NEW EMERGING UBIQUITOUS TECHNOLOGIES AND REQUIREMENTS FOR DEVELOPING COMPLEX BUSINESS COMPETENCES

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Abstract. *Nowadays, new technologies continue to transform commercial, business and social practices on the global landscape. Soon new coming ubiquitous and pervasive technologies such as augmented reality, additive manufacturing (3D printing), Internet of things and ubiquitous computing will bring many new challenges to business organizations. Companies and consumers will be confronted to totally new instruments and applications that will substantially change the way products and services are designed, produced and consumed. Therefore it can be expected that new business competences will be required, in order to realize and adapt new sustainable business models into highly competitive, network-related and technology-oriented scenarios.*

The present research aims to propose an overview and analysis of some of the key emerging ubiquitous technologies and to discuss what type of competences, knowledge and skills will be required from next generation managers and business professionals. The first step will be to explore and analyze the new emerging technologies and how they will emerge in a coherent manner. Further there will be discussed some scenarios about their implementation in different business practices. Finally, there will be discussed how business implementation of these technology can change the required competences and skill-set of new generations of business professionals.

The main outcomes of the paper will be to provide a list with newly identified competences and understandings for next coming technology-oriented business practices.

Key words: *management competences, business competences, information technologies,*

1. Introduction

Information technologies have largely influenced social and business landscape, making the business world closer, interconnected and highly competitive. However, while observing new technology trends we can expect another wave of coming new business transformations. Nowadays, business is largely depending on ICT and digital technologies to improve communication and coordination, to facilitate internal business processes' efficiency and efficacy and to reach new economies of scales by entering in inter-organizational networks, electronic markets and supply chains. Many researchers underline the important economic role of new technologies to reduce transaction costs and agency costs, providing backbone infrastructure for wealth formation (Laudon & Laudon, 2007). During the last 2 decades, the ICT technologies and applications already transformed companies that become more flatten, boundary-less, entrepreneurial, process-and project-oriented, developing complex and innovative global business models.

Nowadays Internet is essential and indispensable infrastructure for business transactions on many B2B and B2C levels, becoming universal platform of services.

Although these advances and practical evidences for the benefits of Internet and ICT in general, many researchers and practitioners anticipate that Internet and new "outernet"[1] technologies will soon leave the digital world in order to come and to make the "real world" objects much smarter, more operational and interconnected. The estimated impact of these new coming ubiquitous technologies will lead to another change in the economic and social development, bringing many new challenges to businesses. Some of the technologies that will be discussed further in our paper will underline the role of this digital-real world transition. These key technologies are for example - augmented reality (AR), additive manufacturing or 3D printing, robotics and Internet of Things (IoT). The common issue for these different technologies and approaches is that at the end, these technologies are closing the gap between the world of bytes and bites to the world of objects. They lead to development of new content- and context-rich connected environments and objects, adding many of the Internet functionality and services to the "real world" objects, people and landscapes. With fast adoption of smart phones and tablets, interactive technologies, wireless Internet and portable devices (as AR glasses or head-mounted devices), this vision is gradually becoming reality. How managers and businesses can prepare and adapt to these new coming challenges?

The methodology of the present research will focus on bottom-up approach, coming from the basic analysis of new coming technologies and discussing different common business scenarios. As managing the business transition with these new technologies, we assume that exploring business scenarios and cases will be crucial factor for success for the next generation of managers and business leaders. Reflecting on these new challenges, the paper will open the door for discussion of new competences and skills for future managers. The first part of the paper will make a short review of the theoretical research in the field of ubiquitous computing and recent advances in the development and implementation of new pervasive technologies. Then there will be provided several examples and scenarios how these key emerging "bridge" technologies connect and transfer Internet and computational power to the physical world. Finally there will be discussed several examples and reflections about managerial and business competences, that will be needed as factor for change technologies transformation, identifying the impact of new ubiquitous technologies.

2. Theoretical research

The first part of the paper aims to propose a general overview of the key emerging technologies. Ubiquitous computing (UbiCom) was coined as a term by Mark Weiser in 1991. He stated that "the most profound technologies are those that will disappear. They will weave themselves into the fabric of everyday life until they are indistinguishable from it." (Mark Weiser,1991). Therefore, ubiquitous computing was identified as a general vision

[1] The term "outernet" as neologism coming from OUT-and Internet was identified by the technology research group – TrendOne in 2009.

for technology evolution, coming to the implementation of technologies in the fabric of everyday life. Ubiquitous computing consists of mobile devices, wireless networks and other advanced technologies and infrastructure. According to Poslad (2009), ubiquitous computing has 3 components - smart devices, smart environments and smart interaction. The author further states that smart devices are “mobile, personalized, planar, macro sized MTOS (Multi Task Operating System) devices, accessed remotely rather than on local services”. Smart environments are environments in which static macro devices are embedded into it, or have micro and nano-sized devices, scattered into social and public spaces. Local interaction dominates the use of smart environments. Smart interaction aims to combine multiple individual smart devices and environments in order to interact in a flexible ways, such as supporting orchestrated, choreographed, competitive and cooperative interaction in dynamic virtual systems. Hybrid designs can also be used where systems combine smart devices, smart environments and smart interaction (Poslad, 2009). UbiCom systems cover a range of interaction: between two or more UbiCom devices (C2C or CCI); between devices and people (HCI); between devices and physical world (CPI). Some of CPI involves sensing the physical environment, performing tasks which are situated in it, affect it and may control it. Moreover, it can be defined that Ubiquitous computing encompasses a wide range of disparate technological areas brought together by a focus upon a common vision (Bell and Dourish, 2006). Therefore, among ubiquitous technologies that will be discussed more in details are those that already have a viable commercial applications and prototypes on the market. But before making a closer view on technologies, there will be proposed a list on how these technologies actually influence and what impact they make on the business reality.

Based on the general concept and vision of UbiCom, there can be enumerated some of its common characteristics. UbiCom technologies aim to facilitate connectivity and exchange of information in real time between objects, people and places, making the world context-aware revealing as well location and time; These technologies open many new opportunities for automation and further implementation of ICT into more business and social fields and practices, where companies can reach better business performance; There can be expected the emergence of a new sensor-enabled digital world, where the objects have “senses” to collect and process information, accumulated through hearing, seeing, communicating, reacting, deciding, memorizing and storing. This can lead on one hand to minimizing resource usage and waste (“cost” oriented approach) and on the other hand, it can provide improved services, based on synergy of value networks for customers (becoming “profit-centers”).

UbiCom technologies on business level can be discussed and analyzed mainly in 4 perspectives: 1) the process of product and services life-cycle design, including stages from the proof-of-concept to the production, sale, use and disposal; 2) the new emerging complex systems for experience-oriented services, 3) a framework for new complex and value-adding business processes, 4) new challenges for professional development and new models and categories of life. Managers should be prepared not only about new technologies, but as well they have to be confronted to many challenges that new technologies will bring to people – how they will transform professions and jobs, how they

will influence the value-adding processes, how products and services will evolve and what business models will emerge.

3. Overview of ubiquitous technologies

New smart and ubiquitous technologies fast evolve and smart objects are already entering in our homes, offices and factories. That is why, in the following sections there will be presented some of the basic technology trends that are emerging and will influence our near future. We will shortly present the technologies but we will not enter in technical details. Our main approach is to identify and discuss new challenges and new opportunities that these technologies will bring to the business. We assume that this is an overview framework, just opening the door for further research.

3.1. Augmented reality

Augmented reality technologies form a class of solutions, aiming to extend and mix the real and virtual objects and its context. Augmented reality (AR) does not describe a specific technology, but a manner to virtually extend the reality. Augmented reality can be understood as a layer model that enriches reality with virtual levels and thus merges the real and the digital realms of experience. Therefore, some of the popular understandings are that AR takes part of the Mediated reality. Thus AR allows us to acquire simultaneously digital content, Internet and computational services to real life objects, to specific tasks, contexts, landscapes and people. Recognizing the real world objects and landscapes, and understanding location and time context dramatically increases the relevance of data and allow its better understanding and further processing. It can be expected that augmented reality will have a tremendous effect in the near future. It is expected the first AR glasses to become soon a reality, but many applications are already accessible through hand-held devices and smart phones. One of the most popular cases today is about AR applications in commerce and marketing (as Homeplus®)[1]. Recently there emerge many new cases of AR implementation for improving the customer access to digital content, improving its self-service and service experience, as for example in advertising, in marketing, in co-production phase, in coordination and many others. For example AR can enhance product previews such as allowing a customer to view what's inside a product's packaging without opening it. AR can also be used as an aid in selecting products from a catalog or through a virtual kiosk. Scanned images of products can activate views of additional content such as customization options and additional images of the product in its use. AR is used to integrate print and video marketing. Printed marketing material can be designed with certain "trigger" images that, when scanned by an AR enabled device using image recognition, activate a video version of the promotional material.

From the production point of view, there can be enumerated the number of advantages for implementing AR to help industrial designers experience a product's design and operation before completion. AR can be used to compare digital mock-ups with

[1] Homeplus is an e-commerce subsidiary of the International grocery company TESCO in South Korea, based on QR shopping business model. More information is available on: http://www.youtube.com/watch?v=fGaVFRzTTP4

physical mock-ups for efficiently finding discrepancies between them. One of the emerging applications is for example the Canon's MREAL® System[1], which is a design/production solution tool that merges the real world with virtual, computer-generated images in real time to create a new "mixed" reality. The system makes possible product evaluations early in the design process through the use of digital data, facilitating reduced development times and lower costs by lowering the number of prototypes required.

AR can help as well to facilitate collaboration, improving communication among distributed team members in a work force via conferences with real and virtual participants. AR can include brainstorming and discussion meetings utilizing common visualization via touch screen tables, interactive digital whiteboards, shared design spaces, and distributed control rooms.

3.2. Internet of Things

Internet of Things (IoT) refers to the emerging trend of technologies, while augmenting physical objects and devices with sensing, computing, and communication capabilities, connecting them to form a network and making use of the collective effect of networked objects (Guo et al., 2012). The term "Internet of Things" was coined as the title of a presentation by Kevin Ashton for Procter & Gamble (P&G) in 1999. Internet of Things (IoT) is an integrated part of Future Internet and could be defined as a dynamic global network infrastructure with self configuring capabilities based on standard and interoperable communication protocols where physical and virtual ‘things’ have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network.

The IoT requires any user to orchestrate its personal intelligent eco-system and will provide a platform for knowledge acquisition and experimentation. It is expected that the Internet of objects would encode 50 to 100 trillion objects, and will be able to follow the movement of those objects. In the IoT paradigm, ‘things’ are expected to become active participants in business, information and social processes where they are enabled to interact and communicate among themselves and with the environment by exchanging data and information ‘sensed’ about the environment, while reacting autonomously to the ‘real/physical world’ events and influencing it by running processes that trigger actions and create services with or without direct human intervention. RFID and sensor technology enable computers to observe, to identify and understand the world—without the limitations of human-entered data. Embedded systems are computer systems that are hidden as part of a larger system or product - from toys to trucks, from mobile phones to medical devices. More of our devices in our everyday lives become smarter, allowing more control over devices and access to data anywhere, anytime, if possible - connected - wired or wireless. Fields of applications include for example waste management, urban planning, sustainable urban environment, continuous care, emergency response, intelligent shopping, smart product management, smart meters, home automation and smart events. There emerge as well the concept of “Connected Home” which is considered as a social tool with the aim

[1] More information available on Canon official web site, http://www.canon.com/news/2013/jun12e.html and http://www.canon.com/news/2012/jun18e.html

to allow people to connect, use, share and compose Things, services and devices to create personalized applications in the field of the Internet of Things.

3.3. Robots and robotics

A robot can be defined as a mechanical or virtual machine that is guided by a computer program or electronic circuitry. While the term “robot” was coined by Karel Tchapek in his theater piece “RUR” in 1920, today it is still a discussing topic how to differentiate robot systems. Robots still cannot be qualified as “artificial humans”, but their role and functionality gradually expand. They can vary from autonomous or semi-autonomous systems and can range from humanoids to industrial robots, collectively programmed 'swarm' robots, and even microscopic nano-robots or nano-bots. One of the common issues between these variable robots is that robots should have a moveable part (not necessarily moving body). It was admitted that industrial robots should form an essential part of the manufacturing backbone of Europe, and will reach up to 18 Millions globally (EU 2009). Robot-based production increases product quality, improves work conditions and leads to an optimized use of resources. Its large implementation is due not only in industry, but today more robots are implemented in surgery and medicine. Only in 2012, according to the data of (World Robotics, 2013), there were sold about 160 000 units of robots. Some of the main arguments for further expansion of industrial robots include (Nerseth, 2013): [1]

- Growing consumer markets require expansion of production capacities.
- Decreasing life-cycles of products and increasing variety of products require flexible automation.
- Technical improvements of industrial robots will increase the use of robots in the general industry and in small and medium sized companies, e.g. easier to use robots for simple applications, collaboration of robots with human workers.
- Improved quality requires sophisticated high tech robot systems.
- Robots improve the quality of work by taking over dangerous, tedious and dirty jobs that are not possible or safe for humans to perform.

The evolution and wide implementation of robots is expected to bring many new opportunities and challenges to companies and management, but as well to the global society.

3.4. Additive manufacturing or 3D printing

Additive manufacturing or 3D printing is a new emerging technology that allows users to turn any digital file into a three dimensional physical product. The objects are built up in a many very thin layers. The pilot implementation of these technologies today cover a wide range of applications from food-production, to fashion and jewelry, to house-building, bio-printing of cells and organs and even to space missions. Thus many researchers and managers predict that 3D printing may therefore soon do for manufacturing what computers and Internet have already done for the creation, processing and storage of information.

[1] http://www.worldrobotics.org/index.php?id=home&news_id=267

The 3D printing can cause the personal fabrication revolution (defined by Gershenfeld, prof. from MIT in his influential book from 2005 – How to make almost everything). Fab Revolution describes the transfer of the digital revolution to the real world. The consequence is that solid materials are subject to similar laws as digital data – they can be copied, modified and reproduced using 3D printers. While 3D printing is still expensive and evolving, it has its main role in rapid manufacturing and in production of specific unique models. Rapid manufacturing is a production method in which components can be manufactured quickly and flexibly using a layered building process (such as 3D printing). The more complex the component and the smaller the number of items, the more valuable Rapid Manufacturing becomes.

Some of the major trends resulting from 3D printing evolution (identified by recent reports of Explaining the future®) can be listed below:

– Decentralized production –anyone can now become a producer or a part of production processes.

– Mass customization – using the advantages of mass production and meeting the customers' growing needs for personalization of products.

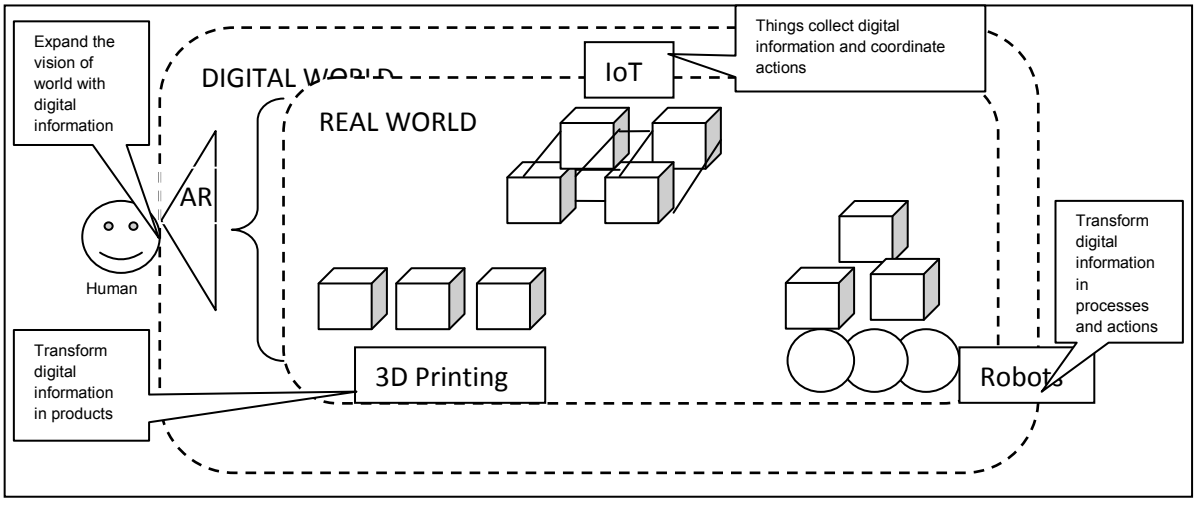
– Product hacking – The need to protect digital data and making systems that cannot simply be "hacked", and prevent products to be copied, modified and reproduced (as today - digital content).

– Home Fadding – 3D printers are becoming more and more affordable and thus product production is therefore shifted from factories to people's home desktops (desktop manufacturing).

4. Discussion

According to the present research, we can expect many technologies to evolve and to become part of the business reality. Some of the key differences will come from accumulated digital data out of the IoT framework, the better understanding and real-time access to digital information, the bigger automation of the production processes, and further transformation of digital information into products. "Digital world" will further expand, becoming an invisible layer, enhancing human (and intelligent agents) ability to have access, to understand, to reach, to analyze, to connect, and to automate the world. On figure 1 graphically are visualized the trends of the discussed bridge technologies.

Figure 1 Interconnecting model of new emerging technologies



Thus, the new coming business reality, augmented with digital layer and transformation of digital information to products, processes, and actions, we will need new business models for adding value. As example, there can be identified the following sources of value formation: real-time information processing, sustainable manufacturing (reducing resource usage and improving quality and customization), smart business (complex value-chains systems for services and products), focus on co-participation, improving the "experience" of customers and communities.

As a summary there can be identified the following managerial competences and skill-set requiring deeper understanding of the business reality, technologies trends and opportunities and skills to manage the change.

– Ability to apply creativity and out-of-the box thinking on every level;

– Holism and complex thinking, thinking outside of the cause-effect linear model;

– Ability and competences to design and coordinate complex value-adding supply chains and network systems across boundary-less organizations;

– Experience-based models of products and services design, focused on the customer's experiences;

– Ability to design schemes and models of interactions between human and technologies (HCI) and between different technologies;

– Working with different scenarios for technology exploitation, coming from complex micro- and sub-worlds,

– Long-term and short term perspective for analysis of the social, technological and business risks for application of company changes.

5. Conclusions

While technologies gradually evolve, we can expect that the new coming ubiquitous and intelligent technologies will have larger impact on the business environment in the near future, more than ever before. In the same time many people accuse technologies today and more specifically robots, to be responsible for large levels of unemployment all across the world. Historically technologies and new discoveries have been continuously transforming the business and have leaded to social unrest since the first industrial revolution. Thus "dehumanizing" business by applying more technology solutions should not mean that working places and jobs for human have to disappear. Creativity, adaptability, flexibility and dreaming make people unique resource on the labor market. In the same time the global economy realizes an expanding wealth accumulation according to the recent reports (Credit Swiss, 2013), reaching new levels of productivity and efficiency. However, the fast implementation of technologies in different social context can threaten different professions, so society as a whole needs to set up new understanding about the ""price" for the technology adoption. Therefore managers and business professionals need to be better prepared how to turn technologies into business opportunities, jobs and business models, successfully overcoming the social price of new coming changes.

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