SMART CITIES 2.0 – CONNECTED CITY, OR HOW TO USE TECHNOLOGIC INFRASTRUCTURE FOR IMPROVING THE QUALITY OF LIFE

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Abstract
The concept of infrastructure related to the smart cities is being used to highlight the physical or social structures together with all the facilities that support the activities of a city helping it being functional. The concept itself refers to roads, railways, access points, buildings, distribution chains, water pipes and electricity lines, and, of course, digital networks. The article is focusing on the connection between the physical infrastructures with the digital ones, presenting, next to a bibliographic research made by the author, few technical solutions implemented successfully in the IoT field of development. In the same time there will be analyzed one of the biggest risks associated with the IoT, and that is related to privacy and security, risk that, due to the exponential growth of the numbers of equipment's that are nowadays connected to the Internet along with the reduced time left for the developers to release a new product, they are bigger and stronger. The vulnerabilities once discovered do allow hackers to infect the system causing damages that are very difficult to handle – and, like hackers are not enough, governments, as well as marketing companies, are also threatening our privacy.

1. Introduction

In most countries, building up the infrastructure elements is a centralized activity, managed by the government which has, as its objective, sequentially solving the issues that the specific country has; such as constructing of a drinking water network pipes or similar for the sewerage system. Future infrastructure projects should also have anticipation components, for the medium and long term, of the global phenomena [1].

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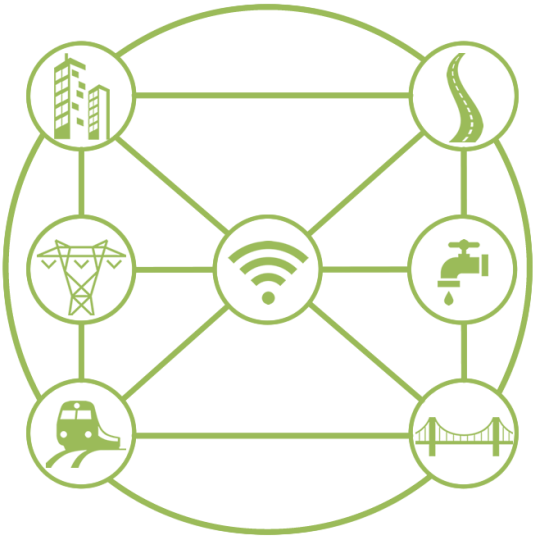

Figure 1. Infrastructure elements needed by a smart city

The urban infrastructure should be able to face pressures given both by the accelerated technical development – e.g. electricity grids should take into consideration the increased numbers of users that make use by their own solar panels, a situation that leads, on the long run, to diminishing consumption [2], as well as by the climate changes, which, due to increasing temperature differences between seasons and maybe an increasingly abundant rainfall, tend to cause large damage to the electricity transmission infrastructure [3].

2. Smart Infrastructure

Smart cities do need to isolate their infrastructure from events like those mentioned. They might need to build new kind of networks or to adjust the old ones in such a way as to meet the new challenges. Cambridge University – Center for Smart Infrastructure and Construction formulated one of the most comprehensive definitions of the concept, namely: Smart infrastructure is the result of combining physical and digital infrastructure with the aim of providing valuable information to help taking decisions faster and cheaper [4].

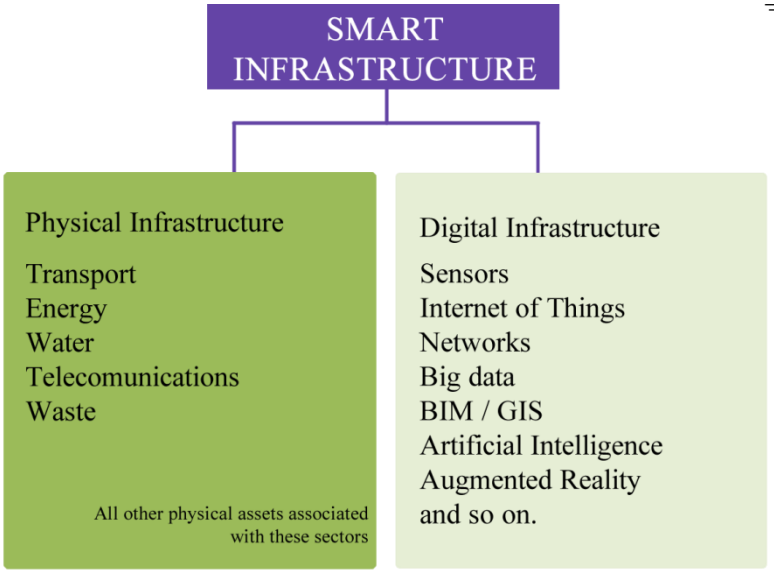

Figure 2. The relationship between the physical and digital infrastructure elements and components of smart infrastructure [4]

Data, by the fact that they build information, are the basis of an intelligent infrastructure [5]. An intelligent system uses the feedback received from different subsystems (like sensor networks, measurement and control equipment etc.) in the decision-making process. It can monitor, analyze, forward or even act based on the data collected from those subsystems [6].

> *We can imagine the road transport network in a city that, equipped with an intelligent traffic light sensing and traffic sensing systems, is designed to streamline car traffic by optimally changing the traffic lights or even signaling bypass routes in order to avoid congestion.*

It is already known that investing in smart infrastructure brings social and economic benefits to public administrations at all levels [7], [8] – by that we mean more integrated, more efficient and resilient services. All this, however, means large investments. Songdo City of South Korea is one example of a smart city built from scratch. It enjoys the most modern infrastructure innovation: high-speed Wi-Fi, temperature monitors, power management consumption synchronized with the day light, a smart transport network, a waste collection system that 'takes' the garbage from the kitchens of the residents (for then, through a well-designed underground network it goes straight to the processing centers). All this, however, costs over 40 billion dollars [9] – nearly one fifth of Romania's GDP in 2018.

Cambridge Centre for Smart Infrastructure and Construction from Cambridge University has identified five weaknesses in infrastructure investment [4]:

1. Integration of digital elements. Many of the infrastructure projects do not foresee the integration of elements specific to modern technology such as sensors, actuators, etc.

2. Use of common industry standards. Infrastructure projects, if carried out at different times or if they belong to different industries, cannot be 100% interconnected because similar industrial standards have not been used.

3. Establish a common type of data and information. In order to maximize the benefits of smart infrastructures, investors need to consider using common data transfer protocols so that their synchronization does not get any difficulty.

4. The poor collaboration between the public environment – who wants to build up the infrastructure project, and the private one – which has the role of doing it. Often the experts of a camp fail to be understood by their counterparts in the other camp. The industrial environment and its operating mechanisms are different from the administrative / political one, which is why a deadlock can be reached. It is necessary for the teams of experts from the two camps to synchronize their vision and to use a common set of procedures and terms.

5. Security. What needs to be done in order to meet the growing demand for open (but not only) systems?

To minimize the effect of these weaknesses, we need to assess the opportunities that come from both technological and administrative environments, made with the utmost accuracy. Challenges must be understood and it should be measured the long-term impact of technology before the project starts. Cities need to be led on their way to becoming smart, they need a long-term vision in their intention to design smart infrastructures, and this is only possible through fruitful cooperation between all actors involved.

3. Internet of Things (IoT)

Clearly the Internet has undergone enormous transformations on most, if not all, levels of our society, starting form from being technology driven up to being, nowadays, opportunity driven [10]. Therefore the split between the connectivity technologies from the wonderful applications able to run on top of it have been a painful [11], [12] but really instrumental shift in unlocking what is now often referred as the forth industrial revolution – also known as digital revolution [13]. Furthermore we will provide information about what is known as the best tool for building up smart infrastructure [14], [15] – Internet of Things (IoT).

The Internet of Things concept – known in the literature as IoT, is not as new as one might think. It first appeared in 1999 when Kevin Ashton – the British who created the RFID (Radio Frequency Identification) systems standards, used it to describe a system in which the Internet connects to the physical world through sensors [16], these having the role of collecting data for sending them over networks to servers. Since back then he described how the devices connected to the Internet will change our lives, which nowadays is already far from being science-fiction. We see everywhere around us either cars connected to the Internet (via GPS terminals installed on board), industrial or agricultural equipment remotely coordinated through the Internet, drones, even refrigerators and washing machines (the smart mobile phones, present in everyone‘s pocket, are the best proof of the development of this IT industry‘s segment).

In his article *Ten ways the Internet of Things is transforming our lives,* Chris Boorman - Head of Marketing for CA Technologies imagines the IoT in “silos” where sensor data make processes within a specific industry, vertical more efficient and effective [17]. He is giving ten examples of the use of IoT:

1. Smart cars
2. Smart clothing
3. Smart sports equipment
4. Smart lighting
5. Smart cities
6. Smart farming
7. Smart planes
8. Smart living spaces for the elderly
9. Smart security for the home
10. Smart traffic systems

What can be achieved when a smart car and a smart grid on a city level start "talking" to each other? A better traffic flow, for example. Instead of just having traffic lights set up on fixed timers, we will have smart traffic lights that can respond to changes in traffic flow. Traffic and street conditions will be communicated to drivers, rerouting them by the use of mobile apps [18] around areas that are congested.

There are now sensors monitoring and tracking all sorts of data; there are cloud-based apps translating that data into useful information and transmitting it to different sorts of computers, enabling real-time responses; and thus bridges become smart bridges, cars smart cars, and cities smart cities [19], [20].

3.1. Components of an IoT product

Sensors & cameras

Firstly, there are things that need to connect. These could be sensors, actuators, robots or any other technological equipment meant to act on human behalf – the most developed technological equipment is using sensors; and they are measuring everything: pollution, noise, acceleration, speed, temperature, humidity, light, pressure, torsion, tension, position, magnetic fields, electric fields etc. [21] – as we can see there is a large array of sensors available on the market. At the beginnings they used to be large and bulky and they were using a lot of energy to function [22]. Today they are almost invisible, energy efficient and their accuracy increased as well [23]. Moreover, this technology field is still evolving, miniaturization is trending and hopefully the Internet of Things by 2025 will be a complex mix of sensors measuring things and robots acting on the insights. If we are to look at statistics, today, the total number of connected equipment already reached 20.35 billion, with the prospect of reaching 75.44 billion in 2025 [24].

As well as sensors, video cameras today they are small enough to actually place them everywhere, to collect images – of course that this might be a subject of privacy issues but we will discuss this by the end of this article.

Connectivity
Secondly, just after sensors and actuators, there is a need to connect them, reliably, to the Internet. Nowadays, wireless connectivity is available everywhere and this is the key to the success of the IoT. Connecting all objects in the long-term future with cellular mobile phone technology is a matter of time since it is a technology which ensures availability, reliability and viability [10].

If we are to take into consideration the huge number of devices that are connected, it is easy to understand the energy consumption around the glove, that's why a lot of hardware developers are now focused on Low Power Wi-Fi [25] – an exciting class of Low Power Wide Area (known as LPWAN) networking technologies, is emerging, diversifying the connectivity portfolio [26] [56] [57].

Platform
Thirdly, the data collected by sensors and transmitted via networks needs to be stored and processed; this is known as the IoT platform, and typically it is using a cloud-based infrastructure [27] [55]. Therefore, it might:

1. Receive and send data via standardized interfaces, known as Application Programming Interface (API);

2. Store the data; and

3. Process the data.

Analytics
Data means nothing if it is not transformed into information [28], its value relies on the insights; therefore, data analytics needs to be applied to the data in order to make it the base for the decision making process. Big data analytics software stretch from simple statistical tools to more sophisticated machine learning approaches [29], with deep learning being the latest and top trend [30] – the AlphaZero computer build by DeepMind [31] as well as Watson from IBM [32] are the most notable examples.

User Interface
Finally, an important component is how the data / information is presented to the final users. There is an increased demand for the IoT products to have an appealing user interface, both web based as well as smart phone based due to the high numbers of people that are coming from non-tech areas but do want to use those products and services. Some developers found that a very well designed front-end do convinces clients to get in the IoT world [33].

In summary, the data collected by IoT devices undergoes a long journey. There is a data up-stream from the sensors, via the wireless networks, into the IoT platforms. After that the data meets the opportunities opened by the platforms allowing users to leverage Big Data opportunities. At the end, there is a data down-stream from the platforms back to the actuators or so on computer screens or smart phones [19].

When all components are found in the same system with the role to deliver services (and sometimes products), then we can really talk about added value created with the aim of developing citizens, the public and the private environment. A short example would be the smart devices that monitor the

evolution/involution of a chronic disease of a patient by transmitting real-time data to doctors who may intervene if the situation requires so.

3.2. IoT and Smart Cities

IoT applications and systems are organically developed – based on needs, but the impact they have on us depends on the degree of acceptance of new technologies by citizens, the public and the private sector [34].

The greatest risks that can arise from the extensive use of IoT come from the data security and cyber-attacks area. However, the laws of the economy must be understood, namely that the most trustworthy products and services will continue to be procured by the beneficiaries – demand and supply are strongly connected. The Statistic Portal tells us that the IoT market has exceeded a trillion dollar at the end of 2017, forecasting an evolution of up to 1.7 trillion dollar at the end of 2019 [20].

More and more cities in the world are experiencing the new dimension of sensor networks. Many are involved in pilot projects with the purpose of monitoring various activities in urban life, such as the level of noise or air pollution, parking management, health monitoring applications for persons suffering from chronic illnesses etc. **Thingful** is a search engine within this new dimension of the digital world. It contains indexes with the geographical positioning of all the fixed equipment connected in the world – a simple typing of a city's name can indicate on the map where different sensors are placed and what function they fulfil [24].

Thingful's goal is not just to provide a map of existing public or private equipment, but also to provide developers with solutions for smart cities to use these devices – of course, with the consent of the owners [24].

In Sibiu, Romania, was developed, thanks to the collaboration of „Lucian Blaga" University of Sibiu with the University College of Southeast Norway, Norway, the project **A Mobile Platform for Environmental Monitoring** with the aim of producing an environmental map that provides all actors in the city's perimeter with information on air quality and noise pollution. The Faculty of Engineering within „Lucian Blaga" University has developed hardware modules that can be placed on cars and which are meant to collect traffic data both when the car is in motion or in the parking areas, when the car is parked.

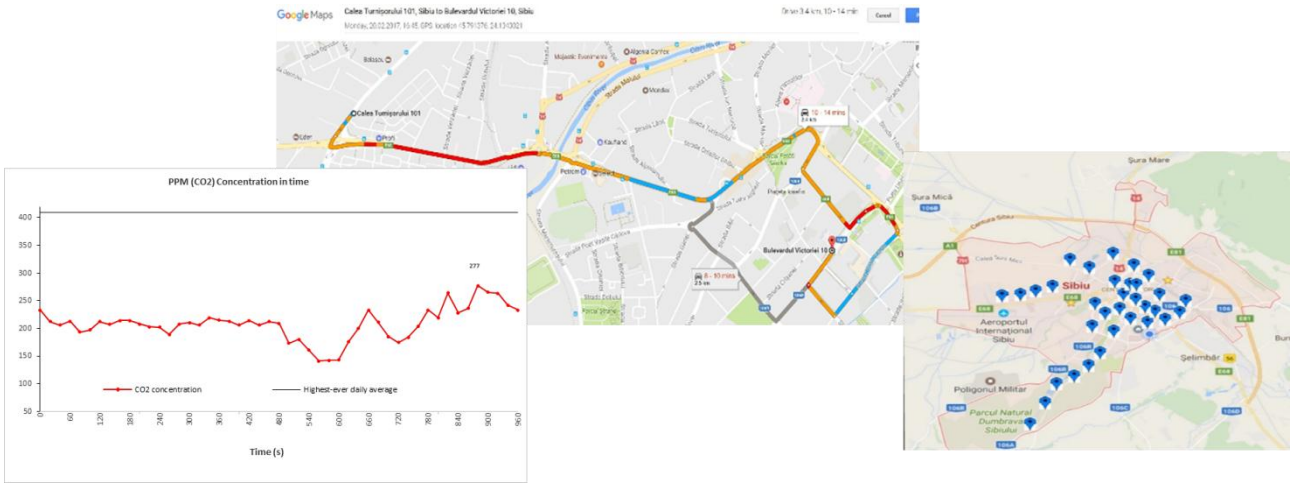

Figure 3. Data collected through mobile traffic platforms in Sibiu [35]

The collected data is transmitted via a GSM module combined with a GPS module implemented on the equipment to a server that has the role of storing them and providing them for analysis to the actors involved. Two prototypes of sensors were realized, the last of them (and the most advanced) being able to collect both data such as the CO_2, NO_x level as well as the amount of suspended solid particles. The project is still in the pilot phase, with only 16 cars equipped with such modules in the city, being completely functional, a number of approximately 100 units will be produced to be mounted on vehicles [36].

3.3. Privacy and the Internet of Things

Starting with the beginning of Web 2.0, Internet users generated a huge amount of data by themselves leaving behind a digital trace. Nowadays, due to the mobile apps, it is even worse – developing companies or the ISPs know where we are, what we buy and so on [37]. Like this wouldn't be enough, cities like London, New York or Shenzhen in China have huge numbers of CCTV cameras as well [38] – and those cameras are picking up every move of the citizens even if they don't use a smartphone.

Even though a lot of people feel anxious when they discover how much information they are leaving behind, there are advantages too. Collecting, sharing, mining of data offer citizens – IT users or not, services in a better way, it helps reducing crime and so on [40].

However, people will need more assurance that all this is being used fairly, that their privacy is respected and the data they generate isn't just being sold without they're seeing no benefit from it. Any other way won't bring the full benefits of this generation of technologies, which might give us a huge advance in social coordination, increasing the effectiveness of how our cities are run [19]. There are already many emerging signs of the scale of this potential backlash, the smart companies realize this, and they realize that we have to have an open dialogue [41] which shows people the benefits they can have by giving up some of their personal data [42]. More and more sensors monitor our lives, and, those sensors are becoming smarter and smarter [43], therefore, it must be taken into account citizens' degree of tolerance for the invasion of data collection equipment – as the number of equipment increases, the citizens feel more supervised [44].

EURODIG and SEEDIG are two of the major events in which stakeholders from the IT world, debate on the legislation that monitor individuals' communications [45], helping them fight against

companies and governments privacy aggression on one hand, and help them facing National Security threats on the other hand (EURODIG, SEEDIG). Being part of a completely connected society means that there will be implications on the economic wellbeing of our cities, so it's quite important to find the balance between privacy and security, so that citizens can continue to move forward enjoying in the same time a very safe society [46].

Therefore, regarding the Internet of Things users find themselves in a very interesting place, where, as the Internet connects everywhere it's very important that when they connect with all the pieces of technology they choose how much information they are prepared to give and how much they want to retain. It is particularly important that that choice is made implicit to the consumer / user / citizen and not taken for granted by any Internet of Things company [47].

The most common questions here are: (1) „Who produces and controls the equipment?", (2) „What do they measure?", and (3) „Who has access to the data?". All these questions are important and answers to them must be available to every citizen in a language that is as easy to understand as possible so that there is no confusion.

Other questions such as those related to the purpose of collecting data, the changes that will follow from these operations and the benefits of citizens, the public and the private sector are also important [48]. Data storage management mechanisms (often software) are also commonly found in studies about IoT.

Many cities consider elements of security (obviously not only digital) and intimacy as key to sustainable and harmonious development. The level of trust and acceptance of the new by citizens is crucial in developing smart solutions. However, there is little written information on how citizens see these things.

Dan Gârlașu, from Oracle Romania, warned IT users that in the future smart cities may be more vulnerable to hackers than smart computers and smartphones are today [49].
With billions of interconnected devices all over the world, cyber security challenges are increasingly addressing also the IoT dimension of the digital world. Often the media poses on the front page of the newspapers titles that refer to hacking actions of different types of equipment. In the summer of 2015, the car producer Fiat recalled 1.4 million vehicles for software updates due to the risks of the machine safety being affected [3]. At the end of 2017, a clip posted on YouTube featured two hackers who stole a luxurious car by remotely cloning the door opening device and starting the vehicle [24]. Shortly after the event, CNN tech has produced the „Watch thieves steal car by hacking keyless tech" material explaining each action of the hackers [50].

Cesar Cerrudo, Chief Technology Officer of IOActive – one of the most prestigious digital security consultancy corporations, stated for The Independent in the UK that „a malicious hacker could use the information to manipulate traffic lights to cause jams and alter speed limits" [51].

Danny Bradbury from The Guardian newspaper said: "I see an opportunity to pay a premium for retaining my own data, or at least guaranteeing that my data is de-attributed from me," he said, adding that he'd happily pay his fitness wearable provider another $1.99 (£1.33) a month not to sell his data somewhere else. [52]

4. The weakest link in IoT & Conclusions

"Addiction" and use of IoT technologies is even worse than losing privacy, and this is mostly because the users do agree to pay for the gadgets with their privacy, not paying attention to any risks – and these encourages developers not to pay attention too, and governments to be more intrusive. More or less it is the same with public speaking. Most of the people do feel nervous about using the words, paying attention to each of them and so on… It should be similar with the data that we share over the networks onto the digital space.

Many people find those technologies very compelling – smart phones for example, considering them as being "cool", and by that they just sign the Terms and Conditions page without paying attention to anything, not seeing any risk.

If we are to take that a bit further, then we will see that people aren't addicted to the technology itself, but to the comfort that this might bring, and this is very dangerous because, one way or another, everybody is struggling to increase their comfort bit by bit.

We started from the assumption that technology, and the whole infrastructure that comes with it, will help us increasing our life quality – this concept being difficult to define but usually used by researchers as an indicator [54] and we saw that, before long, critical infrastructure in our lives will be smarter, connected and will enable us to do all sorts of new and interesting things. It is a matter of time that most successful IoT stuff will just become normal – and that will be the mark of its success. Many of those technologies that once represented the top ones are today viewed as part of everyone's life helping us to increase our comfort, satisfaction, level of independence, education, wealth and so many other things that we, as individuals, are doing regularly – this is what we might start thinking a `smart city 2.0` is.

However, the dimension of IoT is not just a goal to be achieved – often mayors, hearing the concept but not understanding it in its depth, want to invest in IoT sensors and equipment for their cities – it is a remarkable symbiosis between society and technology.

5. References

[1] FULMER, J., What in the world is infrastructure?, PEI Infrastructure Investor (July/August 2009).

[2] INVESTOPEDIA, The Economics Of Solar Power, 2018, https://www.investopedia.com/articles/investing/061115/economics-solar-power.asp, accessed on 10.12.2018

[3] CAMPBELL, R. J., Weather-related power outages and electric system resiliency, 2013

[4] CAMBRIDGE CENTRE FOR SMART INFRASTRUCTURE AND CONSTRUCTION, Smart Infrastructure. Getting more from strategic assets, 2018, https://www-smart infrastructure.eng.cam.ac.uk/what-is-smart-infrastructure, accessed on 10.12.2018

[5] WYNAND JVDM STEYN, Intelligent infrastructure and data science in support of road maintenance, Conference: Advances in Materials and Pavement Performance Prediction (AM3P) Conference, 2018

[6] ROMANS LUKASHENKO, ALLA ANOHINA-NAUMECA, MARKS VILKELIS, JANIS GRUNDSPENKIS, Feedback in the Concept Map Based Intelligent Knowledge Assessment System, Journal of Riga Technical University, dblp.org, 2010

[7] INNOVATION ENTERPRISE CHANNELS, 5 Ways Businesses Benefit From Smart Cities, Benefits for businesses operating in smart cities, 2018, https://channels.the innovationenterprise .com/articles/5-ways-businesses-benefit-from-smart-cities, accessed on 10.12.2018

[8] T.M.VINOD KUMAR, BHARAT DAHIYA, Smart Economy in Smart Cities, Smart Economy in Smart CitiesEdition: 1stChapter: 1Publisher: Springer, 2017

[9] WORLD FINANCE, Could Songdo be the world's smartest city?, 2014, https://www.worldfinance.com/inward-investment/could-songdo-be-the-worlds-smartest-city accessed on 11.12.2018

[10] PROSSER, A., What the Smart City in the Danube Region can Learn from Industry 4.0, CEE e|Dem and e|Gov Days 2018, Austrian Computer Society 2018

[11] INTEL SOFTWARE, Connectivity Technologies and the Internet of Things, 2017, https://software.intel.com/en-us/articles/connectivity-technologies-and-the-internet-of-things, accessed on 11.12.2018

[12] IOT WORLD TODAY, IoT Connectivity Options: Comparing Short-, Long-Range Technologies, 2018

[13] ZISKA FIELDS, What is Digital Revolution, Handbook of Research on Information and Cyber Security in the Fourth Industrial Revolution, IGI GLOBAL, 2018

[14] SAYALI SAWAT, Smart Infrastructure in the IoT Era, DZONE, 2018, https://dzone.com /articles/various-components-of-smart-infrastructure-and-the, accessed on 12.12.2018

[15] BADIS HAMMI RIDA KHATOUN SHERALI ZEADALLY LYES KHOUKHI, Internet of Things (IoT) Technologies for Smart Cities, iet-net.2017.0163, 2017

[16] ASTHON, K., That ‚Internet of Things' Thing, RFID Journal, http://www.rfidjournal.com /articles/view?4986, 2009, accessed on 12.12.2018

[17] BOORMAN, C., Ten ways the Internet of Things is transforming our lives, 2015, http://blog. automic.com/ten-ways-the-internet-of-things-is-transforming-our-lives, accessed on 12.12.2018

[18] WAZE, Waze - GPS, Maps, Traffic Alerts & Live Navigation, 2018,

[19] BURRUS, D., The Internet of Things is far bigger than anyone realises, 2015, http://www. wired.com/2014/11/the-internet-of-things-bigger/ accessed on 12.12.2018

[20] VRABIE, C. & DUMITRASCU, E., Smart Cities, de la idee la implementare; sau despre cum tehnologia poate da strălucire mediului urban, Universul Academic Publishing house, 2018

[21] THE STATISTIC PORTAL, Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025 (in billions), 2017 https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/, accessed on 15.12.2018.

[22] BLAAUW, F. J., SCHENK, H. M., JERONIMUS, B. F., VAN DER KRIEKE, L., DE JONGE, P., AIELLO, M. and EMERENCIA, A. C., Let's get Physiqual – An intuitive and generic method to combine sensor technology with ecological momentary assessments, Elsevier, Journal of Biomedical Informatics, vol. 63, p. 141-149. 2016

[23] BENNETT, S., A History of Control Engineering 1930–1955. Peter Peregrinus Ltd., Institution of Electrical Engineers, London, 1993

[24] NEWATLAS.COM, "World's smallest computer" is a sensor smaller than a grain of sand, University of Michigan, 2018, https://newatlas.com/worlds-smallest-computer-university-michigan/55175/, accessed on 15.12.2018.

[25] THINGFUL, http://www.thingful.net/, accessed on 16.12.2018.

[26] SILOCON LABS, Introducing the First Energy Efficient Wi-Fi Solution Designed Specifically for the IoT, https://www.silabs.com/products/wireless/wi-fi/low-power-wi-fi-introduction accessed on 18.12.2018

[27] JUNKO, Y., Low-power Wi-Fi modules target IoT, Embedded, 2018,

[28] ESDS, Cloud Computing & IOT, 2018, https://www.esds.co.in/blog/cloud-computing-iot/#sthash.Ty0WuKky.dpbs accessed on 18.12.2018

[29] GLEICK, J., The Information: A History, a Theory, a Flood, Pantheon Books (US), Fourth Estate (UK), 2011

[30] ALPAYDIN, E., Introduction to Machine Learning, MITPRESS, 2004

[31] SCHMIDHUBER, J., Deep Learning in Neural Networks: An Overview. Neural Networks. 61: 85–117. arXiv:1404.7828. doi:10.1016/j.neunet.2014.09.003. PMID 25462637

[32] DEEPMIND, AlphaZero: Shedding new light on the grand games of chess, shogi and Go, 2017

[33] IBM - Watson Internet of Things, The Internet of Things delivers the data. AI powers the insights. 2019, https://www.ibm.com/internet-of-things accessed on 20.12.2018

[34] SCHUBERT, G., (et al.), Tangible Mixed Reality On-Site: Interactive Augmented Visualisations from Architectural Working Models in Urban Design, in Computer-Aided Architectural Design: The Next City – New Technologies and the Future of the Built Environment, Springer, 2015

[35] VRABIE, C., Elements of E-Government, Pro Universitaria Publishing House, Bucharest (2016).

[36] FLOREA, A. and BERTNTZEN, L., Green IT solutions for smart city sustainability, paper presented at the Smart Cities Conference, 5th edition, December 8, 2017, SNSPA, Bucharest, Romania (2017).

[37] BERNTZEN, L., JOHANNESSEN, M.R. and FLOREA, A., Smart Cities: Challenges and a Sensor-based Solution, A research design for sensor-based smart city projects, International Journal on Advances in Intelligent Systems, http://www.iariajournals.org/intelligent_systems, Publisher: International Academy, Research and Industry Association (IARIA), volume 9, issue 3 & 4 (2016).

[38] MENCHEN-TREVINO, E., Digital Trace Data and Social Research: A Proactive Research Ethics, The Oxford Handbook of Networked Communication, 2018

[39] WORLDATLAS, The Most Spied Upon Cities In The World, 2017 https://www.worldatlas.com/articles/most-spied-on-cities-in-the-world.html accessed on 20.12.2018

[40] CISCO, Internet of Things - Connected Means Informed, 2016, https://www.cisco.com/c/dam/en/us/products/collateral/se/internet-of-things/at-a-glance-c45-731471.pdf accessed on 08.01.2019

[41] LIM, H., KIM, C., ECK, J.E., KIM, J., The crime-reduction effects of open-street CCTV in South Korea, Security Journal 29(2), 2013

[42] SEEDIG - South Eastern European Dialogue on Internet Governance, https://seedig.net/seedig-process/ accessed on 08.01.2019

[43] MULGAN, G., - Chief Executive Officer, Nesta, Geoff Mulgan: achieving more for less - the innovators catalyst, https://www.kingsfund.org.uk/audio-video/geoff-mulgan-achieving-more-less-innovators-catalyst accessed on 08.01.2019

[44] BUSINESS INSIDER, How smart cities & IoT will change our communities, http://www.businessinsider.com/internet-of-things-smart-cities-2016-10, 2016, accessed on 08.01.2019

[45] VRABIE, C., Your freedom starts where my privacy ends, Smart cities, Pro Universitaria Publishing House, Bucharest (2017).

[46] TELEANU, S., SEEDIG 2018 Annual meeting, Ljubljana, 2018

[47] STEFANITA, A., Elements of Local Autonomy and New Technology in Urban Revitalization Process, CEE e|Dem and e|Gov Days 2018, Austrian Computer Society 2018

[48] NEMESLAKI, A., The Puzzle of ICT Driven Innovation in the Public Sector: Hungary's Case, CEE e|Dem and e|Gov Days 2018, Austrian Computer Society 2018

[49] SAMSON, R., - CEO Big Brother Watch, https://twitter.com/renatesamson?lang=ro

[50] GĂRLAȘU, D., Cyber Security Update on Threats and Trends, paper presented at the Smart Cities Conference, 4th edition, December 2016, SNSPA, Bucharest, Romania http://administratiepublica.eu/smartcitiesconference/2016/program.htm (2016).

[51] CNN TECH, Watch thieves steal car by hacking keyless tech, http://money.cnn.com/video /technology/2017/11/28/relay-box-car-theft.cnnmoney/index.html, 2017 accessed on 10.01.2018

[52] INDEPENDENT, Vulnerabilities in traffic light sensors could lead to crashes, researcher claims, http://www.independent.co.uk/life-style/gadgets-and-tech/news/traffic-light-hack-could-lead-to-road-chaos-claims-expert-9309936.html, accessed on 10.12.2017 (2014).

[53] BRADBURY, D., How can privacy survive in the era of the internet of things? http://www.theguardian.com/technology/2015/apr/07/how-can-privacy-survive-the-internet-of-things accessed on 10.01.2018.

[54] BARCACCIA, B., ESPOSITO, G., MATARESE, M., BERTOLASO, M. and De MARINIS Maria Grazia in Forbes (2013) *Quality Of Life: Everyone Wants It, But What Is It?* - https://www.forbes.com/sites/iese/2013/09/04/quality-of-life-everyone-wants-it-but-what-is-it/#2a00064e635d

[55] TTN Mapper – https://ttnmapper.org/ accessed on 16.03.2019

[56] LoRa Alliance – https://lora-alliance.org/ accessed on 16.03.2019

[57] The Things Network – https://www.thethingsnetwork.org/ accessed on 16.03.2019

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