smart city is referred to a city that includes information and communication technologies to improve the quality of urban services such as energy, transportation, and public services to reduce resource consumption, waste and overall costs. The inclusive purpose of a smart city is to improve the of life standards for citizens with smart technology [14]. The smart city is essentially the development of a technological infrastructure that allows to collect and analyze real-time data to improve their residents' lives [11].

Internet of Things (IoT) is one of the key elements towards building smart cities. Each device within the smart city need to communicate with each other to manage the resources of megacities populations. IoT helps cities connect to different services, infrastructure and public service networks. Smart phones have become the keys of the city and provide information about transit, traffic, health services, safety warnings and community news. IoT companies lead the design and the development of intelligent technological solutions to provide every day services to the inhabitants of the cities in the world [7].

Smart public transportation is another face of smart cities used to ensure that public transport meets user demand. Smart transit companies can coordinate services and fulfill the needs of riders in real time, increasing efficiency and driver satisfaction. For instance, smart traffic management monitors and provides analysis of the traffic flows to optimize street lights based on daylight hours or busy working hours. Energy saving and efficiency are important focuses of smart cities. Using smart sensors, smart street lights are dimmed when there are no cars or pedestrians on the roads. Smart grid technology can be used to improve operations, maintenance and planning, and power on demand and monitor power failures.

Monitoring and addressing the environmental concerns such as climate change and air pollution are other important smart city initiatives. IoT-enabled fleet management systems for the use of internet-connected trash cans and waste collection and extraction, or use sensors to measure water parameters and guarantee the quality of drinking water.

Intelligent city technology is increasingly used to enhance public safety from the areas of high crime monitoring to the improvement of emergency preparedness with sensors. For example, intelligent sensors may be critical components of an early warning system prior to drought, flooding, landslides or hurricanes [15].

Only about 14 percent of the world's population lived in urban areas in 1900s. The number of smart cities in the world is expected to increase, and by 2050, 70 percent of the world's population is expected to be living in cities equipped with smart technologies. According to International Data Company (IDC) [9], smart city technology spending reached \$80 billion in 2016, and is expected to reach \$135 billion worldwide.



Figure 5: Smart City Applications [5].

Kaynak: http://jomeitec.com/Solution_4.aspx

As many people move from rural to urban areas, the cities face challenges to accommodate additional citizens in the cities while making sure that the quality of lives for each citizen remains at acceptable levels and economic growth is achieved. The smart city solutions include smart buildings, smart parking management, smart energy management, smart lighting, smart traffic management, and smart farming to name a few [5].

5. DIGITAL CURRENCIES

Digital currency (also known as digital money, electronic money and/or currency) is essentially a type of currency in digital form. This is different than the physical form of currency such as bank notes and coins. The digital currency allows instant transactions. Virtual currencies and crypto currencies are examples and they are used to purchase goods such like a paper money. The digital currency can be either centralized or decentralized. It can be transferred between users through digital technologies such as smart phones.

The digital currencies, led by Bitcoin, bring many technological trends with it such as encryption, block chain, virtual central repositories, and so on. The digital currencies are expected to become much more widespread in the coming years, making interbank money transfers much cheaper and faster. The most vital benefit of digital currencies will be the development of confidence in online purchases. Bitcoin will eliminate the problems of trust in e-commerce and will facilitate the integration of developing exporters with the global world due to the creation of the digital objects created by the sophisticated algorithms. This development will allow the small companies to provide products to the general public much more than before [3].

6. SOCIAL AND MOBILE ECONOMY

Social and mobile economy is undoubtedly the top of the forces that shape our world. Social media is now an integral part of our daily lives. Social media platforms are both very large. For instance, the number of active users on Facebook is almost over China's population and on average one user spends 2 hours per day on social media platforms. These scenarios made social media one of the most important channels that companies need to monitor and manage. Many customer-oriented companies stand out with their successful use of social media to communicate with their customers.

In the near future, companies will continue to enrich the content and services they offer through social media, and connect social media with other channels to deploy social media to the spine of the omni-channel structure [3].

CONCLUSIONS

Industry 4.0 is an industrial revolution involving data exchange and production technologies with contemporary and modern automation systems. This industrial revolution covers the Internet of Things, the Internet services and physical-virtual systems. Within this scope, by reporting every data with the possibility of technology, it saves time and helps to increase efficiency [17]. With Industry 4.0, the customers will be able to fully customize their shoes via the Internet, and customized shoes will be delivered within a few days after ordering. Continuing the same process in the automobile industry, Industry 4.0 automation will start when the customer decides to configure his customized car at the dealer. As a result, the market environment will change with Industry 4.0.

During the production process in Industry 4.0, the costs are gradually decreasing. Even though the costs may seem to be high, most of the problems experienced in production is expected to be eliminated. The niche products will appear and excess raw material use will end. Digitalized factories will have 7/24 production potential. The fact that this system has an improved and adaptable feature proves the existence of a long-term quality. Industry 4.0, a sustainable application, can be revised to comply with the requirements [2].

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