Management systems of internet of things in business area: an innovative approach to application of internet of things

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H I G H L I G H T S

- Omission of many parallel and unnecessary processes of information management.
- Providing Integration of management systems and IOT for the business and the client.
- Online and smartness complete coverage of all business processes based on IOT.
- Reduction of the number of databases for improve business management.

A R T I C L E I N F O

Keywords:
Internet of things (IOT)
Management systems
Business

A B S T R A C T

Rapid changes of sciences and technologies require changes proportional for all fields. Internet of things is a modern technology that is rapidly influencing all different aspects of life. Therefore, optimal application of this capacity seems ideal especially for creation of competitive advantage. Business is one of such cases that require updating. The present paper presents a new method to integrate business management systems and internet of things in order to meet above mentioned goal. Reviewing definitions, elements and grounds for business management systems and internet of things has led to an innovative method in business management and internet of things and it explains the structure and challenges explicitly in future. By reviewing available knowledge and based on results of other researchers, the present paper analyzed and promoted such knowledge and presented an innovative method in this direction. In conclusion, results have been presented based on available evidences. Results offer a strategy to create a smart optimal business that can bring about a very competitive advantage in future business.

1. Introduction

Internet of things generally means things and devices surrounding us that can be connected to the internet and they are controllable and manageable by individuals. Theory of internet of things was firstly invented by Kevin Ashton [1] in 1999 regarding chain management. However, this definition included a wide range of applications in last decade such as health & treatment, water & electricity, transportation, etc. [2]. For example, there are applications in IOT in relation to the things such as emergency management, medications and provisions [3-5]. Although there has been the concept of communication of devices and individuals for different reasons for several decades (meaning via internet and social networks), such connection of devices, people and other things is relatively new and emerging [6]. Concerning Harbor Research [7], two technological changes have been emerged at the beginning of 21st century that at the moment, they are in the same direction. They are internet of things and internet of public or social networks (web, 2.0). According to CISCO, the things connected to the internet exceeded the number of people on the earth in 2008 and they will reach 50 milliards in 2020 [8].

Although several researches have been done in this field and some standards have been formulated, there are big gaps in perfection of such technology. IOT is an emerging ideal technology for designing new programs by presenting new changeable information and computational sources that are required for creation of revolutionary applications [9]. By looking at the definition and goals of IOT, we can imagine a world in which all the things surrounding us should connect to the internet thus a smart life will be brought about in addition to information exchange. Therefore, we can easily redesign and promote our environment meaning that we can control things surrounding us for optimization and personalization. Most papers available in this area addressed definition of concepts, principles and problems of this new technology whereas the present paper attempted to define new applications of such technology with an innovative approach in order to cover available gaps in addition to considering basic principles and goals. Management systems of internet

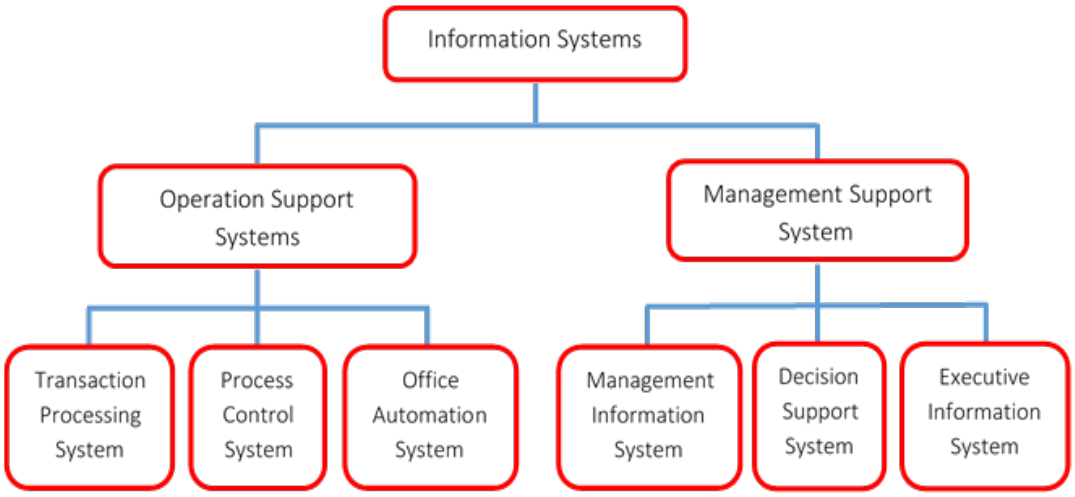

Fig. 1. types of information systems [16].

of things in business area refer to a new, innovative application of such technology in business systems including customer relationship management (CRM), management systems of enterprise resource planning, etc. it shows the new way of the relationship between business, organization and customer by integration of technology of IOT in management systems.

Firstly, technology of IOT, it's executive tools and business management systems have been briefly defined via an analytic approach and study of available sources in the present paper. Then in addition to studying goals, innovative strategies are offered to integrate these two technologies and one new system is proposed in this direction. Finally, the summary and conclusion is presented and integrated with appropriate references.

2. Definitions, elements and grounds

2.1. Definitions

Concerning that theoretical basics of this paper are combination of different technologies brief definition of such technologies is necessary in order that readers become familiar with such basics and imagine it's general picture in their minds. On this basis, following definitions are referred to:

2.1.1. Internet of things

As seen in most interpretations and papers, the definition of IOT is still ambiguous and requires philosophical discussions [10]. Practically, any book or paper written on IOT starts with discussions on previous definitions and it seems that authors insist on adding their own element to the final definition [11]. But generally, a comprehensive definition can be offered. Internet of things consists of many technical protocols which aim is to connect a thing to another thing, database and individual [11].

2.1.2. Executive tools of IOT

Internet of things was emerged with this vision that things are inseparable parts of communication infrastructures of today wired world. Therefore, in order to realize this vision, architecture of IOT requires a high-level network structure in order to integrate wired and wireless technologies within a transparent and integrative way [12]. Currently, the concept of IOT is applied in many papers as RFID technology-based networks [13]. but by the prevalence of devices enabled by open wireless technology such as Bluetooth, radio frequency identification (RFID), Wi-Fi and telephonic data services as well as embedded sensor and actuator nodes, IOT has stepped out of its infancy and is on the verge of transforming the current static Internet into a fully integrated Future Internet [14].

2.1.3. Management systems in business

Obrein [15] believes that there are two types of information systems: 1- operation support systems which supports the required information processing for daily business affairs and transactions. 2- Management support systems which supports the prerequisite for top, middle and supervisory levels management decision making (Fig. 1).

Management information system is one of the second-generation information systems which was designed in the middle of 1960s in order to obviate managers' needs [17]. Management information system

is a system which primarily collects data, records and filters organizational operation and finally offers the selected information to managers so they can produce the information needed for decision making [18].

2.2. Elements

Internet of things is a general concept and is not limited to a tool, system or technology. A number of elements that are supported by this concept and pave the way for IOT are studied and defined in this part.

2.2.1. Radio-frequency identification (RFID)

RFID has been considered as a re-emerging technology to identify, mark and track items automatically. Nowadays, application of RFID is increasing considerably in retailing, production, supply chain, army, healthcare, etc. [19-21]. According to an explicit prediction of IDTechEx, it is expected that total value of RFID market is increased from 4,96 milliards dollars in 2007 to 26,88 milliards dollars in 2017 [22].

2.2.2. Cloud computing

Cloud computing aims to create economy and compare computational requirements of the organization with the best quality of service levels. It especially includes a set of empowering network systems that are accessible via a simple, pervasive way [23]. It also creates added value for the organization and saves operational, sources and staff costs and provides new business opportunities for service-oriented models [23-26].

2.2.3. Wireless networks

Wireless sensor networks are a set of organized nodes inside a joint network [27]. Each node with capability of processing may include different types of memory, one RF transmitter and receiver, energy source, site of different sensors and activator. Currently, wireless sensor networks are being established rapidly. This new technology is applicable with vast potentials in many applications such as environment, medicine, army, transportation, entertainment, crisis management, national security and smart spaces [28].

2.2.4. Web 3

In recent years, internet and research media have faced with new development in the web. They witness the growth of social networks, mobile technologies and increase of user participation. The term, Web 2.0, outlined by Tim O'Reilly [29], was approved via different studies when presenting very important perspectives in policies of web economic development [30-34]. At the moment, business and programs of developers show that there will be a new age of web: web 3.0. It is defined by a new online environment that integrates information produced by users to create a new meaning. Since web 2.0 is based on participation of users, web 3.0 is based on interaction with users [35-38].

2.2.5. Other wireless communication systems (short and long waves)

- The smallest radio transmitter: the smallest radio transmitter is sufficiently small and inexpensive and can be used in many applications especially for internet of things. It was developed by engineers of Stanford University [39].

- The first full digital radio transmitter: primary tests of the first full digital radio transmitter invented by Cambridge consultants' [40] institute were completed successfully. Such invention is a turning point in wireless designs and it can empower internet of things and 5G technology. This invention opens the doors for a new dynamic way in which it has been predicted that 100 milliards IOT systems can work in a busy radio range.

- The fifth-generation mobile network (5G): the features of current band width are not enough for available orientation and technology. According to information available in Wikipedia, 5G (the fifth generation of mobile networks or the fifth generation of wireless systems) shows that the next main phase of mobile telecommunication standards are beyond current 4G/IMT advanced standards [41].

2.3. Grounds

Each innovative technology is created based on other technologies and completed using available grounds. Therefore, technologies and concepts are defined in this part based on the grounds discussed here. All followings are used in form of management systems in today businesses. Therefore, the best capacity is present for using such grounds in form of higher level technology.

2.3.1. Enterprise resource planning (ERP)

Business environment is changing considerably. Today companies are facing with challenges of competition growth, market developments and the increasing customer expectations. Therefore, companies are under pressure to reduce total costs in total supply chain, manufacture time, inventory, and development of various products and to offer more

reliable deadline, better services to customers, improvement of quality and efficient coordination of global demand, supply and production [42]. Organizations should improve permanently their businesses because the world of business goes towards a completely joint model and promotion of its competitive abilities. In addition, companies should share a protected information environment with suppliers, distributors and customers [43]. The capacity of processes inside the company should be promoted for on time and exact information transfer and production. Therefore, the company should implement enterprise resource planning system in order to meet such goals. [42].

2.3.2. Customer relationship management (CRM)

CRM is generally defined as proper management of mutual relationship from view of seller [44].

Winer [45] thinks that CRM has been defined improperly and states that CRM has different meanings for different individuals. For some people, CRM means direct e-mail. For others, it's means mass customization or development of products required by customer. For IT consultants, CRM means complex technical terms related to words such as OLAP (online analytic processing) and CICS (customer information control system).

Recently, Reinartz, Krafft, and Hoyer [46] defined CRM based on the customer. According to them who think CRM is a dependent process, it is assumed that there are three stages of relationship with customer: start, repair and maintenance that associate with CRM. Therefore, CRM is defined as a systemic process for managing start of relationship with customer, repair and maintenance during all connections with the customer in order to maximize the value of portfolio relation.

2.3.3. Supplier relationship management (SRM)

Herrmann and Hodgson [47] defined SRM as a process that involves management of suppliers' priority and finds new suppliers in a way to reduce costs, to provide predictable and repeatable provisions, to integrate experience of buyer and application of cooperation advantages with product supplier.

SRM is a new part of supply chain plans leading to selection of supplier and increase of competitive advantage of producer via three primary mechanisms: 1- supporting improvement of business processes throughout supply chain, 2- architecture of future generation that can deal with processes of some companies and 3- facilitating the speed of product cycle and introducing new product. This mechanism can create competitive advantage via considerable reduction of real cost of parts and materials, increase of flexibility for responding to customers demand and more rapid cycle that result in increase of customer's satisfaction and market share [48].

2.3.4. Business process management (BPM)

BPM is defined as a structured approach for analysis and continuous improvement of basic activities such as production, marketing, communications and other main elements in company operation [49].

In past years, business process management has changed into one of the most stable management methods that can cover organization, culture and methods of information technology and premier solutions resulting in a wide range of PBM acquirement. In today approaches, methods and instruments can be placed in the best state and simulate real business processes [50].

BPM is defined as a comprehensive practice of organizational management that focuses on identification, definition, analysis, continuous improvement, implementation, measurement, control and analysis of business processes inside and outside the organization. PBM requires perception and involvement of top management in process-oriented information systems, exact definition of responsibilities and the culture of accepting business processes. It is a principle in architecture process and creates mutual relationship between key business processes, supporting empowering processes, the processes in the same level and strategies, goals and policies of the organization [51].

3. Business management and internet of things

Internet of things (IOT) is the proposed instance for connection of all physical things in the internet-based global infrastructures for information exchange and communications. IOT determines smart identity, position, tracking, control and management. Therefore, IOT is based on integration of several solutions of communications, technology of identification and tracking, operator & sensor networks and distribution of smart things [52].

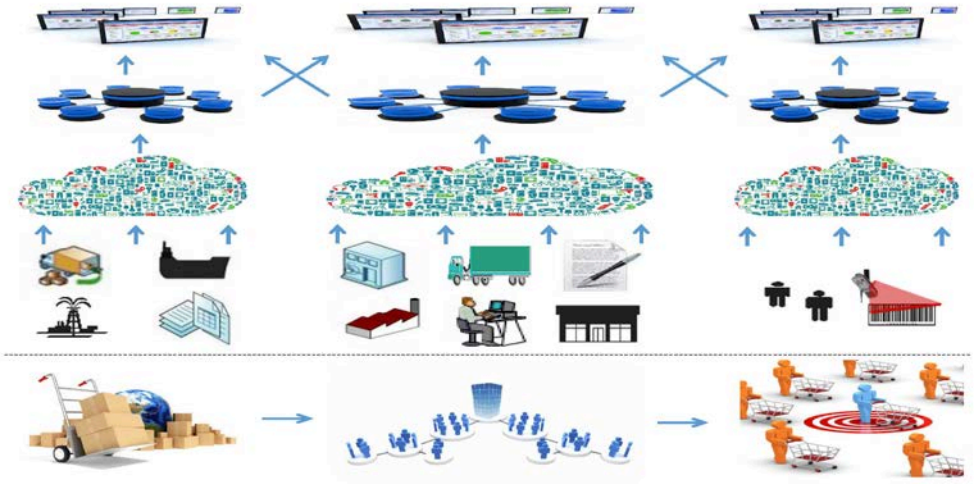

Fig. 2. relational structure in management systems of IOT in business.

The increasing influence of technology in human life is promising for a future in which human life will be smart, automatic and very complex. The ideas that were observed some years ago, only in Hollywood productions as science-fiction films are now inseparable part of our life. Business is not exceptional as well and has been affected by those ideas and has changed fundamentally. When comparing the present business with past business, the present business is even beyond what the smartest individual could imagine it in past ages. This is true about our age as well and certainly future business is beyond our imagination. But generally, imagination of business is not difficult within several decades in future. Today, big organizations throughout the world are seeking agility, flexibility and competitive advantage in order to overcome the problems. Business environment is very complex and data and information flows are required for decision, regular supplies, management of inventory, distribution of services and products. In such environment, management of organizations requires efficient informational systems improving competitiveness by reduction of costs and logistic promotion of organizations. Integration of four main sources of the organization (financial sources, human sources, materials and machineries) creates an added value that brings about the ground for promotion of organization position in today competitive world. All such activities are in direction of offering a product to final costumer. As a result, any interaction with customers is an opportunity. The opportunity means not to sell products to customers rather the organization can get good information via connection with customers. Such information will increase organizational learning, help organization find new ideas and identify customers' tastes [46].

Therefore, in addition to smartness, future business should change many redundant processes into agile and flexible processes in order to control and manage all processes easily via a competitive advantage [43]. Such change will occur if all processes are integrated and a very powerful informational source is available. IOT is the only capacity that can easily provide a powerful informational source for a managerial system in which all processes will be managed in an integrated form. In addition to meeting the goals, business should be very flexible and agile for customers and it will create a competitive advantage for organization and customers.

3.1. Relational structure of management system, IOT and business

Management systems in business and IOT have their own definitions. But the important thing is that IOT has emerged from business and there is undeniable relationship between them [1]. However, the relationship mentioned in this paper is beyond the present definition such that the aim is to combine several business systems (in form of a comprehensive system) with IOT in order to present a high-level technology for problem solving. Relational structure in this model is based on interaction among organization, things, internet and customers based on managerial systems. (Figure 2) shows this relational structure explicitly.

Supply chain from supplier to the organization and customer has a linear structure. In this relational structure, each unit (suppliers, organization and customer) has subsets and elements that can easily change into virtual entities by using concepts of IOT and they can produce information and data. Information and

data are gathered and classified in a database. Therefore, all entities and processes are tracked and managed in all times. Information will require a comprehensive system for processing in order to meet all goals of the units. In addition to labeling all object subsets for realization of concept of IOT, each unit gathers and classifies information in form of current processes in one database. Information will be given only to one system for processing. There is only linear and transverse relationship in these stages. But in higher stages, a relationship beyond the present one is required to realize this slogan "one system for total business". In this case, spider's web relationship should be made. It means that all members and subsets of units are interrelated and exchange information. But this concept has main flaws which are lack of independency and decline of business concept. This problem is completely reasonable and true. In order to solve such problem, only database of each unit will associate with managerial system of the other unit which is based on agreement of both parties and the extent their requirements are met without any problem and interference in parties' activities. In addition to meeting requirements of units, risks and costs will be very low due to division of databases among units.

Today, the knowledge and information available in an organization is considered as a competitive advantage and will develop the organization but unfortunately, this is not always a golden law with successful results. Rather, high costs of information acquirement, their storage and processing are not only profitable but also, they will, brought about irrecoverable losses. The advantage discussed in this paper is to pave the way for entrance of customers in this field. In other words, instead of spending expensive costs on gathering, storing and processing suitable and unsuitable information, the organizations should ask customers to help them in such functions and share such information and storage source with customers via using concept of IOT in order to access them if necessary.

3.2. Management system of IOT for companies and organizations

Management systems are a set of systems that have been developed gradually with aim of optimization, rapid speed of work, control, supervision. Most of systems have been developed in this area due to systematic nature of business such that in addition to management of all sources of a company, they could promote quality of services to customers by different titles in recent years [18]. Therefore, the presence of a new technology (that is highly promising for expansion and influence in different aspects of our life) can integrate with these systems and create a higher level. The present paper aims to promote and combine several technologies for invention of a new and innovative system. Combination of IOT with business management systems provides an environment in which in addition to smart business, immediate relationship of materials and sources are controlled and managed and it makes their planning and analysis possible.

Imagine that the product of a company is under control of that company from the beginning of process (supplying raw material from suppliers) to its delivery to the customer. Activities will be automatic with high accuracy, and physical operator is not needed. Assume that a company wants to produce a product for its customer; ordered materials will be labeled and transported by transport system (as a part of IOT) as a virtual entity and they are given to the company. The company will label the final product using systems connected to IOT and define it as a virtual entity in internet. The product will transfer to stores by the same transport system. The product is placed in shelves that are connected to IOT which is aware of its inventory. As the customer enters the store, he/she will be aware of all information of the store (such as inventory, costs, etc.) by his/her personal management system of IOT that has been included in his/her mobile tool and he/she will see specifications, promotions and ranking of each product as he/she approaches to each shelf. Therefore, management system of person will suggest the best option using information available in database and presented information and it will offer the order to the shelf system based on agreement of the customer. At the same time, all accounting and financial transactions are done and the product will be given to the customer. Then the product and information related to the customer will be recorded in company's management system of IOT. In case of customer's agreement, database will be exchanged between customer and the company with certain access level and the information between them will be shared for next stages. In addition to manufacturing company's control, the product will be ranked and controlled by the customer.

In this assumption, we will see that there is a complete business chain that continues its life with the least physical engagement and repeats with speed, accuracy and smartness without any problem. In the first stage of chain that relates to supply, all stages from order of materials to delivery, are tracked by management system with very high accuracy due to connection of raw materials to IOT. In the next stage, which relates to manufacture of product, all stages are done and controlled by the same system. In the sale stage, the same thing happens. After sale services and marketing are stages occurred after selling the product and they are easily performed by abovementioned system.

3.3. Management system of IOT for customers

As mentioned in previous sections, in order to meet goals defined for business in present paper, customers require their own management system to use the specific place created by business for the customer, realize customer orientation and use advantages of such new concept [46]. To predict and promote product as an innovation and competitive advantage, new management systems defined for the customer make relationship between customer and company, allow companies to manage customer and product even after exiting from managerial cycle of the company.

In addition, the newborn system will have many applications for customers and in fact a management system will be given to the customer which is as same as that of company and all facilities are given to the customer (in customer level). Millions of million databases created by customers (one database by one customer) provide a great source of information that can be used by all users easily without any mistake and extra equipment and a great informational & data exchange network is brought about that supports company and customers' profits. As mentioned, organizations can use such database; different customers can share their source with a greater network and promote their place and quality of their purchases.

3.4. Taking a look at tomorrow and future challenges

As seen, human life is changing rapidly and different concepts are replaced with each other and produce new science and technology. Such changes direct towards automation and smartness of human life [53]. Therefore, leaving such high-speed train will result in failure or even destruction of the individual or the company. IOT is one of such capacities that can meet many goals [52]. Management systems of IOT in business have been produced in this direction.

Concerning that many processes are implemented automatically by implementation of such concept, the presence of human being will reduce. On this basis, artificial intelligence will get a special place due to no involvement of human being. And it can delete many extra processes easily by gathering online information and immediate analysis and reinforce presence of robots in human life. Therefore, in addition to abovementioned, presence of robots and artificial intelligence in human life via such system are among its potential powers.

Although the present idea is apparently ready for implementation and operationalization, each idea has many challenges and ambiguous points in practice. There may be necessary grounds but realization of such concept requires public acceptance, many tests, estimations and analyses in order that it's efficiency is proved.

4. Results

IOT is not a definition that can be summarized easily in some sentences. Also, the range of such technology is too vast to explain completely [10]. Therefore, only business has been paid attention in this paper and it has been attempted to consider the main processes of companies with an innovative approach and we face a new definition of management systems [49]. Reduction of the number of systems for business to a comprehensive system, reduction the number of databases, collection of information and data and prevention from any mistakes resulted from high number of databases, omission of many parallel and unnecessary processes, omission of human error, smartness of processes, comprehensive management, complete coverage of all processes by management and many other advantages are occurred by such systems. Therefore, the ground for smart and agile business is provided and it is a competitive advantage for next generation of business.

5. Summary

IOT, although it is new, could provide a suitable place for itself. This claim can be seen in attempts of big companies such as Samsung, Microsoft, Google, Tesla Motors that seek their future in such modern technology [54-56]. Therefore, it is better to understand it before this communication network surrounds our life and to use it properly. Human life is going to provide comfort and welfare and all human being activities are performed in this direction. The science can be an instrument for reaching such goal. Information technology and communication have special places that have changed Planet earth in to a small village and they are expanding their boundaries every day. In addition to other technologies with age less than two decades, modern technologies (such as artificial intelligence and robotic) will change human future in direction of mentioned goals and they will become a part of our lives. IOT refers to the same subject and with a prospective view tries to arrange possible complexity and disturbance because it seems impossible to have a life in which some family members are things. Learning such sciences is not specific to individual life and will cover all living aspects such as business. Therefore, the present paper attempted to cover this aspect of IOT that has not been studied yet. In this direction, one of the main goals of the paper was to define a new business management system for settling current problems and it is promising for a new system in this area.

5.1. Discussion and comparison

Although many papers have been compiled about different areas of IOT such as business, management system of IOT has less been discussed with such concept. Therefore, comparing this concept with other papers is not suitable and appropriate because despite concept of IOT was firstly outlined in management of supply chain, but the concept was to use RFID labels for promotion of productivity of current systems. Unlike the concept mentioned in this paper which is a completely new redesigned system for business, it is beyond RFID. Therefore, it seems that definitions of strengths of this new concept were more effective and encouraging than comparisons. Smart and automatic processes and systems will be one of its requirements in human life in future. Therefore, IOT plays one of the main roles and provides the ground for realization of such goal. Management systems of IOT in business area with mentioned concept will change this area from current method to an optimal method. This system is responsible for omission of redundant processes, promotion of quality of process, integration of process, agility, flexibility, acquirement of competitive advantage, reduction of costs, save of sources (human and financial), reduction of errors, exact control of business, rapid evaluation of business, promotion of customer place, active participation with suppliers and customer and share of business sources based on IOT technology. Thus, exact implementation of this concept will facilitate the ground for presence of artificial intelligence and robots in human life with such advantages.

5.2. Conclusion and applications in real world

High number of business management systems will bring about not only complexity with high costs but also processes and sources will be consumed non-optimally. In order to provide competitive advantage in an organization or company, agile and flexible systems and processes are required. Although, current systems could meet this goal compared to past systems, they are inefficient and expensive. As mentioned, the reason is the high number of systems. Management systems of IOT in business area can make all current systems efficient only by one integrated system using IOT technology and they can omit or optimize many current processes in addition to smartness and automation. By omitting many parallel and extra processes in current systems, such systems can easily reach all goals only by one system. Nevertheless, management systems of IOT provide a potential power for organizations and companies for acquiring competitive advantage in addition to promoting the right of selection for the customer, meeting customer's goals.

5.3. Suggestions for future researches

As seen, a new concept was presented in this paper but despite it focuses on new ideas, the way is open for researches and new ideas because it has tried to explain materials completely but there are still many gaps that can be effective grounds for future researches.

Every individual idea, although it is perfect, will fail against public thinking but generally it will be a spark for attraction and thinking of others.

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