

INTERNET OF THINGS AND ROMANIAN MANAGEMENT

Liviu Dumitru RUSU¹

ABSTRACT: *I will briefly summarize the state of knowledge in terms of technology regarding "Internet of Things" the onset and evolution of this technological phenomenon, but also it's impact on management in Romania, first step in developing this technology, history, trends, and evolution of this technology in Romania and the changes caused by this technology to the Romanian management. Although its visibility is still relatively low, the Internet of Things revolution is also speeding up in Romania. It highlights the steady increase in the number of companies that promote their own IoT solutions, as well as the new home-based startups that make their entry into the new market with original projects. Till 2018 IoT market will increase in Romania by 200 % mostly due to private sector (manufacturing, utilities, transport, logistics, car industry and consumers but also in the public sector (healthcare like telemedicine, smart cities, public transportation, traffic management, retail). The Romanian management will have to respond to the challenges generated by this technology and adapt to the new requirements generated by its introduction in all sectors. The objectives: consist in relevant answers to the question of how IoT will transform the Romanian management in its functions and subsystems, but also in terms of the structure and functions of the enterprise. As a methodology: from the answer to this question will be taken some conclusions on the influence of IoT on the Romanian management using interviews on a sample of IoT companies in Romania. As a result: I've highlighted some transformation induced by IoT in Romanian management both in private and public sector.*

KEYWORDS: *Cloud, Computing, Sensors, devices, E-business, I-business, e-government, management, SCM, ERP, CRM, BI.*

JEL Classification: *M10, M12, M14*

1. INTRODUCTION

The „Internet of Things" is the network of physical objects around us that contain electronic components, software, sensors and networking systems, preferably the Internet, which allows these objects to exchange and acquire information. The Internet of Things (IoT) generally allows the remote control of these objects using the already existing telecommunication infrastructure allowing direct integration into the classical computer networks with immediate benefits at reasonable costs. Has its origins in cloud computing and especially big data and consists essentially in the interaction of intelligent plug-in devices using computer network infrastructure with broadband Internet and processing of messages and data transmitted by these devices to automate the surrounding world that includes slowly but surely all fields (Deichmann et al., 2015).

. Connecting physical things to the Internet makes it possible to access data from remote sensors in order to control the physical world from a distance. Combining captured data from sensors with data extracted from other sources, for example (with data contained on the Web), gives rise to new

¹Bucharest University of Economic Studies, liviu_rusu1964@yahoo.com

synergic services that outweigh the wealth of information and utility that services can be provided by an integrated system. The Internet of Objects is based on this vision. Billions of sensors are attached to natural resources, production lines, power grids, logistics networks, recycling streams and implanted in homes, offices, shops and vehicles, feeding Big Data's global neural network with large amounts of data. Companies as well as small and medium sized manufacturers and consumers will be able to connect to the network and use Big Data. Analytics and optimization algorithms compete to accelerate efficiency, increase the productivity dramatically, and reduce the marginal cost of generating and exchanging physical and broadband products close to zero, making them almost free of charge.

2. SHORT HISTORY

The first paper in the academic environment that discusses this issue is "The Computer of the 21st Century" by Mark Weiser in 1991, this paper presents a fairly close picture of the IoT phenomenon as is currently understood. In 1994, Reza Raji in the IEEE Spectrum magazine (the magazine produced by the most important organization of electronics engineers, the Institute of Electrical and Electronics Engineers) presented the concept of data node systems that circulated impressive amounts of data by connecting home systems such as refrigerators and TVs to factories and heavy machinery. Large corporations such as Microsoft that offered Microsoft at Work and Novel solutions with NEST have tried since 1994 to generate a market based on this phenomenon but a vision ahead of its time and a state of the art that did not yet offer the necessary solutions caused a failure. In 1999, the phenomenon reappeared with Bill Joy, the founder of Sun Microsystems and co-inventor of BSD Unix, who proposed the Device to Device (D2D) protocol as part of its "Six Webs" framework under the umbrella of The Weird Web." The Internet of Things (IoT) was brought to the forefront by British entrepreneur Kevin Ashton, co-founder of MIT's Auto-ID Center, creators of the RFID standard. The IoT vision presented by it involved a switch from IoT used in B2B situations, where it was used as a technology for closed network warehouse management, a technology that works for the individual, a computerization of privacy”

3. TRENDS

ABI Research estimates that “in 2020 will be over 30 billion wireless devices connected to the Internet. Pew Research Internet Project has contacted a large number of IT specialists and related fields, over 83% of them believe that in the future, most of the things we will have will be connected directly to the internet by 2025. Companies like Google, IBM and Microsoft are already investing enormous amounts of money for the infrastructure that will begin to be used for this phenomenon” (Table 1).

Table 1 Internet of Things Units Installed Base by Category (billion units)

| Category | 2014 | 2015 | 2016 | 2020 |
|-----------------------------------|------|------|------|-------|
| Consumer | 2277 | 3023 | 4024 | 13509 |
| Business Orizontal | 632 | 815 | 1092 | 4408 |
| Business vertical Industry | 898 | 1065 | 1276 | 2880 |
| Total | 3807 | 4902 | 6392 | 20797 |

Source: Rivera and van der Meulen (2014)

3.1 How the Internet of Things will look like in Romania in 2017

So far, the entry of IoT into our country has been achieved only at the level of the big private companies in the private sector or in the local subsidiaries of multinationals in Romania. Today, almost 7% of Romanian companies have implemented IoT technologies and in the future nearly 21% are planning to implement these solutions. The Internet of Things (IoT) accelerates both in the business and personal areas in the most unexpected ways. The Romanian IT specialists are expecting this year that the IoT adoption slope will get some extra degrees. In Romania, there have already been IoT implementations in the private sector in manufacturing, smart grids, industrial processes, asset management, or home security. According to an IDG study (2015) by 2018, the Romanian IoT market will double in value due to most spending sectors like:

- Manufacturing
- Transport
- Utilities
- Consumers

Public sector followed the trend starting with telemedicine (e-health and e-patient) developed first in emergency medicine by unifying and standardizing charts send through sensor to the nearest emergency unit. The next growing areas will be hospitals, public transportation connected cars and entertainment area. But the most important transformation that IoT will affect the public sector will be the smart City. I-government and I-learning will follow. The Internet of Things will transform not only cities, industries and companies but also our way of life. Romania is one of the fastest growing economy related to M2M market, between 2015-2020 connected devices are forecast to grow from 1.56 million to 7.84 million. The first platforms that used IoT are fleet management platforms for transportation and logistics where consumption and route sensors are the main sources of data. Cloud-based solutions are, in fact, an effective alternative for all technology consumers. This is a solution especially for software vendors, because those solutions require scalability, security and far more superior availability and flexible costs. IDC predictions for IoT (Outsourcing Today, n.d.):

- By 2020 90 % of IoT will be hosted on cloud platforms
- By 2020 90 % of networks will implement new security policies
- By 2018 40 % of IoT data will be stored, processed, analyzed on the network edges nodes.
- This year (2017) 50 % of IoT activity is concentrated on manufacturing, transportation and logistics, smart city and consumer applications.
- By 2018 25 % of government spending will focus on Smart Cities
- By 2018 60 % of IT Industry solutions will turn to open-source facilitating IoT markets to grow.
- In 5 years 40 % of wearable will become smartphones alternatives
- By 2018 16 % of the population will adopt smart devices accelerating IoT adoption.(4)

3.2 Romanian IoT platform users

The first companies that introduces IoT platforms according to the research were mobile network companies. Late in January, Orange Romania launched M2M Control, a IoT platform to manage their car fleet and users can check devices, access information such as position, fuel consumption, localization, routes as graphic representation. Telekom Romania is a user but also a provider for IoT through its Innovation Hub (as part of Deutsche Telekom) and a Romanian start-up Transit Director joined it in developing Smart City pilot program developed in Tineretului Park in Bucharest with 4 integrated components of an IoT platform:

- Smart parking
- Smart lighting
- City safety
- Wi-Fi spots

And analytics component to be added in the future as Deutsche Telekom group focusing vertical strategy. Last month a Romanian mobile distributor Quick Mobile expands its offer of smart devices based on IoT to Romanian homes:

- Pets monitoring systems
- Home surveillance
- Connected thermostats
- Health and fitness products

Intrarom (Telecom Romania) has a unified management and monetization platform for IoT solutions. The solution is to build an interactive relationship between the municipality and the citizen by integrating numerous applications from various fields of activity such as:

- Intelligent Parking
- Intelligent Lighting
- Waste Management
- City Noise Monitoring
- Traffic Management

The platform also includes a unified management and control module that enables aggregation of all relevant information for the municipality monitoring the status and equipment wear identifying and managing potential errors optimizing all processes. Romanian IoT providers:

Vector Watch: A start-up in the wearable industry, founded in Romania but has offices in London, Silicon Valley, Hong Kong and Bucharest.

FaceRig: A Romanian start-up providing image-base tracking for creating digital characters in real time, tracking sensors and webcams.

Skin-Vision: The company’s app detects skin suspicious moles that suggests a dermatologist visit depending on each case on an accuracy of 81 %.

MIRA-Rehab: transforming traditional exercises into videogames by motivating patients through physical therapy. The start-up was founded by 4 Romanian software students allowing remote monitoring and treatment prescription.

Axosuits: is creating exoskeletons that people with disabilities use to have a normal life.

Device-Hub: Providing smart home helping users to monitor and remote control houses. It has also projects in public transportation, medicine, industry and agriculture.

Accenture: provider of digital healthcare IoT platform as well as other software products Also quoted a study that estimates the potential savings for some of these digital technologies: “For each patient with type 2 diabetes, at least \$ 697 a year can be easily saved by using digitally accessed intermediates and remote monitoring, resulting in an annual savings of 19.2 Billion USD. In Romania, only 48% of the adult population uses the Internet, compared to an average of 75% in the EU, but the percentage is annual growing. Even in our country, agricultural combines or tractors are equipped with GPS and automatic control have already appeared. According to Gartner data study, for 2020, the expectations amount of connecting devices will be more than 25 billion products. On April 8, 2015, the Romanian government adopted the Digital Agenda for Romania 2020” that redefines the strategy of transforming the IT infrastructure in Romania to include the IoT phenomenon.

4. METHODOLOGY OF REASERCH

It was a survey on 12 Romanian IoT companies interviewed using questions about their products and how IoT platforms helps customers to manage better their businesses through managerial functions and subsystems. The following questions were used:

- What subsystem of management is improving their IoT platform
- Does the IoT platform induce changes in the management system

- How IoT platform helps Romanian manager to improve managerial functions.
- Does the client company uses IoT platforms and if so, in what managerial function?
- If the introduction of IoT changes the specific-structure of the organization due to adaptation to digital environment.

Answers of Romanian managers give us an image of transition of Romanian organizations to digital environment and the impact of IoT to management system in the size of its functions.

1. **The prediction function** in which IoT platforms provide trough sensors and cloud services collected data stored in data warehouses, perform analysis with real time engines using artificial intelligence and data mining methodologies for simulations and forecasts.
2. **The organizational function** in which IoT ensures communication links between departments and departments changes trough simulation and the circuit of information and decisions both upward and downward sent and received with instant feedback and liaising stakeholder trough front office.
3. **The coordination function** Supported by IoT platforms through the calculations made available on the tasks to be performed and the possibilities of replacing staff with sensors or equipment, as well as the pursuit of these tasks on time and the required quality, workload with tasks, tracking their achievement, timing allocated for each task and the degree of achievement allotted time, the steps necessary to achieve the objectives and address any gaps.
4. **Drive function** through which the data provided by the IoT platforms received from both sensors and equipment, as well as those delivered by personnel and analyzed by the platform’s analysis systems, are made available to the management for the decision-making process as well as the decisional variants suggested by the platform(that can also include decision support systems) on optimization, transport problems, ERP efficiency, etc. and staffmotivation and coordinates with training and coaching programs to calculate the degree of achieving goals and corrections required through feedback.
5. **Control Function** in which IoT platforms can provide real-time status of activities monitoring resource allocation and consumption, transport costs, energy and fuel efficiency, monetary and human resources used in the process and harmonize limits needed to planned objectives , determining the degree of deviations from indicators and corrections of them.

Table 2. IoT technological evolution

| Used Tehnologies | | | | | | |
|------------------|---|---------------------------------------|--------------------|----------------|---|---|
| Intranet | internet | Web pages | Integrated systems | Mobility | Knowledge/ Data bases Social Networks | Shared resources/ Cloud IaaS PaaS SaaS DbaaS |
| | | Data Bases | | | | |
| IoT Evolution | | | | | | |
| Things | Sites/ Barcode/ QR Code/ Bluetooth | Machine 2 Machine communication | NEST | Mobile devices | Wearables | IoT Platforms |

Source: author

Managerial functions are assisted by IoT and network platforms for real-time embedding of the entire organization. The goal of using IoT is to increase efficiency and productivity, reduce costs and speed up the movement of information from sensors and people to decisions making and verifying their implementation.

IoT and managerial subsystems:

Although the impact of IoT is manifested on all managerial subsystems, some are more strongly influenced than others due to the current technological level.

4.1. Informational subsystem that includes the computer system described in the figure 1.

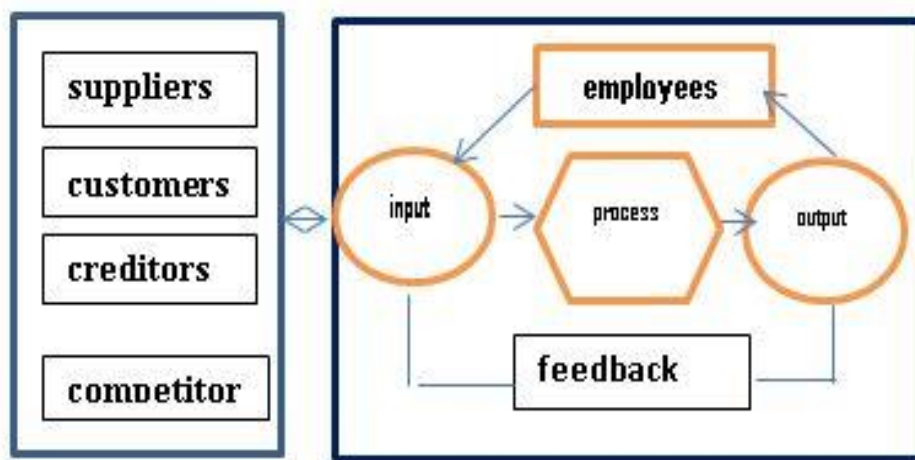


Figure 1. Informational Subsystem

Source: Bing (n.d.)

IoT is changing the informational subsystem by speeding up of information and networks, increases the speed of information and networks, shortens information circuits, reduces human factor delays and exponentially increases collected data and processing capacity.

IoT powered Informational System (fig 2)

Environmental context is recognized by IoT sensors, sensors is a stand-alone or embedded device with networking capabilities and home appliances, wearable devices or vehicle control systems(fig 3). Information is the context obtain by sensors and transferred trough networks as communicating data , being processed on cloud platforms and provide value by exploiting the information. Below are a few valued information that are processed:

- Automation
- Caring for customers
- Business Intelligence
- Entertainment (5)

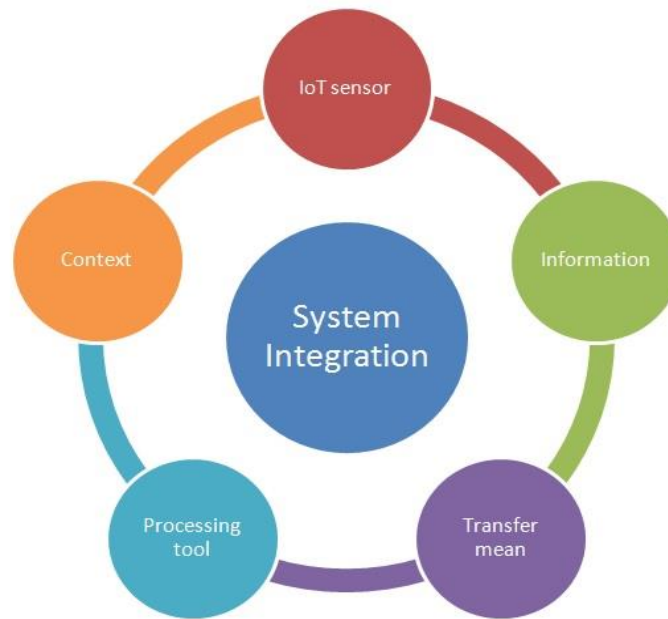


Figure 2. IoT information system

Source: Lee (2015)

4.2. Organizational Subsystem (fig 3, 4)

Transition from a traditional IT organization architecture to an optimized IoT powered will not be easy due to redesign the current technology stacks to support billion of data and processes transmitted between sensors, devices, data storage and applications in cloud. Computer systems must react on real time to changes and information and therefore networks, devices, communication protocols, data storages and applications are critical elements of hardware and software of the system. Many software platforms must be integrated to collaborate across IT business units and must be able to collect, analyze, store and process data emerging from these architectures.(6) Digital transformation needed to approach a modular architecture , standardization, design and maintenance, security layers to manage products that newer IoT apps and devices account for platform requirements.

Digital management architecture (fig. 3) vs traditional organizational architecture (fig. 4)

4.3. Decisional subsystem: Use of decision IT support subsystem powered by IoT, changes decision making environments and managerial request limitations, needed for better decision support system, to improve the quality of decision requiring computerized support. Feeding organizations with large amounts of data collected and by IoT and processed by artificial intelligence that uses Artificial Intelligence algorithms, helps making predictions. Knowing huge amount of personal data, buying behaviors, addresses and locations, companies will use more and more DSS (decision support system), instead of taking decision based on what they know.

Make the owners of such huge quantities of personal data to gain value from their use on the market. My study revealed that companies with decision making using IoT through DSS are more productive by 5 % and more profitable by 6 %. Consumers' personal data will raise concerns about who has access, determining legal action from governments and EU. Accessing so large data by organizations and processing them by automated decision making will influence data, analytics engines using AI, machine learning and big data including those from social networks without regulations will increase concern.

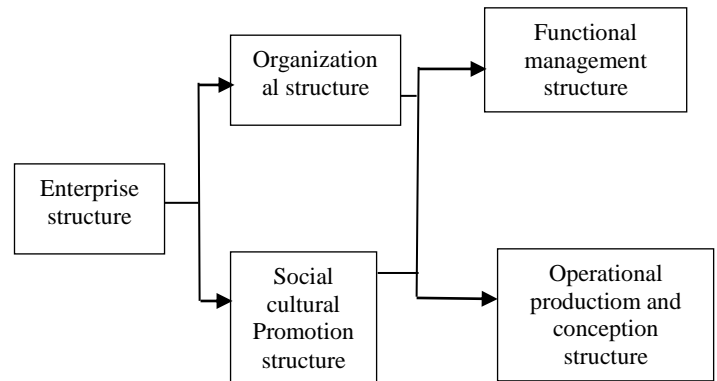
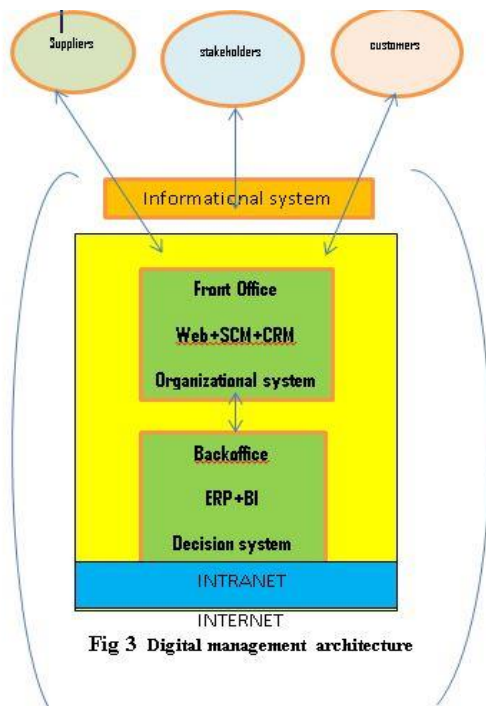


Figure 4. Classic organizational architecture

Source: author

The future of the decisional subsystem powered by IoT will be a multiagentsystem agents distributed through the network and which have different roles to execute. Use of decision support IT systems: Romanian managers have increasingly begun to use decision IT support systems to increase the performance of their companies and keep them in an increasingly competitive market. The prohibitive costs Managers at all hierarchical levels of the organization are direct beneficiaries and users in the decision-maker-subclass of the decision support system (fig 5) have fallen and internet development has been democratized. The simplest and cheapest form of architecture is client-server architecture (fig 7).

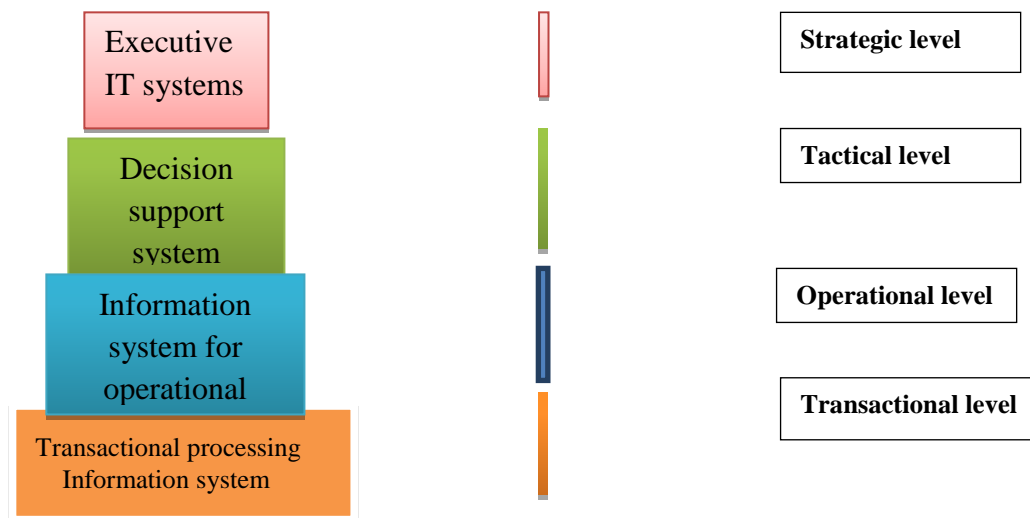


Figure 5. DSS Architecture

Source: author

The DSS (fig 6) structure is selected by user type individual, group collectivity or orientation type:

- Database oriented
- Text oriented
- Spreadsheet calculation oriented
- Rule oriented
- Solver oriented

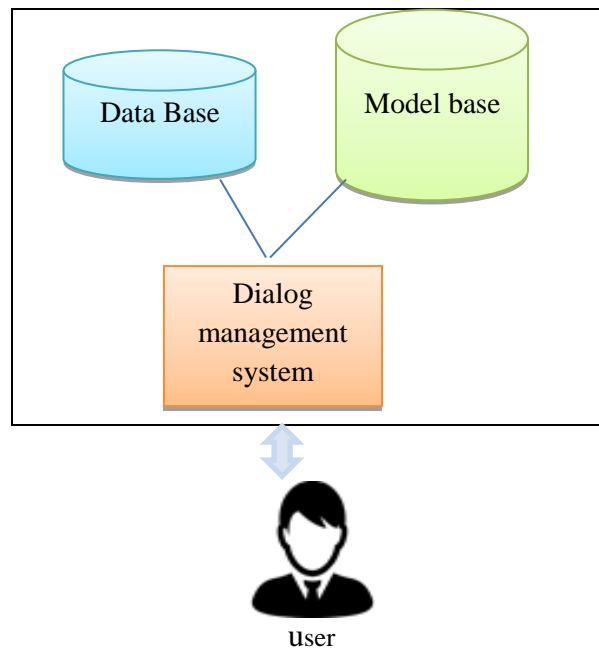


Figure 6 DSS Structure

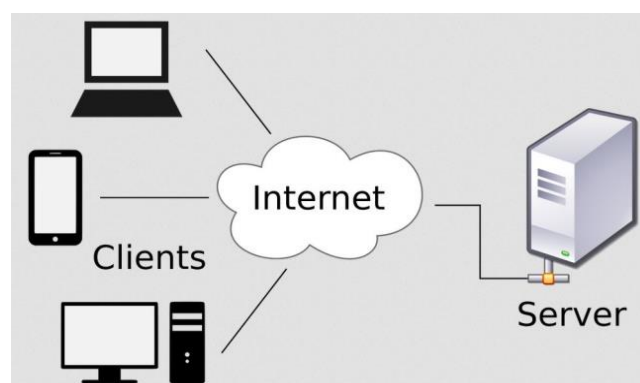


Figure 7. Client-server architecture

Source: author

Lately, decision support system have been extended with ERP modules that oversee the organization's resource planning. These modules together with the Business Intelligence are connected to the front office with the CRM and SCM modules to help increase the economic and managerial efficiency of the organization.

4.4. Methodological Subsystem

- Objective management
- Budget management
- Exception management
- Participatory management

The methodological subsystem consists of a set of methods, procedures and tools that ensure the good functionality of the other components, decisional, informational, and organizational subsystem. Management methods and techniques:

1. Diagnosis
2. Meeting
3. Dashboard
4. Delegation
5. Autophotography of the daywork
6. Creativity

Methods do not change overnight, but techniques and procedures adapt to the impact of new cloud and IoT technologies that provide data, analytics and decision scenarios more accurately and in real time. A modern IoT platform is based on an architecture developed on 5 levels:

1. Level of perception, sensors, beacons, servomotors
2. Level of security and context
3. Network and transport level
4. Cloud storage and mobility level
5. Analytical level, algorithms, data science, machine learning

To further increase efficiency in the future, we can no longer use only classical methodologies such as diagnosis, delegation, scoreboard, creativity, or cost management, and it is imperative to introduce enterprise resource planning or resource planning company and CRM or customer relationship management.

What are the advantages of implementing ERP ?

- Integrated management of all business components through access to a common database.
- Provides an online workflow that facilitates communication between people, departments and workstations.
- Automation and standardization of operational processes, eliminating manual operations leading to increased productivity.
- Improvement of the acquisition process, by the possibility of sizing the acquisitions according to the sales activity.
- Increasing customer service quality through the transparency of product, stock, and price information.
- Decreasing order delivery time due to faster data transfer between departments.
- Improving cash flow by implementing coherent commercial policies.

What is CRM? CRM stands for customer relationship management and it is a category of data-driven solution that can improve the interaction between business and customers. It is designed to maintain and manage relations with customers, sales and delivered data, track engagement all in one place.

The advantage of implementing CRM are (Vodafone 2015):

- It centralize the customer information
- It makes marketing interactions automate
- Provide the Business Intelligence
- Facilitate communications with customers
- It tracks sales opportunities
- It analyze the data
- Enables a responsive customer service

The degree of adoption of IoT platforms in Romania is different, each service provider has its own vision of integrating this technology:

- 37% energy and utilities
- 32 % Automotive
- 32 % Retail
- 29% consumer electronics
- 28% pharmacies and health
- 19% logistics and transport
- 17 % Manufacturing

5. CONCLUSIONS

The analysis of the answers received in the survey questionnaires shows that the IoT platforms and the technologies that promote them have an overwhelming influence over the management functions and subsystems that will lead to a revolution in the field. Virtually IoT platforms will fundamentally change the management in both functions and subsystems. IoT platforms and equipment will increasingly replace human resources, not just at the execution level but also at the decision-making level. More and more data will be generated by devices and not by users, which means we are expecting an increasingly interconnected world and unprecedented amounts of data that require storage, analysis and processing that can't be done without IoT and cloud platforms. With IoT, companies will be able to reduce their operating costs by up to 30% and increase the quality of their services by about the same percentage. Besides the many benefits that the Internet of Things brings to the business, it is important to bring to light the challenges that companies that want to take a step towards such a concept can face. We mention some of them:

- Initial investment is not negligible at all. The cost of equipment can rise to sums that can be very high.
- Data security may require new operating rules.
- Data analysis tools may have some limitations on the speed of response and high data traffic.
- The Internet of Things is the technology that will govern our lives for over 20 years by now.
- Robots will drive the cars.
- Entry into the era of personalization is accelerated by technology and for the consumer this means a more efficient and convenient experience.
- Purchase platforms. Today, the data collected from the sensors and their interactions with the staff can be strengthened, but future platforms could provide a complete picture of the state of affairs in business.
- Intelligent systems. The growing power of computation and the data available to patients in the medical field with history or similar affections will allow computers to learn and provide prognosis more and more accurate.
- At the intersection of the new devices with the multitude of data we can collect and examine is the patient's personal benefit and efficiency.
- With help from technology and data, doctors and other health professionals will be more accurate and effective.
- But the biggest impact of IoT will be in the field of smart cities. Internet of Things and Internet of Services will become the building blocks to progress in unified urban scale development transforming smart city into open innovation platform. IoT will support a large and heterogeneous complexity of sensors and technological platforms and applications deployed in urban spaces.

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