A STUDY OF OPEN INNOVATION IN CLOUD COMPUTING

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ABSTRACT

This paper is dedicated to the analysis of theoretical and methodological problems of innovation and offers a synthesis of ideas to create a theoretical model for future more extensive and detailed work. Subject of this study is the information-technology sector of economics. Goal of this contribution is the concept and implementation of open innovation paradigm. This implies that companies can and should use external ideas and their own ideas as well as internal and external paths to telecommunication services market.

The basis of this study is the behavior of participants, their interaction and cooperation opportunities with external partners. This interaction has a great potential in developing new products and design of services. It is implemented by the so-called "cloud" that offers new ways in which users connected to the Internet or private network can take advantage of the available IT services, resources, software and processing capacity without having to invest in IT infrastructure, staff training or buying expensive software licenses.

1. INTRODUCTION

Over the past 20 years we have witnessed a rapid development of technologies. Most strong factor in this direction is the Internet system, which connects the world in many aspects and has completely changed the way companies conduct business. Internet technologies enable communication and collaboration for interested participants at different levels all over the world. Almost every day we see new products and services in the Information Technology (IT) sector. The keyword for the development of the modern world is „innovation" (Schumpeter, 1934). To develop and commercialize their innovative products as well as the service process, the companies are turning towards open innovation strategy for cooperation with external partners to be enriched with new knowledge from outside the company. The paradigm of open innovation (Chezbrough, 2006) suggests that companies can and should use external ideas as well as internal ideas, and internal and external paths to the market. Innovation has become a major factor for the companies' development, which changed their concept for innovation.

2. PROBLEM FORMULATION

There exist many definitions of the term „innovation". The first who introduced it was the Austrian scientist Josef Schumpeter in the early twentieth century. He defined innovation as new combinations stimulating the

economic development. This includes creating new products or existing products with new quality; new production methods, opening of new markets. Based on this definition we can say that innovation is an act by which a company creates a new product or service, different from other companies' products or services, or realizes the existing ones in a new way. Chezbrough introduces the term „open innovation" (Chezbrough, 2006) which we have examined in more details in the article and which will be applied in „Cloud computing" (Goldin, 2011), (Rittinghouse & Ransome, 2010), (Cloud Security Alliance.2011). Cloud computing is considered to be the third revolution in IT after the PC and Internet. We also have presented a model of the participants in the network of Cloud computing, and there interaction as well as the cooperation opportunities with external partners. This interaction gives greater possibilities in developing new products and services design. Cloud computing offers a new way that users connected to the Internet or private network can take advantage of the available IT services, resources, software and processing capacity without having to invest in IT infrastructure, staff training or expensive software licenses purchase.

3. CHARACTERISTICS AND PROBLEM PRESENTATION

Cloud computing opens space for new entrepreneurial opportunities for both large multinational companies and for small and medium business. In recent years, increasing attention is paid to the concept of open innovation, both in theory and in practice. The paradigm of „open innovation" was introduced by (Chezbrough 2006) as a new paradigm for innovation. He compares it to the existing innovation that is internally focused, closed in the companies' innovation process. Open innovation he presents as the use of purposive inflows and outflows of information to accelerate internal innovation and external use of innovation for market expansion. Using external and internal ideas and external and internal paths for innovation realization on the market, companies strive to improve technologies. In Figure 1 is presented a model of open innovation. (Chezbrough 2006)
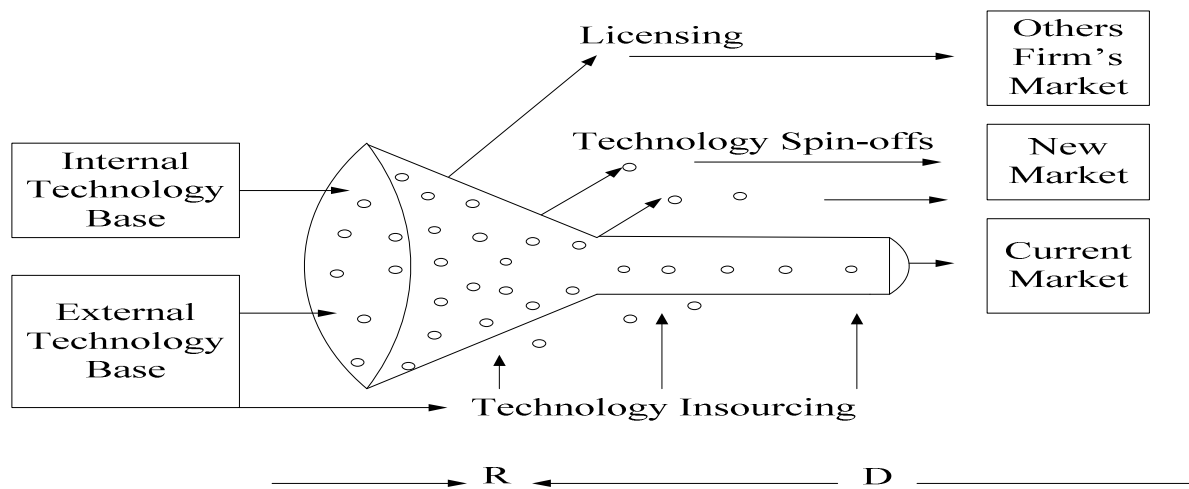
The Open Innovation Paradigm (Chezbrough 2006)

Chezbrough's definition for open innovation can be apprehended in two ways.

- **Outside – In** To search and find ideas outside the company including competitors, customers, suppliers, universities and other third parties, is more favorable than close cooperation within the company. According to (Davis, 2006) benefits of this approach are: wider access to new research as well as to new technologies and products. Companies are able to open up new market segments, improve the production of their products, reduce cost for product development by accelerating R & D. As a consequence they increase their competitiveness, reduce the risk in taking decision. The business model

plays a major role in the company's management. Companies are able to take advantage of their own strengths and combining them with opportunities from outside, to realize income from the innovation. Building a better business model might be a better perspective than to think how to be first to market which is one of the principles of closed innovation paradigm (Chezbrough, 2006).

- **Inside – Out** Another way to capture value from technological innovation used in business is to provide it to other companies for use in the form of a patent or license. Therefore, licensing of technology to other companies can be commercialized and applied by partners working in different spheres of market. Thus, companies that have purchased the technology, accelerate time to market, while others increase their revenue from the sale of technology. These are the main benefits of this approach (Davis, 2006).

In addition, open access to innovation can be presented as a strategy within a large company that facilitates the flow of information between departments.

Innovations are necessary to lead the inevitable wave of change. Most companies strive to reduce the costs for IT by means of virtualization (Goldin, 2011), (Forester, 2011). The growing needs of companies of servers with bigger capacity and related with this additional costs, leads to the emergence of virtual servers as a good economic decision. Virtualization is the starting point of Cloud computing and fundamental infrastructure for Cloud deployments. (Goldin, 2011) , (Forester, 2011). The implementation of server virtualization as a standard model for server deployment, is a critical or high priority for business. Interest in virtualized technology remains high, as it reduces costs, gives high effectiveness – results whit less efforts and resources, faster recovery from natural and industrial disasters and greater flexibility This demand for reducing the cost of computing power has led to innovation in Cloud computing. Over time the ability to build a common interface to the Internet is duo to the evolution of hardware and software. Using web browsers has led to steady migration from traditional models of data centers to cloud based models. Using technologies like server virtualization, parallel processing, massive parallel data processing has caused a radical change.

As (Dylan Larson, 2011), Director Xeon Platform Marketing in Intel Data Centre Group said „By 2015 one billion users and 15 billion devices will be connected to the network, and the annual traffic on the Internet will be one zeta byte." According to Intel Cloud 2015 Vision cloud technologies will be linked (with the possibility of sharing data in social and public clouds in a protected environment), automated, and customer oriented.

4. METHODOLOGICAL APPROACHES TO SOLVING THE PROBLEM

What is Cloud computing model?

The concept of Cloud computing began to take shape in 2000 as a result of technological developments. Definitions of different authors are very considerably, but the process can be described as a supply of hardware and software services via the Internet. Cloud computing is described as technological change caused by convergence of new and existing technologies (Skilton, 2010) .NIST defines Cloud computing by describing five characteristics three cloud service models, and four cloud deployment models.(Cloud Security Alliance. 2011) They are represented visually in Figure 2.
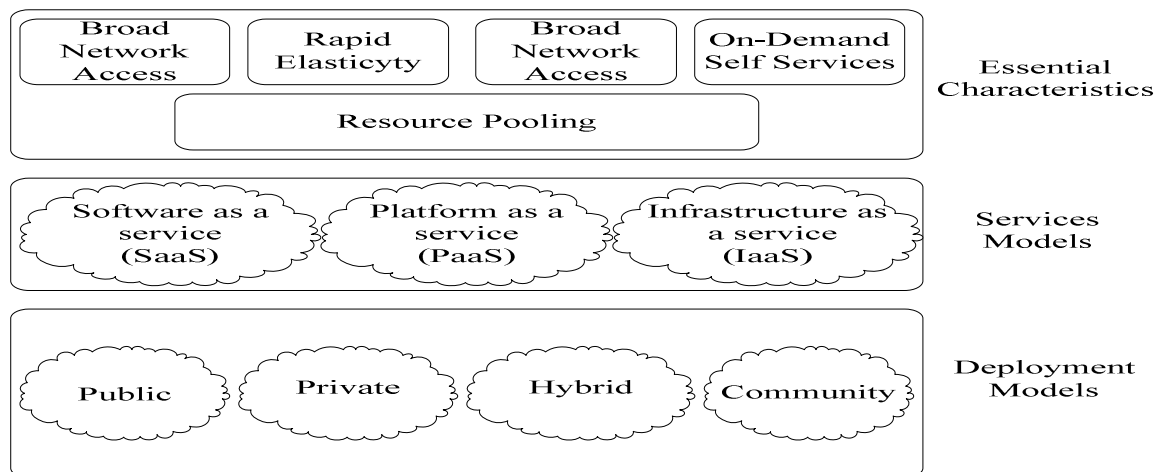
Figure.2 – NIST Visual Model of Cloud Computing (Cloud Security Alliance, 2011, p.14)

Cloud computing can provide new levels of connectivity, flexibility, speed and cost savings for various types and size businesses. Cloud is a data center, where hardware and software systems are located. Cloud computing provides the IT (information technology) resources at the request of the customer. As shown in fig2 above, there are five main characteristics of Cloud computing, which explain the relationship and differences from traditional computing. According to (Cloud Security Alliance. 2011) and (Mell and Grance, 2009) they are:

- **On - demand – self – service**
- **Broad net access** – opportunities to access the network via a standard mechanism.
- **Resources pooling** – computing resources of the provider are combined to serve multiple users with different physical and virtual resources.
- **Rapid elasticity** – C necessary.ustomers are able to increase the capacity of resources as or to reduce it. Opportunities provided by customer's perspective are unlimited.
- **Measured service** – an appropriate measurement system that allows clients to transparently monitor,control and report the resources used.

5. SOLUTIONS TO PROBLEMS

Cloud computing – provides traditional services via Internet, as well as hardware and software systems as a type of service. There are three main types of IT services that can be provided through the cloud.(Goldin, 2011), (Rittinghouse, Ransome, 2010),(Mell and Grance, 2009), (Cloud Security Alliance. 2011).

1. **Software as Service (SaaS) –** In this model the service provider applications are located on the cloud and interact with end user through the Web portal. SaaS includes Web based e-mail, database management, implementation on of business process and inventory control. This service is used by end users anywhere and at anytime that the Internet is available.
2. **Platform as a Service (PasS) –** Includes providing a set of software tools and tools for application development. The providers of this service use API (application program interface), website portals or software portals that are installed on the computers of the end users.
3. **Infrastructure as a Service IaaS** – Through API of the providers, customers get access to start, to stop, and also to configure their virtual servers and their data storage. This service gives customers the advantage to pay only the amount of capacity they need.

As seen in the example above four models of the cloud are identified – Public, Private, Community and Hybrid.

1. Public cloud – The earliest examples of cloud computing are public clouds. They provide flexible computing resources remotely via Internet from an outside company, such as Amazon Web Services, Google and others. The public cloud is owned by an organization that sells cloud services to a wide audience. They continue to be a rapidly growing business opportunity.

2. Private cloud – It infrastructure is owned or rented by an organization and used exclusively by it. This model is beneficial because of its flexibility and speed and would be very important for companies that have a high degree of software innovations, such as Yahoo, which have invested heavily in the delivery of their own cloud services called Sherpa (Goldin, 2011) In other words, eliminating the complex IT infrastructure that can be used in a highly automated cloud platform, innovators cam focus more on their efforts to turn their ideas into great services.

3. Community cloud – The infrastructure is shared by several organizations and supports a specific community of users who share a common mission, policy, etc.

4. Hybrid cloud – A combination of two or more cloud (public, private, community) which retain their identity in spite of the fact that they are associated with common technology.

The reasons for the widespread use of computing are;

- Economic incentives to offer new products and services
- Economic incentives to reduce costs
- Higher efficiency of the materials used
- Increasing personal comfort and friendliness towards users

Services offer greater opportunities for distributing computing, because new technologies and infrastructure allow companies to track their customer's needs and provide personalized services anywhere and anytime. Concerns of Cloud computing users are connected with the data security. Cloud providers have taken security measures and privacy policies trough cryptographic method to authenticate users. Users can choose whether to encrypt the information before they store it on the providers' server.

6. CLOUD TYPES AND PATTERN OF CONNECTIVITY AND INTERDEPENDENCE OF THE PARTICIPANTS IN IT.

In Figure 3 we present a model of different types of clouds, as participants in a network and their interaction.
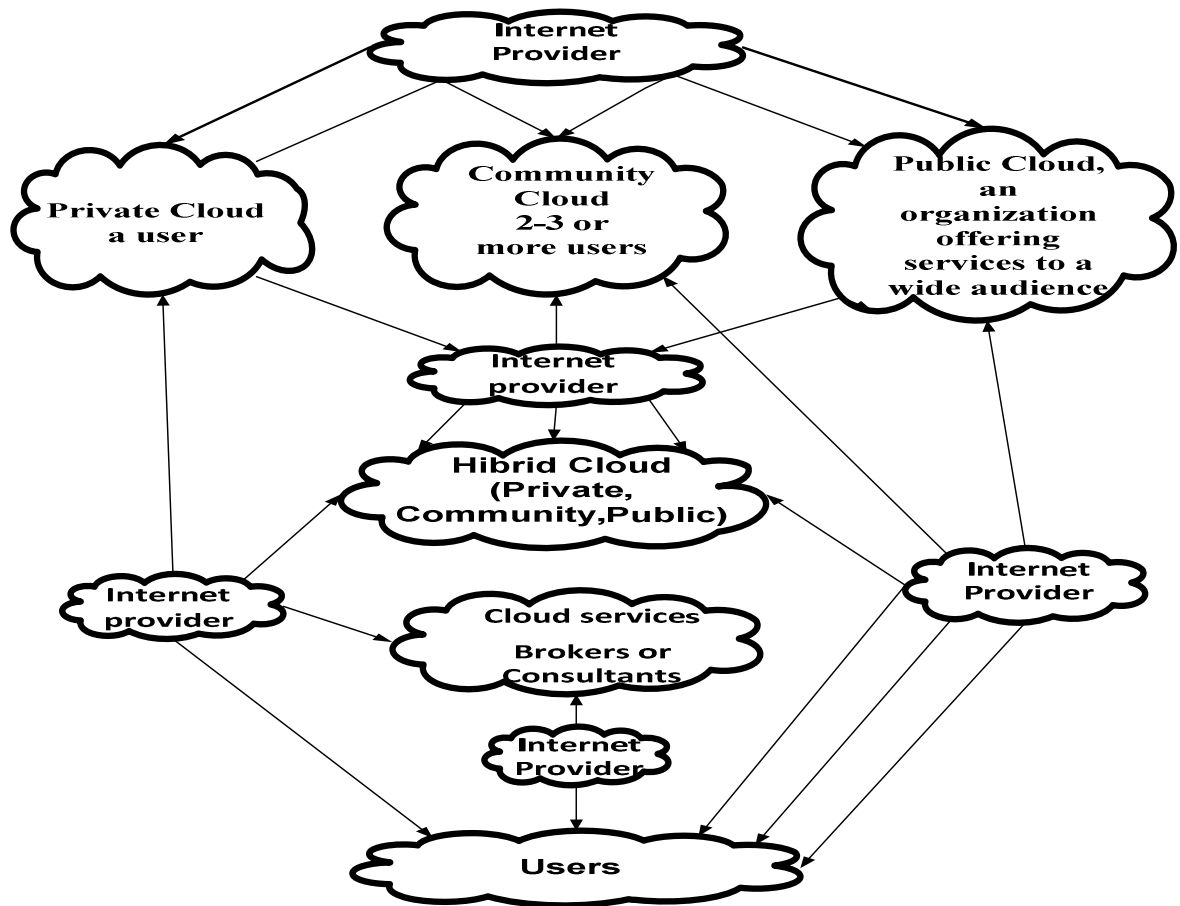
Figure 3 Model of different types of clouds, as participants in the network

It obvious that the most important role in this model is played by the Internet providers who make the connections on the network possible. Internet providers are organization providing Internet access. Depending on the type of clients the Internet providers can be – "connection providers" and "retail providers". (Sherif, 2006).

Internet operators provide Internet access through different technologies. The majority of users use the following types of Internet access:

- Dial – up access
- In phone
- In digital network with integrated services
- In digital subscriber line
- Wired access
- In a cable TV network
- In LAN
- Wireless

Some consumers have access to Internet through high – speed lines – usually through optical networks for data transmission, built by Internet service providers or leased by telecommunication companies. Often the Internet providers offer not only Internet access but other services as well, like collocation (providing physical space for installation of customers' equipment in providers' technical centers), building websites and providing web space, domain registration, free email, free disk space and so on. Therefore they can also be Cloud service providers and Cloud owners too.

Cloud service providers - They advertise their services to potential Cloud service applicants. They have to describe the service in a standard format and publish it in a central services register (in our case, this register may be in Hybrid Cloud) or these services may be provided to brokers and consultants of Cloud services. They posses additional information about the Cloud service provider (address, contact), as well as technical details concerning the service. Cloud service providers (public, private, community) can integrate in Hybrid Cloud or develop existing services by suitable techniques. They can record a description of the services they offer, and also to manage and monitor their implementation.

Cloud service applicants – May be any participant of the developed model. They extract information from the register using the service description to find the service out and if it satisfies them respectively, to receive it.

Cloud service brokers – They maintain records of published services and can offer different providers with their services to Cloud applicants. They use universal description integrator detection to find the desired service. Cloud service brokers provide storage for services with their description, where Cloud providers publish their services and thus Cloud applicants receive information and find the needed service. Cloud service brokers can act as consultants on request of the Cloud service applicants to provide the best solution referring the type of service or combination of services whit their providers, prices, quality, delivery time etc. to satisfy their needs.

Participants in the Cloud computing network cooperate on the basis of the open model. They can be Cloud service applicants as well as Cloud service providers. Acting as Cloud service applicants they can declare and use services like IaaS, SaaS, PaaS,.and to become Cloud service providers of a new service or improve old ones based on external ideas or provide their own unrealized ideas to external partners and therefore receive income.

7. CONCLUSION

The aim of this paper is to present the main characteristics of Cloud computing, the various Cloud models and the services offered by the Cloud. We also present a pattern of the participants in the network of the Cloud computing and their interaction based on the open innovation. From the facts exposed in our article it is obvious that Cloud computing offers an entirely new way in which the users connected to the Internet or private network can take advantage of the available IT services, resources, software and processing capacity. Cloud computing open new space for entrepreneurial opportunities directed to big multinational companies, as well as to small and medium business. Each company with its IT organization may act as a service broker and so create value through the open innovation approaches: **Inside - Out** and **Outside-In**.

To implement Cloud computing some important steps have to be made, like standardization and consolidation of IT resources. The benefits of standardization are decrease in capital costs and staff expenditures. Applying virtualization as a major consolidation technology gives the companies potential to use their servers more efficiently. Automation of IT processes enables companies to provide physical and virtual resources to the server in real time. Main advantage of automation is the labor costs reducing.

As main disadvantages of Cloud computing we can indicate: necessity of a fast and reliable Internet everywhere and at anytime, elaboration of models for better service scalability. As another disadvantage we can point also the users' concern regarding eventual abuse of personal information by the Cloud service providers, which raises the question of better law regulation and development of new technologies to ensure data security.

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