

SMALL STEPS OR BIG CHANGES IN ACTUAL SOCIETY: THE IMPACT OF INTERNET OF THINGS

Roxana HUCANU

Alexandru Ioan Cuza University of Iași, Faculty of Economics and Business
Administration
Iași, Romania
roxana_hucanu@yahoo.com

Mircea GEORGESCU

Alexandru Ioan Cuza University of Iași, Faculty of Economics and Business
Administration
Iași, Romania
mirceag@uaic.ro

Abstract: *The Internet of Things is capable of transforming the business area and generating an impact among many areas covered political, from health to commerce. As a result, the Internet of things technology becomes the spotlight for both business area and governmental leaders who are striving to adapt the new digital landscape. The number of potential application of the IoT is in a continuous growth and development, across all areas of everyday life of individuals, enterprises, and society as a whole. The digitization has to transform the computer from past years from a memory card into a button that represents the computer from nowadays. This makes Moore's law remain valid in our days and transform the Internet information and people in the Internet of Things.*

Keywords: *IoT, Intelligent systems, intelligent devices, Mobile Applications.*

INTRODUCTION

The Internet of things - IoT concept was first defined by Kevin Ashton in 1999. In 2016, the Internet of things is already a disruptive technology capable of determining fundamental changes that are happening in everyday life and it is considered the fourth industrial revolution after steam engine, mass-production and the appearance of the Internet.

The Internet of things represents an ecosystem where ordinary objects around us, objects like phones, cars, clothing, appliances, and even food that are communicated and they are connected to the Internet using smart processors and have the ability to collect and exchange data.

Currently, an average person owns at least two objects that are connected to the Internet, it is estimated that the number of objects it is in a continuous increase, so the number of owned objects connected to the Internet will increase to six or seven by 2016, when worldwide will be in use 6.4billion connected things. By 2020, their number could double reach 20.8 billion, according to areport by Gartner.

According to Gartner Group, the Internet of Things will support total services spending of \$235 billion in 2016, up 22% from 2015. In the top of services is the professional category (in which businesses contract with external providers in order to design, install and operate IoT systems), however, connectivity services (through communications service providers) and also consumer services will grow at a faster pace. According to IERC¹, whose vision is “the major objectives for IoT are the creation of smart environments/spaces and self-aware things (for example smart transport, products, cities, buildings, rural areas, energy, health, living, etc.) for climate, food, energy, mobility, digital society and health applications” (1).

THE IMPACT OF THE INTERNET OF THINGS

The Internet of Things has a major impact in our future of mankind and on the daily life of the individuals. We are part of a world where everything has the potential to be connected. As a matter of fact, it is estimated by Gartner that by 2020, the installed base for the Internet of Things will exceed \$212 billion and will be over \$30 billion of “connected things” (2). From a Financial perspective, the IoT project value it is expected to strive for \$30 billion by 2020 and will be a major factor in the global economy.

Social impact

The Internet of Things technology will influence our society by facilitating the possibility to work from different workspaces, increase the rate of migration abroad without loose the contact with family or friends, making physical environments more accessible and easier for old people and by using surveillance improve the personal security. Of course, using this technology will generate negative aspects like the exposure of formerly private personal behaviors, loss of livelihoods and affects political implications (in the case of bad solutions or mismanagement of major flood events may lead to disconnect or loss of trust in state, authorities or governments).

TECHNOLOGICAL IMPACT

According to Nick Jones² (3), "The IoT demands an extensive range of new technologies and skills that many organizations have yet to master. A recurring theme in the IoT space is the immaturity of technologies and services and of the vendors providing them. Architecting for this immaturity and managing the risk it creates will be a key challenge for organizations exploiting the IoT. In many technology areas, lack of skills will also pose significant challenges."

The technology will have a very broad impact on companies, will affect the business strategy and risk management by transforming the business. IoT combines the physical and digital worlds and even if the changes for physical spaces hasn't been fully realized it can be observed changes in the manner in which the good are manufactured, distributed, serviced, refined and how networks are managed and protected.

¹ IERC – European Research Cluster on the Internet of Things

² Vice President and analyst on Gartner

ECONOMIC IMPACT

The increasing of total number of Internet of things devices has an economic impact in the way of cost saving, general economic growth, productivity improvement and value creation.

According to McKinsey Global Institute, the potential economic impact of Internet of things technology will be \$6.2 trillion per year by 2025, the largest of which will be felt in the manufacturing and health care industries(4).

APPLICATION AREAS

Our society has experienced in recent years major challenges and transformations caused by the evolution of marketplaces and applications, challenges and transformations that are creating important opportunities in the marketplaces of consumer electronics, automotive, medical applications, and communications. These societal trends can be grouped by domains: transport, health, security, e-society, energy, industry, etc. The applicability area of Internet of Things brings together existing area of daily life, enterprises and society as a compact group where are developed a large number of applications designed to make life easier and smart. More exactly, a smart life can be obtained by transforming various vertical domains into a single and unified horizontal domain.

According to Strategic Research Agenda (SRA), the main applications of IoT (also named “vertical domains”) are smart energy, smart buildings, smart health, smart living, smart cities, smart transport, smart industry.

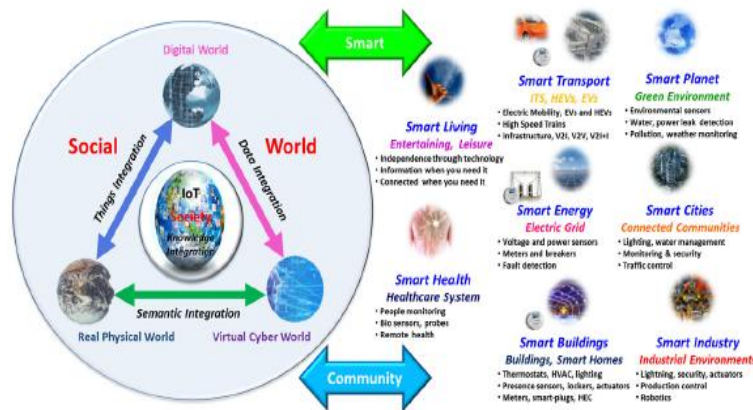


Figure 1 The Internet of Things – Smart Environments and Applications³

SMART LIVING

Smart living is referring to the use of Internet of Things applications for houses, payments, offices, security and industries. The main idea of smart living is to equip home

³ Source: <https://www.linkedin.com/topic/smart-environments>

using technologies that allow people to control all the existing electronic devices. The solutions are using open platforms and a network of smart sensors in order to procure information about the state of the home (see Figure 2). Systems like air conditioning, lighting, ventilation, security, heating and so on are monitored using smart sensors that provide information using smartphones, tablets, and touch screen (5).

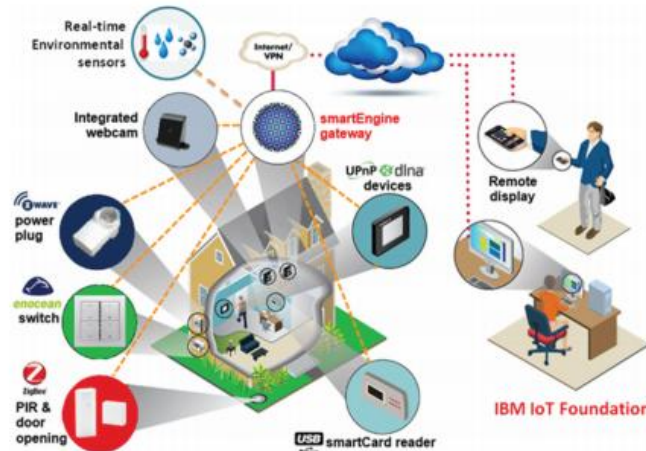


Figure 2 Home equipment and appliances (6)

Examples of applications:

- Applications used to heat efficiently your home by using smart thermostats (for example Nest products⁴) that allow saving energy;
- Application for Smart refrigerator with LCD screen that displays a list of products that are in the refrigerator, that are about to expire, or gives the person the possibility to create a list of the needed products and send directly to the application;
- Application for weather stationable to transmit information like humidity, temperature, wind speed, rain levels no matter the distance involved.

Applications that provide the possibility to light you home in many ways, for example, Philips's Hue⁵ enabled user to change to ambient lights when the owner is 5 minutes away, automatically turn the light off when the room is empty, secure home by turning lights on and off when everyone is away.

Use devices like the Ninja Block⁶ that allows tracking if a water pipe has burst or if there is motion inside your home and send automatically a notification using e-mail or text message when something changes at the home.

Example of companies: Nest, Ecobee, Ring and August.

⁴For details, visit website <https://nest.com/>

⁵ For details, visit website <http://www.postscapes.com/wifi-lights/>

⁶ For details, visit website <http://www.postscapes.com/home-wireless-sensor-systems/>

SMART ENERGY

Because the changes that are happening in the world we must no longer base on fossil resources when it comes to obtaining energy, and based on various renewable resources. The energy consumption behavior must be prior because of the fact that the energy is wasted in many places and influence in a negative way our society. When we discuss Smart Energy, the most popular applications are related to Smart grid and Smart meters. Smart grid represents an electrical grid which includes a range of operational and energy measures, among which may include smart meters, smart appliances, renewable energy resources, and energy efficiency resources (7). The most known projects of Smart Energy are implemented in Tucumán, Argentina (8) and Jeju Island, South Korea (9).

Other applications are:

- Wind Turbines – Analyze consumption patterns obtained by controlling the flow of energy obtained by wind turbines and two-way communications with consumers smart meters;
- Water Flow –Measure water pressure in water transport systems;
- Radiation Levels–Generate leakage alerts according to radiations levels in nuclear power stations;
- Photovoltaic Installations - Monitoring and optimization the obtained performance in solar energy plants.

SMART HEALTH

Using Internet of things technology in the Healthcare industry is adding more value and improving the quality and accessibility of devices. Advantages that can be obtained by using this technology are Medical Fridge, Drug tracking, Ultraviolet Radiation, remote monitoring, Sportsmen care, Ambulance telemetry, etc. This will have a positive impact on our lives helping us to live a happily life avoiding medical issues. For example, we can use Medical Fridge to control the conditions inside freezers that storing vaccines, medicines and organic elements, or we can measure the UV sun rays by using Ultraviolet Radiation that can send alerts to people to avoid exposed in certain hours.

SMART CITIES

We can define the Smart city as a city that has the ability to control and supervise conditions of all of its critical infrastructure, water, power, roads, airports, rails, subways, communications, buildings in order to track and optimize its resources, create preventive maintenance plans while maximizing services to its citizens. Also, problems like traffic congestions, pollution or shortage of energy supplier can be solved by using Internet of things application. The impact of the Smart city on society is obtained by creating sustainable economic development and increase the quality of life by exceeding in other multiple areas like mobility, economy, living and government.

Example of applications:

- Smart belly trash – use cellular communication to send alerts when a bin is full to the municipal services;
- Find available park slots by installing sensors and send them to the web applications
- Smart parking - monitoring the available parking spaces;
- Structural health – monitoring the material conditions and vibrations in bridges, buildings and historical monuments;
- Smartphone detection – detect any device that has use WiFi or Bluetooth interfaces;
- Traffic congestions – optimize driving and walking routes by monitoring cars and pedestrian (e.g. Intel and Siemens developed Smart Parking solution available in the city of Berlin);
- Smart lighting – control adaptive light for street lights.
- Smart roads – track warning messages and diversions depending on the weather or unexpected events. We can consider an example, the Indians that are developing the first Indian smart city that's located near Gujarat' capital, named Gandhinagar (10).

SMART TRANSPORT AND MOBILITY

The Smart Transport and Mobility represent the connection of vehicles to the Internet in order to create new possibilities and applications which bring new functionalities to the individuals and making transport safer and easier. Internet of Things represents an inherent part of the vehicle control and management system, enables new transport scenarios (for multi-modal transport), and enables traffic management and control.

Example of applications:

NFC Payment: Process payments in different locations and based on activity duration for transport tickets, gyms, parks, so on;

Item Location: Find individual products in big surfaces;

Quality and shipments conditions: Control and apply insurance in the case of vibrations, strokes, container openings;

Storage incompatibility Detection: Control emissions and prevent the storing of inflammable goods across others inflammable goods;

Vehicle Auto-diagnosis: Send real-time advices and alerts to drivers in the case of emergencies;

Road pricing: is referring to automatic vehicle payment systems that allow improving traffic conditions;

Smart Industry

The Smart Industry it's based on IoT projects footprint in Oil & Gas and in factory environments that contain a wide range of "connected" things from shop floor machinery (for example, the German food producer Seeberger (11)) to printing equipment. One of the most known example of monitoring equipment is RasGas' LNG (12), located in Laffan, Qatar, that allows the provider to perform predictive maintenance on its assets.

Example of applications:

Tank level: Control and manage the water, oil or gas levels in big cars like tanks or cisterns.

M2M Applications: Machine auto-diagnosis and assets control;

Maintenance and repair: Control products and create reports based on sensors located inside equipment in order to provide service maintenance and repair in the case of part failure.

Indoor Air quality: Management of toxic gas and oxygen level to maintain workers and goods safety.

Ozone Presence: During the meat, the process allows the control of the level of ozone levels in food factories.

INTERNET OF THINGS APPLICATION RANKING

According to K. Lasse the most ten popular applications available in 2015 on the Internet of things are:

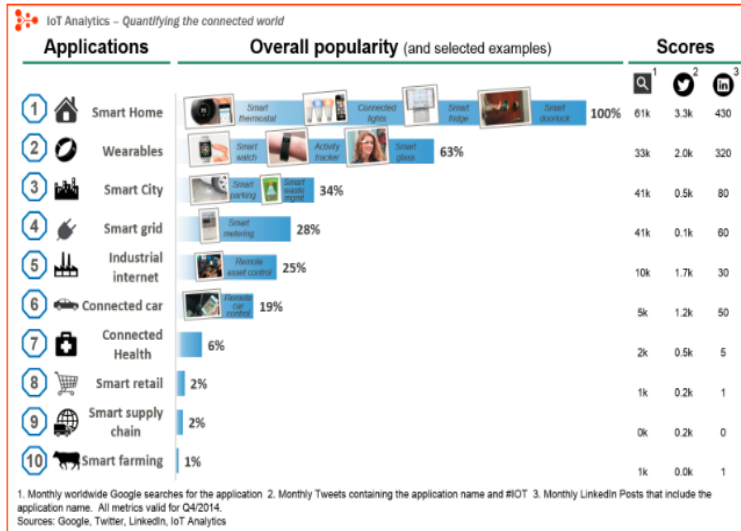


Figure 3 Internet of things applications ranking (13)

As we can see in Figure 4, the Manufacturing market segment is the largest IoT market segments. The analysis is based on the reports that are trying to forecast revenue or device specific development per segment (14).

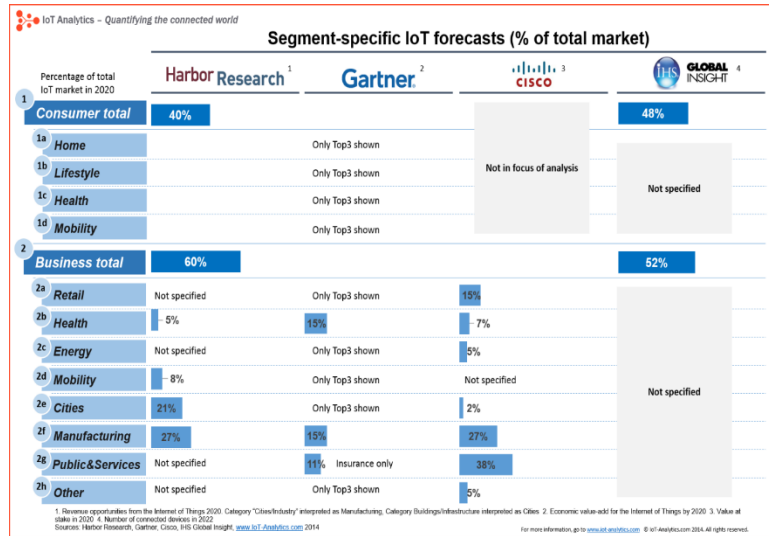


Figure 4 Internet of Things markets segments forecasts

As we can observe the Internet of things is about data, devices and connectivity. The IoT and Big data represent the interconnected by the massive amount of data, obtained by connecting objects. In 2015, the IDC⁷ notes that “Today, over 50% of IoT activity is centered in manufacturing, transportation, smart city, and consumer applications, but within five years all industries will have rolled out IoT initiatives.” (15) Major advantages and benefits can reside by sensing big data model: built-in cloud computing by inheriting all the benefits from cloud models; participatory sensing by enabling a rapid deployment of sensors across a wide area of locations from where we can capture various phenomena; sharing and reusing by accessing others sensors and pay a fee to the sensors owner.

INTERNET OF THINGS: 4G VS 5G

Even if the 4G⁸ networks incorporate the latest technologies and offer faster data access, the road beyond LTE⁹ and LTE-A is far from clear. Due to increased demand for wireless communications, the industry has difficulties in offering faster data and greater access. The mobile Internet has inspired researchers to think beyond faster data and greater capacity. These new networks, referred to 5G (fifth generation), may transform our lives and unleash enormous economic potential.

⁷ IDC – International Data Corporation

⁸ 4G – is the short name for fourth generation wireless, the stage of broadband mobile communications that will supersede the third generations (3G) (18)

⁹ Mobile communication standard

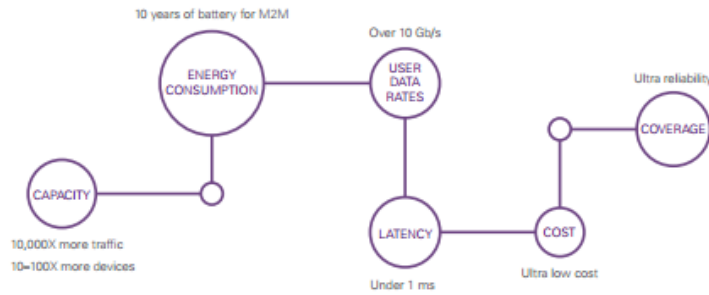


Figure 5 The Fifth-generation technology challenges

5G will appear and its impact will be transformational, but this will take the time to design tools and technologies. The 5G technologies are moving forward, and the vision of IoT applications for everyone and everything comes closer to reality every day.

CONCLUSIONS

The explosion of devices connected to the Internet has been dubbed the Internet of Things (IoT). These devices may incorporate sensors to measure pressure, temperature, or stress and perhaps include actuators to turn on and off devices or make adjustments in real time. The Internet of things minimizes the human interventions and will have a major impact in the way we live and work. Ways of how The Internet of Things will change every Business are allow companies to make smarter products, enable smarter business operations and smarter decisions and change the business model.

The IoT impact in the industry it is significant for operational efficiency. Rising low costs for sensors and the increased demand for optimized processes will lead to an expansion of IoT applications in this sector.

References

1. O. Vermesan, P. Friess et. *Internet of Things – From Research and Innovation to Market Deployment*. s.l. : River Publishers, 2014.
2. *Gartner*. [Interactiv] 10 11 2015. [Citat: 30 10 2016.] <http://www.gartner.com/newsroom/id/3165317>.
3. Jones, N. *Gartner*. [Interactiv] 23 02 2016. [Citat: 30 10 2016.] <http://www.gartner.com/newsroom/id/3221818>.
4. *Projecting the Growth and Economic Impact of the Internet of Things*. A. Thierer, A. O'Sullivan. us : Mercantus, 2015.
5. R. Govindan. Connected Devices for Smarter Home Environments. *IBM Big data & Analytics Hub*. [Interactiv] 18 04 2014. [Citat: 30 09 2016.] <http://www.ibmbigdatahub.com/blog/connected-devices-smarter-home-environments>.
6. Boem, J. Interoperability Testing in the Age of Cloud, Things and DevOps. [Interactiv] 02 02 2015. [Citat: 30 09 2016.] <https://www.sogeti.nl/updates/blogs/interoperability-testing-age-cloud-things-and-devops>.
7. Federal energy regulatory commission . [Interactiv] 12 2008. <https://www.ferc.gov/legal/staff-reports/12-08-demand-response.pdf>.

8. [Interactiv] 5 8 2015. [Citat: 29 10 2016.] <http://ccap.org/assets/Oscar-Medina-Argentina-Smart-Grid-Pilots.pdf>.
9. [Interactiv] http://www.gsma.com/connectedliving/wp-content/uploads/2012/09/cl_jeju_09_121.pdf.
10. *Govt builds first smart city in Gujarat as urban population swells*. Shah, A. s.l. : Business today, 2015.
11. [Interactiv] <http://www.cisco.com/c/dam/en/us/products/collateral/se/internet-of-everything/seeberger-voc-case-study.pdf>.
12. [Interactiv] <https://www.ge.com/digital/stories/apm-improve-reliability-and-availability-rasgas-assest>.
13. *The 10 most popular Internet of Things applications right now*. s.l. : K. Lasse, 2015.
14. K. Lasse. [Interactiv] 01 10 2015. [Citat: 30 10 2016.] <https://iot-analytics.com/iot-market-segments-analysis/>.
15. McLellan, C. *The Power of IoT and Big Data*. *ZDNet*. [Interactiv] 02 03 2015. [Citat: 30 10 2016.] <http://www.zdnet.com/topic/the-power-of-iot-and-big-data/>.
16. *Internet of Things Convention Europe*. [Interactiv] 8 06 2016. [Citat: 30 09 2016.] <http://iot-convention.eu/en/agenda/smart-cities/>.
17. *GSMA*. [Interactiv] <http://www.gsma.com/newsroom/wp-content/uploads/15625-Connected-Living-Report.pdf>.
18. *4G (fourth-generation wireless)*. Rouse, M. s.l. : TechTarget, 2010.