The Internet of things

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ABSTRACT

The article presents the concept of the Internet of things, which is attracting increasing interest from the world of science and business every year. The below contents present the spheres that should be noticed while designing smart things, and the benefits brought by their occurrence and utilization to the society. Moreover, the article demonstrates technological trends from the last 20 years.

*Keywords***:** marketing; sustainable development; communication; Internet of things

1. INTRODUCTION

It is an undeniable truth that today's society is using modern technologies increasingly more often, in order to communicate, educate or run business. A reason for such a state of affairs may be posed by their perception, as they are quick, and they enable effective access to information of a global nature, which often pose a manner to obtain information about the market, competition or even transforming trends [1].

We witness a new era, where communication can be established via things. Therefore, the products/services offered to consumers will be adjusted to their behaviors and needs to an even greater extent. The Internet of things corresponds to items of every day use, which are connected to the network. These products are defined as "smart", because they are embedded with knowledge, communication skills and artificial intelligence. They are perfectly aware of their work scope. They have information on location and knowledge about other devices and users being nearby. Thanks to the technology of smart surrounding and sensors, smart

products are capable of cooperating with other users and devices, which use identical interface.

Smart products that have access to the Internet provide opportunities for new functions and possibilities for their recipients, offering reliability and greater effectiveness. Development of those new products will modify the whole branch, opening new possibilities to market entities and occurring threats [2].

According to Ph. Kotler and J.P. Happelmann, the Internet of things is the third wave of changes, related to development of technology within the course of 50 years. The first one regarded automation of manual work, the second stage started at the moment, when access to the Internet was granted, enabling minimization of geographical boundaries among the society, and advanced coordination and integration of actions on a global scale. Furthermore, the Internet changed the society awareness in the field of communication and interaction [3]. In turn, the third level of changes will cause that the existing technology will become an integral part of every man's life, which will provide access to four areas of benefits, presented in Figure 1.

Figure 1. Benefits flowing from utilization of smart devices.
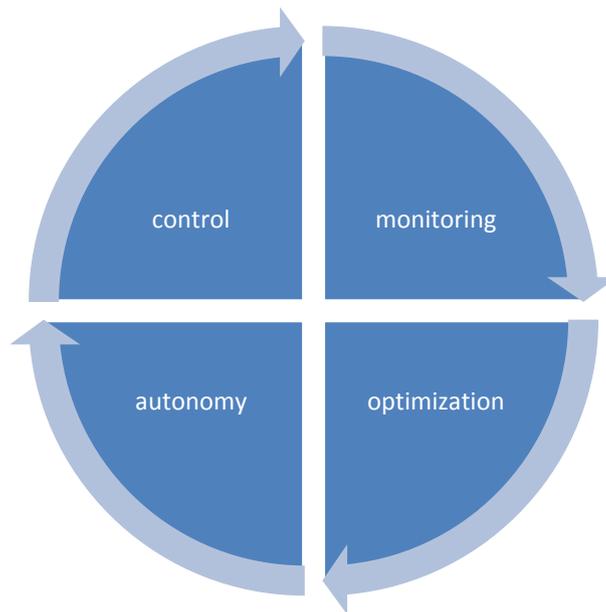
Source: Harvard Business Review Poland: How smart product with access to the Internet changing competition, HBRP Magazine No. 145,
http://sklep.hbrp.pl/jak-inteligentne-produkty-z-dostepem-do-sieci-zmieniajakonkurencje.html
[access date: 1/11/2016].

As presented in the figure above, the group of benefits flowing from utilization of smart things cover:

⸻ monitoring - a product is capable of informing about its status and external circumstances,

— optimization - a product based on algorithms allows to improve effectiveness and carry out diagnostics in real time,
— autonomy - a product identifies the need to connect with other products, even those on the background, as well as self-repair and automatic diagnostics,
— control - a product can be monitored through orders, or it can identify the user's needs through embedded algorithms [4].

If a smart device is to be fully intelligent, it needs to cover four field, which must be considered while at the creation and implementation stage. The figure presented below demonstrates those fields.

Figure 2. Areas employed while designing a smart product.
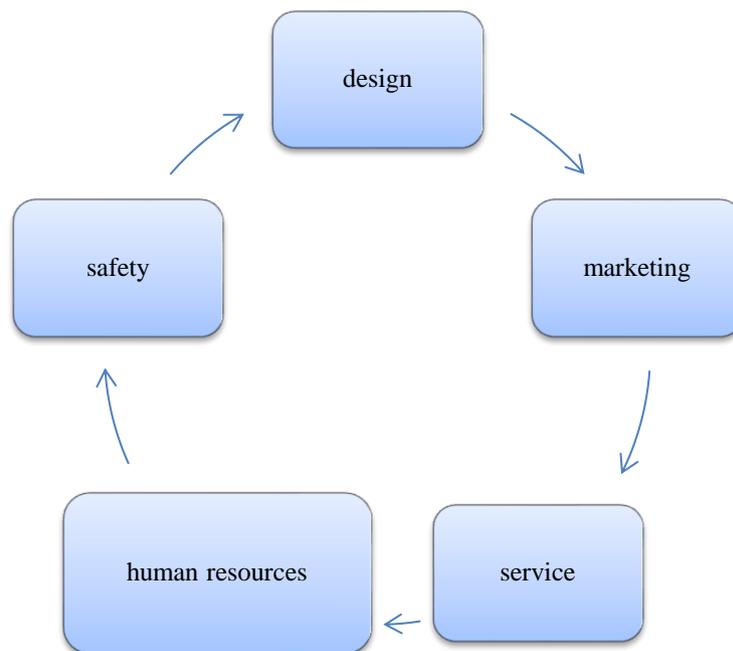
Source: Porter M. E., Heppelmann J. E.: How Smart, Connected Products Are Transforming Companies, Harvard Business Review, October 2015., Gartner Inc.: Gartner Says 4,9 Billion Connected "Things" Will Be in Use in 2015, article available online at: http://www.gartner.com/newsroom/id/2905717 [access date: 1/11/2016].

The group of those five areas, which are necessary during smart planning cover:

— *design* - standardization, personalization and update of software, as smart product require a whole set of new software, currently functioning within the economy, based on new design principles such as: templates, which govern standardization of equipment and adjustment of software, which will enable personalization, planning possibilities of operation, updates of products and expansion of provided services. Experience in programming of engineering systems is inevitable while developing an integrated computer system, electronics, software, an operational system for a product and communication as a superior attribute of a smart product.

— *service* - this is the sphere where data acquisition and analysis takes place. Smart products are characterized with greater efficiency in the field of maintenance and service. Real utilization of products and data related to efficiency enables reduction of costs of services. What is more, information about an approaching defect can be obtained, what enabled an early response to the emerging threat, which can distort effective operation. Data generated during utilization of products are used to its improvement during another design phase. This allows to decrease the risk of a failure and increase effectiveness of service,

— *marketing* – in order to use a smart product to its fullest extent in marketing operations, it is inevitable to develop relationships with consumers through services, which create an added value. Therefore, it is significant to collect data and analyze them in details. In a longer perspective, this forces creativity, skills and new marketing practices to be adopted by persons dealing with marketing. During product analysis, companies can obtain a new look on the product, and while employing this information, develop it towards more individualized customers needs, what can become reflected in an increase of added value and better positioning of the offer. Data analytics tools allow the enterprises that offer smart products to segment the market in relation to their assortment. Therefore, the services will be integrated and the product will be adjusted to a certain group,

— *human resources* – development of new skills among human capital, related to software and data acquisition. Persons, who will be creating the product in its physical form (engineers) must expand the scope of their skills with programming, big data analytics, systems engineering, product clouds and other areas.

— *safety* – data protection pertaining to the protect and its user at the same time. A challenge for smart products is to create a solid system for safety management for data flow protection. The protection is to pertain to the communication process with/between production, against unauthorized access. Access protection between the product technology and other systems. New authorization processes are inevitable for that purposes, such as protection of stored data and protection from hackers attacks. All of this is to be reflected in utilization of products and the persons, who use them [5,6].

Taking into account the considered areas while designing smart items, a conclusion can be drawn that basis departments in an enterprise will participate in its creation. Technological changes emerging thanks to such products seem to be significant. The table below present technological trends within the course of 20 years, which are highly probable, regarding the research potential, and can be perceived as evolution of previous achievements in the area of technology.

Currently, using the Internet of things can seem time consuming, but thanks to development of technology, the usage time is minimized. More and more devices are equipped with sensors that monitor their users. Therefore, they obtain information regarding their behaviors, position, etc. Today's technologies enable creation of new models of companies, which improve business processes, reduce costs and the risk of failure. The diagram below presents the number of devices specified as the "Internet of things".

Figure 3. Technological trends in the course of 20 years

|	**Before 2010**	**2010-2015**	**2015-2020**	**After 2020**
Society	• Social acceptance of RFID • Realization of benefits (food safety, health care, etc.) • Worries of privacy protection • Change of working methods	• Changes in models of enterprises (processes, manners of work) • Smart devices • Access rights • New manners for organization of retails stores, solutions in logistics	• Integrated devices • Smart transport • Energy and resource efficiency	• Individualized objects • Interactions between virtual and real worlds
Politics	• Creation of legal provisions related to privacy preservation • Analysis of cultural barriers	• Analysis of the topic in EU • Arrangement of notions related to frequency • Arrangement of principles for sustainable energy consumption	• Authorization, development of trust and verification of all assumptions • Development of social security and well-being	• Authorization, development of trust and verification of all assumptions • Development of social security and well-being
Standards	• Standards for privacy and security • Standards for frequency	• Standards according to sectors	• Standard for interactions	• Behavioral standards
Technology	• Combining objects • Adoption of RFID in logistics, commerce and pharmaceutics	• Creation of objects networks	• Preparation of semi-intelligent objects • Global applications	• Fully intelligent objects • A network that combines people, things and services • Integration of enterprises
Devices	• Smaller and cheaper tags, sensors, active systems	• Improvement of memory capacity and measuring capabilities	• Cheaper materials	• Intelligent objects
Energy	• Lower energy consumption	• Improved energy management • Better batteries	• Renewable energy • Multiple energy sources	• Limited energy consumption

Source: http://rfid-lab.pl/internet-rzeczy-w-2020-roku (access date 30.04.2016)

Figure 4. The number of IoT devices (bln)
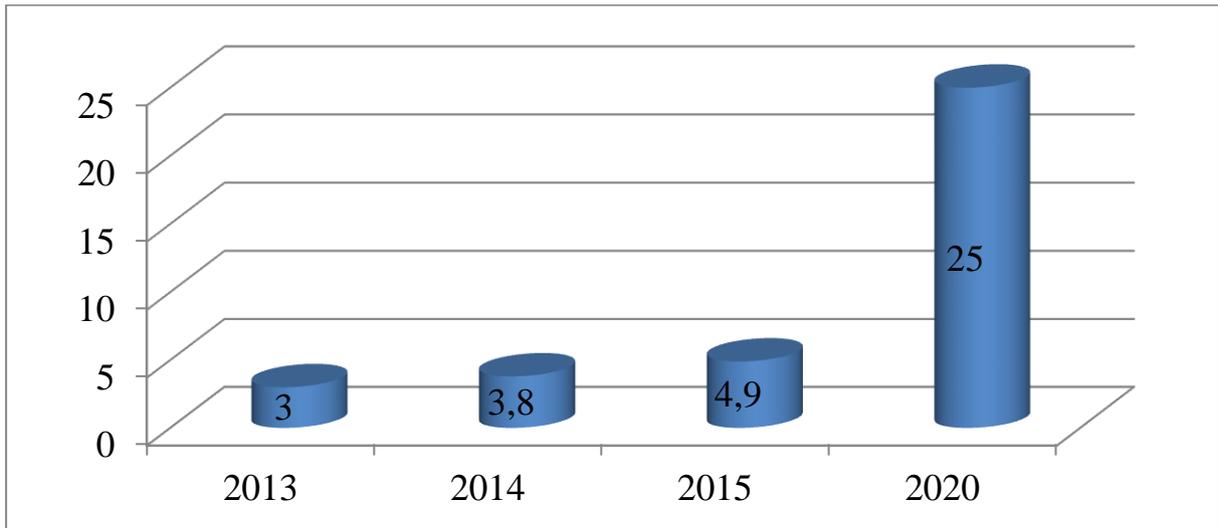
Source: Gartner: Gartner Says 4.9 Billion Connected "Things" Will Be in Use in 2015, listopad 2014; http://www.gartner.com/newsroom/id/2905717 (access date 30.04.2016).

Figure 5. IoT benefits according to Polish Internet users.
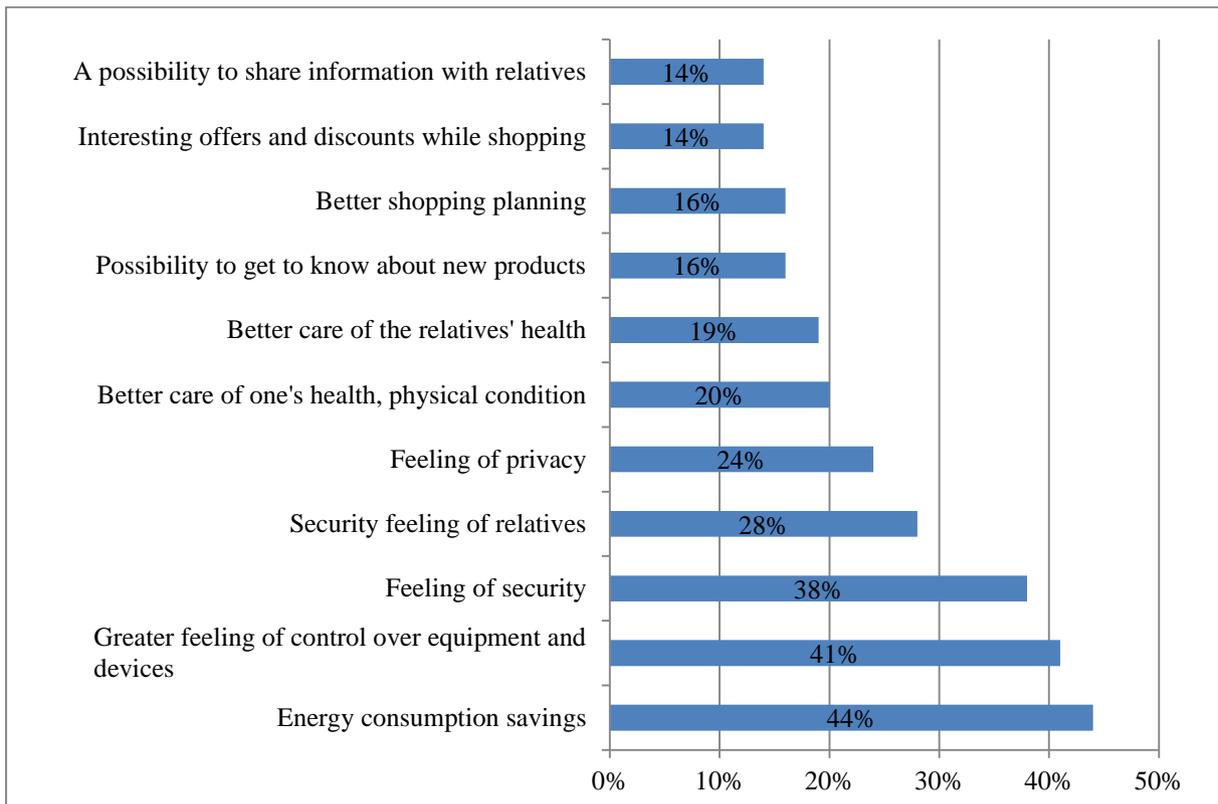
Source: IAB Polska, „Internet Rzeczy"; May 2015, p. 17.

As presented on the diagram, the number of IoT devices is on a dynamic increase. According to prognoses, it will reach 25 bln in 2020. It may mean that the society accepts smart products, and demand for such solutions exists.

The Interactive Advertising Bureau researched 1221 persons more than 15 years old, in a study entitled the Internet of things. The respondents where asked about benefits flowing from smart things. The results are presented on the diagram below.

According to almost a half of the respondents, the smart devices enable energy savings (44%). More than forty percent of respondents obtain a greater feeling of control over equipment and devices, and 38% has a feeling of security. In turn, the respondents claimed that the greatest threats resulting from utilization of smart devices come from too intrusive and frequent advertisements, leakage of data (47%) and loss of privacy (43%). This suggests that most persons responsible for marketing are worried the most. Because thanks to available technology, communication through smart things can pose a key to success.

2. CONCLUSIONS

Summing up, it may be concluded that development of smart devices will be on the increase, regarding comfort of use and benefits for users in a form of utilization easiness.

The Internet of things can pose an "ecosystem", where objects can communicate with each other through a human or without their part. Currently the time is precious, and utilization of devices enabling communication that was previously unavailable, poses a modern solution.

Furthermore, development of technology allows fulfillment of individual users' needs. Therefore, all offered products/services must be directed to a very narrow group of customers, after previous analysis of their preferences.

All solutions witnessed and utilized by contemporary society we brought in by the Internet. It changed a human approach to life, science, business, etc. within 20 years. This revolution improved the standard of life. A possibility to connect in any given place around the world, providing text, image, sound and other formats, forced changes [7], which caused that thanks to the Internet, the things, which had limited possibilities previously, gained new functionalities, what is perfectly embedded into the concept of the Internet of things.

Biography

Artur Sawicki: a doctoral student on the Faculty of Management of Częstochowa University of Technology, Częstochowa Region Head of the Silesian Marketing Association, a proponent for practical and responsible solutions in marketing, and cooperation between science and business, participant of numerous marketing events, a fan of dress code.

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