The Internet of Financial Things: Today and Future Perspectives

Ali Osman Serdar Çıtak[a] and Gökhan Silahtaroğlu[b1]

[a]Department of Banking and Insurance, Istanbul Medipol University, Istanbul Medipol University, Istanbul – Turkey

[b]Department of Management Information Systems, Istanbul Medipol University, Istanbul – Turkey

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Abstract

With the inexorable increase of network technologies, the awareness and conception of the Internet of Things (IoT) are growing and expanding rapidly. From retailing to automotive sector new applications have been efficaciously developed and industrialized these days; besides, along with the integration of cloud technology, WIMAX and machine learning algorithms, data collected via the IoT may be used for various practical purposes such as CRM, marketing, risk management, strategic planning, recruitment, procurement, supply chain, shelfing and so on. On the other hand, financial domain should be dealt with separately regarding its vulnerable or delicate nature as well as being very important to every single person on earth. In this paper, following detailed technological analyses of the IoT and related technologies, some new proposals have been dissertated to be consummated on financial sector within the concept of shared economy. Bearing in mind financial benefits and aspects, the IoT may be assented and regarded as a standalone the "Internet of Financial Things".

Keywords: Internet of things, Radio-frequency identification (RFID), Internet of shared things, Shared economy, Machine learning, WIMAX.

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1. Introduction

When things are equipped with a sensor and electronic circuits, things have gained special abilities to establish communication with people and to update status of information on the spot. Accompanied by the development of mobile networks and the Internet itself, communication of things with the outer world has become easier and people have enjoyed the opportunity to monitor and control them (Vermesan and Friess, 2013).

[1] Corresponding author, E-mail: gsilahtaroglu@medipol.edu.tr

It is expected that current life on earth will become smarter throughout the development line of the Internet of Things (IoT). Some of the applications have already come into our lives. Correspondingly, with the development of new systems, it is expected that people will lead a better and smarter life, especially in areas such as human health, transportation, communication and urbanization. In this case, expected developments will trigger other advances in some other domains and a chain reaction will take place (Vermesan and Friess, 2013).

According to recent studies, it is forecasted that today, 10-11 billion devices are connected with each other and it is predicted that this number will rise to 50 billion-device-level in 2020. According to the same studies, while the ratio of interconnected device per person is 0.08 in 2003 all over the world, it is estimated that it will be 6.48 by 2020. Besides, in 2020, it is expected that the information traffic which will be created by 20 typical home appliances will be much more than the all internet traffic produced in 2008 (Evans, 2012).

After the internet technology has been put into practice, a lot of significant phases have been gone through. In order for things to connect to the Internet medium and form the information infrastructure by means of communicating through a mutual network, the Internet had to reach a specific point and achieve some levels or phases in this development process. The first phase of the internet can be named as research period. This period is the introduction phase which was dominated by academic networks and mostly used for researches.

The second phase covers the period when companies and institutions make briefings and updates about their activities through the internet. The second phase can be defined as a period of time which is static and mostly dominated by servers and websites to transfer information to masses.

The third phase is the period when the internet proceeded to interactivity, far from being stable. Real-time purchasing transactions of products and services were performed, presentation to the large masses were enabled, and mass marketing implementations started to become widespread by means of prevailing in infrastructure facilities. Last phase is the period we currently live today and it represents an environment where the concept of social media has become widespread (Anithaa et al., 2016).

From a broader perspective, the term Web 1.0 is used to define the first two phases. Web 2.0 symbolizes the third and fourth phases in terms of the content abundance which is fostered by the social media and the user. For this reason, Web 3.0, semantic web and ultimately Web 4.0 can be entitled as the process of the Internet of things. These sequence numbers stating the phases of the internet should not be regarded as

processes which start as soon as the previous one finishes, on the contrary, they should be interpreted as the interpenetrated rings of a chain (Li et al., 2015).

The phase that the IoT has moved into a network which directs the technical applications in many industries and in many parts of our lives has required the simultaneous management of a great deal of concurrent processes. In terms of market environment, it is observed that the implementation of the IoT has brought solutions in five different areas. These areas are classified as smart clothes, smart houses, smart cities, smart environment, and smart enterprises. Among those, the most important and concrete implementation which reflects into the consumer lives is the shared IoT (Li et al., 2015).

In recent years, sharing economy appears as a rapidly rising new economic model. Business models such as instrument and furniture sharing within the scope of social innovation appear as new application forms of shared economy, where studies related to the internet of things are conducted. When consumer trends have been examined, sharing the IoT which is the next stage, takes place among the rising trends (Tan and Wang, 2010).

When we take a look to the speed of the shared internet of things application trend, it is expected to occupy more in consumer preferences in upcoming years. An important example of business model related to the shared things is the implementation of vehicle sharing which was initiated by the big car-making companies in Switzerland. In this model, 4-5 people who share the same purpose can rent an automobile up to two years and can pay the rent as monthly fixed instalments on a usage based model.

The system of the shared IoT provides the users with the current location and availability of the 'shared thing' through a mobile smartphone application. Thanks to the shared IoT, efficiency in source utilization has been enhanced and profit maximization per consumer has been reached in a much higher level despite the limited budgets of firms.

The paper is organized as follows. Section 2 details the Internet of Things. Sections 3 and 4 examine impact areas of IoT in the insurance industry and banking industry, respectively. Section 5 concludes.

2. The Internet of Things

The Internet of things (IoT) is a new architype which finds more space in industrial practice (Atzori et al., 2010). According to a general definition made by International Telecommunications Union, the internet of things is the global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies (Vermesan and Friess, 2013). European Technology

Platform defines the internet of things as “the information exchange between a mutual network which hosts physical and virtual property having predetermined capabilities and working in smart mediums along with their physical and virtual attributes and other networks and users.” IoT is made up of small chips embedded within devices and integrated with each other via a network and database systems. From electronics point of view, those agents are called as Radio Frequency IDentification (RFID). A simple RFID consists of three parts; these are an antenna, a semi-conductor chip, and a form of capsulation (Want, 2006). These tags may also have a battery or power supply technology. RFID systems are capable of holding small amount of data and transferring those data to another system. However, IoT is not a simple electronic setup which consists of batteries, chips and antennas. It is more than a computer system.

Those things are smart systems as well. A smart system should have sub-systems which make it smart. So, the IoT must be considered as an intelligent information system. When the IoT are consummated in different domains such as banking, finance, medicine they should have a feature to help decision maker with his/her assessments, plans, resolutions, and pronouncements. Such an intelligent information system requires Artificial Intelligence (AI). AI is defined as an intelligent and flexible rational agent which perceives its environment and takes actions to achieve a certain goal (Biswas et al., 2005). Those agents are capable of collecting data and make their own decisions (Jennings and Wooldridge, 1998). However, colloquially an AI system is considered to encompass cognitive functions that humans associate with other human minds, for example "learning" and "problem solving are some of them (Russell et al., 2003). On the other hand there is not a single system or algorithm which forms an AI. It consists of electronic devices, network communications, database connections, machine learning algorithms, antennas, and batteries just like the IoT are.

Machine learning is a sub-field of AI which introduces learning algorithms and generates rules and patterns based on data. It has mainly two types of learning system: supervised and unsupervised. Supervised learning algorithms are used for predictive analysis. The system needs a class variable to learn the rules, patterns, and rationale behind the class variable in order to make accurate future predictions about the class variable. Unsupervised machine learning algorithms do not need a class variable. These type of machine learning algorithms are used for descriptive analyses and they do not only predict the future value of a certain variable but also the variable itself. They assess all of the variables in the data-set and rank their importance for clustering data. The number of the clusters in the dataset is supposed to be determined by the algorithm(s) as well. The IoT should exploit machine learning algorithms for predictive, descriptive, and prescriptive analyses as well. A prescriptive analysis puts forward some suggestions to be exercised in practice. Deciding the type, amount, and direction of a financial investment is one of them.

Connection and communication among RFID things and between things and servers could be realized by various wireless technology standards such as Bluetooth, WI-FI, GSM, and WIMAX (Ghosh et al., 2005). Bluetooth communication standard is preferred for small amount of data over short distances up to 100 meters. Bluetooth standard using short-wavelength UHF radio waves from 2.4 to 2.485GHz typically operates well for the data exchange of RFID tags in a perimeter of 10-20 meters (Weng et al., 2009). WIFI standards operate within the 2.4 GHz UHF and 5 GHz and is suitable for exchanging data even in Gigabytes. Its communication distance is 20 meters indoors according to Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards (Bianchi, 2000). WiMAX (Worldwide Interoperability for Microwave Access) wireless communication standards are constructed on the IEEE 802.16 set of standards (Ghosh et al., 2005). Mobile or fixed WiMAX may be considered as an substitute or alternative for cellular phone technologies such as GSM (3G, 4G) and CDMA, it is capable of providing communication service for large amount of data across cites kilometers away from each other (Andrews et al., 2007). As for the IoT, WIMAX is a standard to synchronize things scattered over the world. Using WIMAX, things may send and receive data from remote servers therefore they exchange data and information no matter how far they are from each other.

Data or data servers are usual and inevitable part of an IoT model. The things get connected to the Internet not only to communicate with other things but also to retrieve information and rules to apply in practice. This information and rules are generated from big data sets residing on data centers or servers. Today, most of the data available for this kind of analysis comes from social media which consists of user generated data (UGD). Instead of using only transactional corporate databases for data mining, pattern recognition, or complex event processing (CEP) and Big Data are used. The IoT are mere dummy devices without Big Data and related algorithms. Big Data is collection of data brought together from different sources like transactional databases, online webpages, forums, social media entries, and third party databases like weather forecast, currency exchange rates and so on. Big Data is supposed to be in different formats like text, image, voice, and raster. Considering Big Data is coming from different data sources and different formats, it is labeled with five features: Variety, Velocity, Volume, Veracity and Value (Vardarlıer and Silahtaroğlu, 2016).

3. Impact Areas in the Insurance Industry and Expected Developments

The internet of things is on top of the list of technologies which will change the world. While the concept of the IoT and related applications formed around this concept are gaining speed, in first stages, it was not expected that finance industry would be the area of successful implementations in this technology. However throughout the development line of the IoT, finance industry has gained a major momentum in terms of

current practices and expectations for the future. As of the reached phase, current and expected impacts of the IoT on finance industry is expected to show a momentum which will directly impact the insurance and banking industry practices in future years.

In the upcoming years, smart thermostats, integrated security systems, smart fridges and cooling systems and wearable fitness devices which are expected to become more widespread in the area of the IoT will add new dimensions to shape the services of insurance companies (Chen, 2012). The implementation of the IoT is expected to change the traditional practices in the insurance industry dramatically. For a home owner who can keep the lightening, cooling and heating systems and other electronical devices of his house under control by means of a mobile application, it will not be possible for the insurance company to draw elemental branch insurance in traditional sense. Since the insurance companies will be able to obtain much more detailed information about the real estate subjects to insure, in the new environment where such a data flow will create policy pricing of the insurance companies will be much more different and the possibility of a more efficient pricing compared to traditional methods will increase accordingly.

Although 23 million cars were followed and monitored in 2013 all over the world by the IoT, this is expected to reach 152 million cars in 2020. Route records of automobiles tracked and drivers' deeds are kept in this medium. In this way, information about the drivers' driving styles and performances can be generated on driver basis from the data server. At the end of this process, the possibility of driver basis and usage based policy assignment and policy premium determination appears in parallel with the customer exposure. From today's projection, with the implementation of the IoT, accident risk will completely disappear in an environment where all automobiles can communicate with each other. This case will create a brand new milieu for insurance industry therefore automobile risk insurances will have to be redefined.

Furthermore, when an automobile heads to the customs to go abroad, the car tracking system and IoT will warn both the driver and the insurance company to extend policy to cover damages to happen out of the country. Perhaps it will be an automatic update which will terminate when the automobile comes back to the home country. Hence, this service will be a win-win both for insurer and insured.

On the other hand, in case of an earthquake, tsunami and nuclear plant accidents which are classified as catastrophic risks in insurance practices, level of development of the IoT gains prominence in the case of informing the public and creating awareness before the risk realization and management of the risk before it takes place or has an effect. In this respect, an impressive example was experienced in Japan. After the nuclear plant disaster, people could have the information about the radiation level all over Japan by means of Geiger counter's connecting to the Internet and under the light

of this information they did not travel to the regions where the radiation level was high or they were moved away from such regions bearing radiation risk (Evans, 2012).

Expectations from the IoT in health insurance industry are in a more path-breaking level. Health insurance policy owners' blood pressure values and figures of calorie burning as a result of daily activities will be collected by the IoT which communicate with the insurance company's computers Thus, critical values related to the health of the insureds will be monitored continuously and the following year, their renewal policies will be priced according to the development of the collected data.

World population is continuously getting older. In the middle of the century, it is predicted that there will be one billion people older than 65 years old and retired. The IoT may present life quality increasing solutions for the people in this age group. A portable device which is connected to the system can send the health parameters of people in this age group to health institutions and insurance companies. In this way, both health institutions and insurance companies may have the opportunity of taking preventive measures and offering solutions (Evans, 2012). This will stop a risk before it comes to pass. That is another win-win situation.

4. Impact Areas in the Banking Industry and Expected Developments

Banks, with the innovations provided by the process of the IoT in their activities will take on new roles in their services which they present to their customers. Traditionally, in addition to a bank's consultancy service for its customers' financial needs and managing the accounts of the customers, consultancy roles will gain different dimensions in the process of the IoT and banks will be able to produce solutions for their customers' non-financial needs. An individual banking consultant who continuously collects data from the fridges, electrical counters or automobiles of his customers will also attain the ability of continuously monitoring the budget status of them. In this sense, banks can forecast certain expenses which can potentially arise in the budget of the customer and even they can give preventive advices. The fact that the IoT exists in individual banking activities will have the current banking business gain brand new dimensions (Citak, 2016; Accenture, 2014).

In respect of commercial banking, it is observed that changes that will occur along with the development of the IoT will show more dramatic and radical progress when they are compared with traditional practices. Because the banks will have more information about their commercial customers, starting from their supply and production chain, they can simultaneously analyze a wide range of information from the dynamics of the companies with whom they compete with and the distribution network of the end product to the consumer preferences and submit the results of these analyses to their customers. In traditional commercial banking, while banks ask their commercial customers to submit their financial statements at the end of each period to analyze

them, in banking practices which will be created by the IoT, banks will be able to direct and manage the statement formalization processes with their customers.

In banking practices dominated by the IoT, it will be required that they should turn out to be able to divert a huge data flow and produce information in accordance with the needs of their customers by processing these data so that the banks may render a successful operation. For this reason, it appears as a necessity for banks to make a great deal of investment on the information technologies infrastructure (Citak, 2016).

Banking practices will be designed in a complete alignment with the customer's needs, by moving away today's standard understanding of product and service. In parallel, pricing process will be realized within the framework of a dynamic model. Since banks will have the finest detailed information about their customers such as their habits and lifestyles, products and services will take shape in line with the specific customer needs.

Owing to the prevalence of the IoT, banks will have to change over from traditional risk management to digital risk management approach. As banks collect more data, they will require more data capacity and this will bring the requisite of producing more information.

5. Conclusion

In order for the institutions in the finance industry to survive in the future, it is required that they should be susceptible to financial innovations and they should always have active reflexes to shape the future.

Financial institutions, while developing products and services in line with the expectations of the new consumer appeared in the axis of changed investor behaviors and market trends, should take into consideration that financial product function of the future should simultaneously evaluate the social and environmental impacts in addition to the profitability (Brynjolfsson and McAfee, 2014).

Following the developments in the IoT, the insurance industry policy to be designed for the insured party who asks insurance service with the purpose of being protected against risks in both elemental and life branches will have to be designed in a totally different way. For this reason, insurance companies which can cover the data requirement of actuarial calculations to be resulted from this new situation in advance and which can perform the pricing and underwriting procedures in a successful way will get ahead in the competition. Probable risks and therefore policies will be determined and formed through automations depending on the information collected by the IoT which are embedded in insureds.

On the other hand, banking practices will be dominated by the IoT, in order for the banks to render a successful operation. For this reason, it appears as a necessity for

banks to make big amounted investment on the information technologies infrastructure, in order to protect current level of their competitive powers.

It is a known fact that finance industry takes technologic solutions and reflects these into the customer based solutions more promptly than the real industry does. In addition to the development of the IoT, solutions to become concrete will find an implementation area in international dimensions. For this reason, it is considered that insurance companies and the banks which operate locally will lose their competitive advantages considerably, if they do not make the required system investments on time and what is more in the long term, they may face the risk of withdrawing from the industry.

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