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INTERNET OF THINGS – MONITORING THE HUNGARIAN BUSINESS SECTOR AND CONSUMERS

Abstract

Humanity runs towards automatization in every aspect of life. Daily processes become automatized, the environment as well as the tools we use every day. By following this pattern we create a possibility for an easier, more predictable and enjoyable lifestyle. It is presumable that in a few decades everything will be connected with everything, controlled centrally by people, driven by machine learning techniques and relying on Internet connection. These changes will affect our lives significantly, however, there is no other option in order to maintain the sustainability of our environment. Internet of Things (IoT) will have an important role in private life as well as in business. It will give the opportunity to monitor devices and processes more accurately, mining huge amount of data and create precise and predictable statistical forecasts. Nevertheless, it will have an impact on revenues, operational costs, capital expenses, human resources, marketing and sales strategies, technical innovations and the operation of enterprises as well. It will change the culture of business and the culture of life. This paper focuses on the IoT phenomenon, its construction, purpose, the analysis of the underlying solutions as well as discusses the potential growth of the future Hungarian IoT market and analyses the Hungarian consumer.

Az emberiség az élet minden területén az automatizálás felé rohan. A napi folyamatokat, a környezetünket, az eszközeinket automatizáljuk abban reménykedve, hogy egy könnyebb, kiszámíthatóbb és élvezhetőbb életstílust tudunk kialakítani. Várhatóan néhány évtized múlva minden mindennel össze lesz kötve, központilag emberek által irányítva, gépi tanulási módszerekkel vezérelve és internet kapcsolatra hagyatkozva. Ezek a változások alapvetően megváltoztatják az életünket, azonban, a környezet fenntarthatóságának érdekében elkerülhetetlen. A „dolgok interneté”-nek (Internet of Things (IoT)) része lesz mind a hétköznapi mind az üzleti életben. Lehetőséget ad az eszközök és a folyamatok precízebb monitorozására, adatbányászatra és pontos, kiszámítható statisztikai előrejelzések elkészítésére. Hatása lesz a bevételekre, a működési, a tőke, az emberi erőforrás, a marketing költségekre, az eladási stratégiára, a technikai innovációkra és a vállalati működésre is. Megváltoztatja az üzleti kultúrát és az életminőséget. Ezen cikk az IoT jelenséget vizsgálja, annak célját és a mögöttes megoldásokat. A cikk megvizsgálja a magyar IoT piacban rejlő potenciális növekedést, és elemzi a magyar felhasználót.

***Keywords**: IoT; Internet of Things; big data; data mining*

INTRODUCTION

Although we refer to IoT (Internet of Things) as one of the newest innovations of information technologies, it has been an existing scientific area for several years. Strictly speaking, it literally applies to things or devices connected to the Internet, collecting data about user habits and device activities, forwarding these to cloud-based servers which store them centrally and provide the opportunity to create forecasts by using them. Although there is a huge hype around IoT nowadays, the concept existed for decades [1]. "Conventional diagrams of the Internet include servers and routers and so on, but they leave out the most numerous and important routers of all: people…. If we had individual and self-thinking computers, they could use the data gathered without any help from people's side – we would be able to track and count everything, and greatly reduce waste, loss and cost" [2]. IoT has "the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction". IoT solutions could be based on wireless technologies (Bluetooth, NFC), the Internet and micro-electromechanical systems, for example RFID (Radio Frequency Identification) [3]. RFID and sensor technology enable computers to observe, identify and understand the world—without the limitations of human-entered data. The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so" [2]. According to Gartner [4] "The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment".

The broadband addressing IPv6 overcame the constraints imposed by the limited address space of IPv4 and enabled the massive expansion of Internet of Things devices. Based on the statement made by Steve Leibson, "the address space expansion means that we could assign an IPv6 address to every atom on the surface of the earth, and still have enough addresses left to do another 100+ earths" [3].

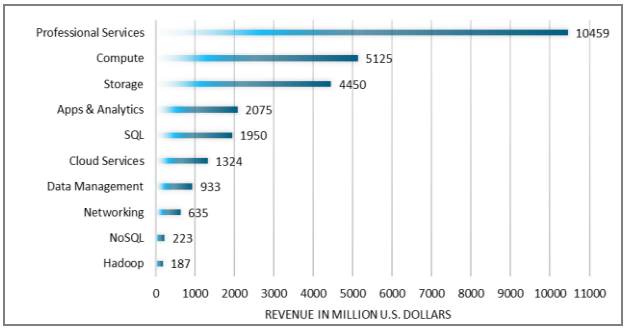
THE UNDERLYING TECHNOLOGY

Building a platform, such as Internet of Things needs underlying technologies which aim to secure the proper functioning of the solution. In order to create an automatized IoT environment, not only devices with sensors are needed, but also a communication channel between the devices, the capability of the devices to communicate; a cloud storage, where data could be stored; analytical formulas which can analyse the collected data; the ability of machine learning, and precisely written commands which instruct the machine to act in a certain way.

Big Data

Without the term 'big data' it is quite impossible to talk about Internet of Things as a service innovation. Since every single IoT device produces massive amounts of data, in order to analyse them, we need the capabilities of cloud computing and built-in solutions, such as BI of big data. The appearance of bigger storages, such as the cloud, enabled us to collect our specific data set in one single place. Today many enterprises started to collect, store, compile and analyse massive amount of data in real time, and we indicate it as 'big data' in consideration of the 3Vs: *velocity* (speed of data), *volume* (amount of data) and *variety* (the range of data types). A fourth V has also been announced that has an impact on data [5]: *veracity*, which expresses the uncertainty of the data. Since the needs of businesses have changed there is a huge demand for "powerful, new analytical techniques and data-sharing models to handle the size and complexity of the necessary data-processing operations" [6].

Figure 1. shows the statistics in 2014 how big data affected each segment of business globally in terms of revenue.



1. Figure. Global big data revenue by segment in 2014 (in million US dollars) [7]

1. Volume

With the appearance of Internet, businesses and enterprises became capable to monitor human behaviour through their online activities. While each purchase is recorded during e.g shopping online, the server also stores the time and date when the purchase has occurred. „As firms have moved their day-to-day operations to computers and then online, it has become possible to compile rich data sets of sales contacts, hiring practices, and physical shipments of goods. Increasingly, there are also electronic records of collaborative work efforts, personnel evaluations, and productivity measures. The same story can also be told about the public sector, in terms of the ability to access and analyse tax fillings, social insurance programs, government expenditures, and regulatory activities" [8] According to certain IBM research [5] about 2.5 quintillion bytes (approximately 2.3 trillion gigabytes) of data are created each day, and with a vague estimation, it is forecasted that 40 zettabytes (43 trillion gigabytes) of data will be created a day in 2020, an increase of 300 times from 2005. Based on the research it is shown that 100 terabytes data are stored by a U.S. company on average. The same amount of data created by IoT devices and the amount generated by YouTube videos stand in need of capacity differently.

2. Variety

Variety is another decisive feature in terms of big data. As the system should be able to collect different types of information on a large scale, starting from monitoring the hours of sunshine, through the amount of precipitation, and the consumption of the electrical system; the capacity for collecting such variety needs to be extended. At the same time, calculating capabilities must be raised extremely in order to become able to monitor upcoming data from different IoT devices.

3. Velocity

Examining velocity means collecting information about the speed of data which is dominant in many ways. As one part of IoT devices has to transfer information in real time and need to change the circumstances in accordance with the collected data, this feature is a determining one. The success of a business depends on the velocity of the data transmission.

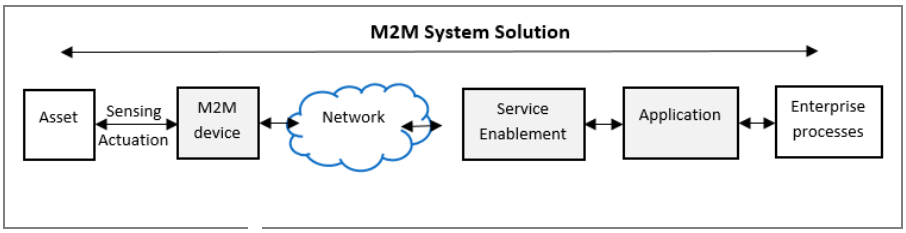
Machine Learning

Machine Learning means "weak" or "specialized" artificial intelligence – a machine that recognizes patterns in data and learns to perform a specific prediction, but has no general intelligence. The opposite end of the spectrum would be "strong" Artificial Intelligence, a machine that can solve general problems like a human. Machine Learning enables the

machine to monitor and analyse a large amount of data sets. Even if the examined information is extremely complex and the deviation is significant, the machine could still define correspondence and relations between the data [9]. Machine learning can be valuable in predicting outcomes as in healthcare, or e.g. in filtering spam emails. Machine Learning is grouped from different aspects, supervised vs. unsupervised, active vs. passive, online vs. batch learning. The role of the training, test and validation data sets, the active or passive role of the learner and the method of online or batch learning all depend on the task to be executed.

M2M communication

The M2M is a solution which enables the communication between devices of the same kind and a certain application, through a wired or wireless network. In general, the machine-to-machine communication is deployed to reduce costs, increase safety or achieve productivity growth [10]. M2M communication happens between devices through different connection channels, such as Bluetooth, RFID or magnetic information routes. In case of M2M, data sharing or the connection between devices through the Internet is not always supported. Reasons could be the lack of lasting batteries and the fact that the typical IoT devices with sensors are not smart enough to be able to connect to the Internet directly. Figure 2. displays a typical M2M solution that is composed of M2M devices, a communication network which enables the connection between devices, an application logic and the integration of the M2M apps into business processes.



2. Figure. M2M System Solution [10]

Security of IoT

Basically two types of security methods are needed, firstly, the protection of the devices, the data on them, and securing a save communication path between different things. This requires hardware security on the devices, and software related protection through the communication channels. The other security concern is storing the collected data by sensors/IoT devices in the cloud. Storing information in the cloud raises human-related concerns as well. Data is easily accessible, needs hardly any hardware capacity, however, on the other hand, storing all the data in the cloud requires intelligent encrypting and high level security using alternative methods in encryption.

Cloud computing

Finally, we have to mention cloud computing as a key component in the usage of IoT since the storage of massive amounts of data at a business enterprise would be too complicated, expensive and exhausting. When it comes to analyzing the huge amount of data collected by IoT devices the attributes of could computing like “infinite computing resources”, virtualization, dynamic flexibility and scalability, cost reductions are among the ones to be explored and utilized. With cloud solutions, CFOs can stop worrying about capital expenses, and start covering the company’s license and IT cloud infrastructure needs monthly as operational expenses. This will not only result in cost optimization, but will take over the

responsibility to maintain the infrastructure from businesses – since cloud providers will handle it –, and also will improve the productivity, because the data and solutions are available from anywhere. It will also have a significant impact on innovating the companies and evangelize them with the newest and most up-to-date software solutions [11].

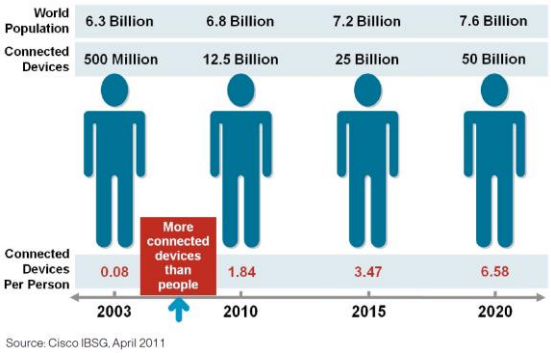
IOT INITIATIVES AND MARKET POTENTIAL

A.I.O.T.I. is last years' most impressive initiation by the European Union. "Aware of the potential of using the IoT, in March 2015 the European Commission initiated the Alliance for Internet of Things Innovation (AIOTI), aiming at creating an IoT Ecosystem that would enable Europe to get a global lead in this field and foster a Digital Single Market (DSM) for IoT. The overall goal of this Alliance is, therefore, to strengthen links and to build new relationships between the different IoT players (industries, SMEs, start-ups, stakeholders) and sectors, also promoting interoperability and convergence between standards, thus facilitating policy debates, and preparing a Commission's initiative for large scale testing and experimentation, scheduled for 2016" [12]. Although the alliance was just recently born – roughly about 8 months ago – already 325 members have joint the network from different sectors and industries like manufacturing, healthcare, mobility, automotive, supply chains, energy, utilities, cities, buildings, lightning, etc. The alliance intends to bring together key IoT market participants both from the public and the private sector. Members become able to contribute in shaping IoT-related EU regulations and could participate in large-scale pilots as well. It does not matter if a company comes from the small-and-medium sized segment, as a start-up, or as a large company (IBM, Bosch, Intel, Cisco), everyone has equal possibilities to contribute in this fellowship.

In November, 2015 Gartner [13] held one of the most important events amongst CIOs and Senior IT Executives, the Gartner Symposium/ITxpo. Among other things, Gartner shared its newest research findings on IoTs and the impact it could bring into businesses by 2020. According to this, the company forecasted a significant growth in the number of IoT units in specific segments. Data provided by high qualified analysts presume that almost 21 billion devices will exist by 2020 which will be referred as IoT solutions. This is an astonishing number, but highlighting the incredible revenue effect it could present in the business area, it could be a strong negotiating fact as well. Furthermore, Gartner [13] also stated that the endpoint spending in businesses will reach 1 477 billion US dollars based on current statistical data [13].

Intel predicts that the 2 billion IoT devices used in 2006 will grow to 200 billion by 2020. According to their projection, about 26 devices will surround each person on the Earth. Knowing this number, it would be expected that most of the devices will play an important role only in the consumer sector, however, the biggest part of these devices will be used in major industries, such as business-manufacturing (40.2%), healthcare (30.3%), retail (8.3%), security (7.7%) and transportation (4.1%) [14].

According to Cisco [15], by the end of 2020, 6.58 IoT devices will be "attached" to one person, and altogether, 50 billion IoT tools will be in the market for the entire population as seen on Figure 3. It seems an extremely overestimated number compared to the statistics of Gartner, but Cisco goes even further. According to the company, the 6.58 devices per person is relatively low, since the overall number of devices were divided by the number of the entire population. However, many people of the current 7.2 billion do not have access to the Internet, and it is roughly estimated, but around 3 350 million people use the Internet today [16]. By implementing this number into the figure, "the number of connected devices per person jumps up to 7.57 in 2015, instead of 3.47" [16].



3. Figure. IoT devices per person [15]

IDC also forecasted that "by 2017, 90% of datacentres and enterprise systems management will rapidly adopt new business models to manage non-traditional infrastructure and BYOD (Bring-Your-Own-Device) categories. Just as by 2018, 16% of the population will be millennials and accelerating IoT adoption due to their reality of living in a connected world" [17].

THE ANALYSIS AND POTENTIALS OF THE HUNGARIAN MARKET

The statistics above could easily make people wonder whether the change will be that significant all around the world or just in certain parts of it. That is why examining the effects it will have on the Hungarian market and businesses of the country is crucial. On the IoT market the statistical forecast by Gartner [4] are the commonly accepted standards. As Table 1. shows Gartner distinguished the IoT markets based on the areas of presence. Our analysis focus on the Hungarian business segment since it has a bigger potential in development than the customer segment.

1. Table. Internet of Things units installed based by category (million units) [13]

Category	2014	2015	2016	2020
Consumer	2,277	3,023	4,024	13,509
Business: Cross-Industry	632	815	1,092	4,408
Business: Vertical-Specific	898	1,065	1,276	2,880
Grand Total	**3,807**	**4,902**	**6,392**	**20,797**

Table 2., however, displays the IoT endpoint spending by category. It calculates with a 115% increase, having 682 billion dollars in 2014 going up to 1 477 billion by 2020.

2. Table. Internet of Things endpoints spending by category (billions of dollars) [13]

Category	2014	2015	2016	2020
Consumer	257	416	546	1,534
Business: Cross-Industry	115	155	201	566
Business: Vertical-Specific	567	612	667	911
Grand Total	**939**	**1,183**	**1,414**	**3,010**

Although building a country specific statistical forecast based on international trends could be misleading, since the revenue and unit growth could differ based on other country specific factors like the geographical places, a country's economic situation and economic growth potentials, GDP etc. however, it still could show a theoretical potential obtainable in the national market.

The current research in this field is restricted to only such companies that provide complex solutions of IoT devices with sensors, where the collected data is stored in the cloud, BI and

big data analytics are provided to enable data processing and analyses, and which have an overall sense of innovation, such as remotely controlling the IoT devices located in homes. That is the reason it was crucial to focus on the innovation part of IoT, What made the research difficult is that the Hungarian IT market is extremely small and, at the same time, the target group is much smaller compared to other markets. When analysing the Hungarian market it is crucial to know the consumers and their attitude towards IoT, since they drive the market and part of the business demand. According to the Principal Software Engineer of LogMeIn, the Hungarian market has some disadvantageous factors that set back the Hungarian IT market from outstanding and rhythmic growth. In the Hungarian market language barriers still hinder the proliferation of IoT devices resulting in differing preferences compared to the international market. Furthermore, the adaptation to new things and solutions is also slower. A further obstacle is that the Hungarian consumers are extremely price sensitive and finally, that the Hungarian legal process of approval to import new innovations to the country is lengthy, cumbersome and complicated. By the time an IoT gets a green light it becomes out-of-date. Consequently, to boost the spread of IoT devices the Hungarian market would need either more Hungarian vendors developing IoT solutions or create a less complicated legal regulation system for IoT innovations to enter the country.

According to IDC (International Data Corporation) Hungary [18], which is the only research company in Hungary that has already dealt with the analysis of the significance of the IoTs and M2M devices in the national market, the IoT device market should be split into different groups: one of them uses only M2M and GSM solutions and the other one covers all of the IoT devices which is presented in the market. Since the M2M communicating devices with SIM card have a significantly simpler technology than solutions with RFID, NFC, Bluetooth and the Internet, this is going to be analysed first in this chapter.

As Gartner differentiated the segments using IoT, IDC did the same as well, but they created smaller and more specific groups, such as Fleet Management, Security, Commerce, Smart metering, Health and Other. They also divided the market by layers, such as Hardware, Service, and Access. Fortunately monitoring the number of IoT devices using SIM card is a lot easier than those without it.

It is crucial to mention that IDC counted SIM cards used by only those devices which are not used by consumers. Therefore phones, 3G capable tablets, and any interacting devices are excluded from these numbers. More precisely an M2M SIM card could be built in a home alarming system, or any IoT device-like tool, the difference is that these devices are not able to communicate through the Internet or any other communication channel (RFID, Bluetooth, and NFC).

Table 3. shows the actual and the expected number of M2M SIM cards between 2013 and 2017, and displays that the M2M SIM card market could more than double just in 4 years. This suggests that in the next 2 years many innovations could twist into the market. Since this is only one part of the IoT devices, much larger growth could be expected. The strongest rise is visible in the commerce segment, especially between 2013 and 2014 (a 321% growth), but knowing the facts, that the government made an obligatory POS terminal change from offline version to the online POS cash-registers, this is totally understandable.

3. Table. M2M SIM Cards (pcs)

	2013	2014	2015	2016	2017
Fleet Management	109 000	152 000	173 000	187 500	200 000
Security	145 000	150 000	155 000	165 000	175 000
Commerce	56 500	238 000	250 500	315 000	360 000
Smart metering	75 500	87 500	92 500	117 500	137 500
Health	10 000	12 000	14 500	18 000	25 000
Other	119 500	139 500	162 500	192 500	242 500
Total	**515 500**	**779 000**	**848 000**	**995 500**	**1 140 000**

a. Source: IDC interview November 2015

In terms of spending, however, different numbers are represented. The largest growth is expected in the field of smart metering, forecasting a 77.32% annual growth between 2013 and 2017 (See Table 4.).

4. Table. M2M spending by segment - 2013-2017 (HUF million)

	2013	2014	2015	2016	2017
Fleet Management	6 968	9 890	9 388	9 490	9 980
Security	11 490	11 375	11 658	12 815	13 285
Commerce	3 980	18 619	7 363	10 825	8 570
Smart metering	1 973	1 453	4 397	24 006	19 506
Health	598	616	714	860	1 280
Other	7 223	7 816	8 867	10 345	13 692
Total	**32 232**	**49 770**	**42 385**	**68 341**	**66 314**

b. Source: IDC interview November 2015

The two most developing layers will be hardware and service as seen in Table 5., which is absolutely not surprising in case of IoT solutions. New devices will be presented in the market since the demand for service boosts innovation and import. The growth of hardware is inevitable because of the new devices, and, at the same time, the demand for services will grow both from the consumers' side, but from the vendors' point of view. This could result in a market gap waiting to be filled. Providing services for vendors – such as predictive analysis – could result in preventive maintenance, therefore, companies will be able to revise their services and products. Table 5. shows a 24.42% and a 18.07% annual growth in the hardware and a service market respectively, so hardware is expected to outgrow the service demand. This was also justified by LogMeIn, who bought up Xively [19], an originally UK-based company, to provide a much needed and adequate service for vendors developing IoT solutions.

5. Table. M2M spending by layers 2013-2017 (HUF million)

	2013	2014	2015	2016	2017
Hardware	12 779	25 227	16 080	36 464	30 624
Service	15 224	19 140	20 861	26 080	29 585
Access	4 228	5 403	5 444	5 798	6 105
Total	**32 232**	**49 770**	**42 385**	**68 341**	**66 314**

c. Source: IDC interview November 2015

Table 6. gives a rough forecast of revenues from the IoT devices in the future Hungarian industrial market till 2018 provided by the Principal Software Engineer of IDC. The forecast was created by a joined work of the Czech and the Hungarian subsidiaries. According to the forecast the Hungarian IoT market is expected to jump by 150% in terms of revenue (in $

millions) between 2013 and 2018. Comparing the IDC and Gartner forecast, we can examine the years from 2014 and 2016 and calculate an expected growth from them.

6. Table. Hungary IoT spending ($ million)

INDUSTRY	Revenue in year (million $)					
	∑ of 2013	∑ of 2014	∑ of 2015	∑ of 2016	∑ of 2017	∑ of 2018
Consumer	147,41	186,88	272,56	336,08	447,72	509,99
Government	284,70	317,37	386,27	427,01	527,74	589,73
Healthcare	55,55	64,22	77,06	87,50	104,38	120,73
Insurance	0,54	0,70	0,88	1,13	1,47	1,73
Manufacturing	68,76	84,06	103,90	117,11	144,93	164,27
Resource Industries	1,65	1,73	1,88	2,01	2,29	2,44
Retail	1,61	1,94	2,25	2,76	3,31	3,83
Transportation	58,65	65,36	75,57	87,24	111,36	125,18
Utilities	3,97	4,87	6,19	8,10	11,63	16,54
Cross Industry	7,28	9,32	11,58	15,69	22,66	30,86
Other Industries	53,11	58,07	79,23	91,12	116,27	128,97
Grand Total	683,23	794,53	1 017,38	1 175,75	1 493,75	1 694,26

d. Source: IDC interview November 2015

IDC forecasts a 48% growth in terms of total revenue from 2014 to 2016, which is in compliance with the Gartner forecasts of the international market since it expects a 50% growth in the IoT market in terms of revenue. (from $ 939 billion in 2014 to $ 1414 billion in 2016). According to this, Hungary, even with its disadvantageous market circumstances, is capable of following the international market trends.

CONSUMER ATTITUDE TOWARDS IOT IN THE HUNGARIAN MARKET

The Hungarian IoT market has some drawbacks compared to the international market since it is relatively small, consumers have language barriers thus having special needs that the producers and the vendors need to react to. The previous chapter dealt with the industrial, cross-industrial sector. However, if this market has such a big potential, then the consumer attitude towards IoT devices on the Hungarian market is also expected to change and follow the international trend. The research, which finally gave a non-representative sample, but made it possible to draw some conclusions surveyed 132 people, out of which 112 answered the online survey. The age of the surveyed ranged between 18 and 65, 68% of them being between 18 and 25 (Generation Y). At the same time 68% of the surveyed was aware of what IoT was but only 37% of them considered it a super innovation. 32% of the surveyed did not care about IoT or have not heard about it, which raises the question whether it is as popular as the market situation presumes. The results also showed that 81% of these people had at least 1 smart device, which is presumably a smart phone. The sample showed an average of 2.6 devices meaning 2 or 3 smart devices. This device is probably a smart phone, since Statista [7] states that only in 2014 approximately 1.2 billion smart phone units were sold to end-users. Approximately 3% of the surveyed stated that they had more than 10 smart devices. According to Statista [7], the number of people who will use smartphone by 2019, will increase by 67%, and by 2018 almost 37% will be the penetration of the total global population which uses smartphone [7].

Comparing the spending on smart devices or IoT the survey gave the following results. While the surveyed people spend an average HUF62 500 on smart phones they would spend an average HUF424 137 on IoT, which is a remarkable difference. In the first case roughly 83% of the surveyed spend under HUF100 000 on smart devices while in case of IoT devices

83% of the surveyed would spend under HUF300 000. Most of the surveyed would spend between HUF 50 000 and HUF100 000 on IoT. Using the population data from the Central Statistical Office [20], the number of population between 25 and 65 was roughly about 6 664 153, so the average annual amount of money a consumer in Hungary would spend on IoT devices would be between HUF 326 thousand and HUF552 thousand (90% confidence), while the total spending would be between HUF2.2 billion and HUF3.5 billion (90% confidence).

7. Table. The amount of money people would spend on smart devices

Spent amount of money (thousand HUF)	Number of people
None	9
0 – 50	60
51 – 100	28
101 – 200	11
201 or more	8
Total:	***116***

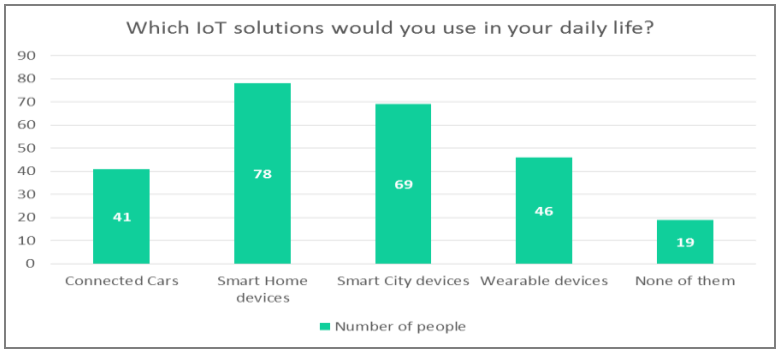
e. Source: Online survey

8. Table. The amount of money people would spend on IoT devices

Spent amount of money (thousand HUF)	Number of people
0	4
1 – 50	22
51 – 100	28
101 – 200	22
201– 300	11
301 – 700	7
701 – 1 500	6
1 501 or more	16
Total:	***116***

f. Source: Online survey

Grouping the IoT devices people gave the following answers as seen in Figure 4. As it shows smart home and smart city devices have a significant potential in the market.



4. Figure. Distribution of IoT solutions people would use in daily life

The following factors were among the fears and threats mentioned as risk factors that keep people away from IoT solutions: risk of over automatization; avoiding independent thinking; disaster management; untraceable data moving; data theft; lack of data security; hacker attacks; threat on community security; lack of personality rights; cyber criminality; technology addiction; depending on digitalization; non-technology people will be unable to follow the system.

Based on personal opinions most of the surveyed people expect to use only machine driven devices by 2050. These opinions are rather pessimistic compared to the prognostications made by research companies. The main blockers are the lack of IT knowledge and fears of new technologies. Another barrier could be the situation of the Hungarian economy and market, the average salary of people, which lead to less possible spending on IoT solutions. Education on IoT might also significantly impact the attitude of the consumers. Until this gap is not solved adequately, no significant growth can be expected in the consumer market.

CONCLUSION

It is unperceivable that Internet of Things as an innovation will have a huge impact on our life. It will not only affect the way we live, business and everyday processes, but finally will provide a solution for many problems, such as sustainable environment, waste, energy and traffic management, possible issues in logistics. With the help of it, we will be able to create smart cities and homes, and absolutely involve the technology into our life. IoT devices will play a significant role in urban transportation, healthcare and agrarian solutions as well. The tools we use in our everyday life are going to be developed and appear on the market as IoT devices.

Internet of Things couldn't exist without many solutions we already have today. Big data, machine learning, machine-to-machine communication and cloud computing will have a huge role in the creation of IoT environments. Spending time, money and effort on the development of the above mentioned solutions is crucial. In time, everything will become controllable and trackable from anywhere with the help of Internet, and everything become connected to everything with the help of secondary solutions such as cloud computing, machine learning, etc. The devices will generate and collect massive amounts of data, then store them locally on the device itself, but essentially transfer them to the cloud.

However, with the appearance of innovative solutions and devices, serious concerns raise as well. Vendors still have to find solutions to store the consumers' data anonymously, safely and securely, but at the same time make it possible to track the devices and transfer the collected data to the cloud for review only by authorized people. If we want to keep the quality of the products and services provided by IoT, security gaps need to be filled in.

This paper presented that while the Hungarian IoT market in the industrial and business fields is capable of following the international growth, the consumer market will probably leg behind due to economic, financial, security and privacy concerns as well as some human preconceptions about cloud computing, big data, security and privacy.

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