THE ROLE OF INFORMATION COMMUNICATION TECHNOLOGIES IN PROMOTING INNOVATION IN THE REPUBLIC OF MACEDONIA

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Abstract

This paper highlights the significance of innovation and ICT, in other words, the tendency is to provide proper perception of the importance of ICT regarding innovations condition as one of the key elements for developing Macedonian economy by efficient analysis of the existing data in the Republic of Macedonia and in worldwide. Innovation analysis is not an aim perse, but a powerful tool for understanding the real condition and a basis for suggesting measures for its development. The significance and role of ICT and innovation is great both on company's and economy's level. Innovations generally are human activity, and innovation support is the principal task of the management and key responsibility of the companies' managers. The fast development of technology has created new requests in companies in search of new technological improvements by applying new ICT.

ICT and innovations are of great importance for the economical development and prosperity in the Republic of Macedonia, which is the main hypothesis, "ICT plays an important role in promoting innovations and innovation activities". Analysis results demonstrated that the developed countries have greater contribution in promoting ICT and innovations. While the results from the empirical research implied to accepting certain hypothesis, which led to accepting the main hypothesis that ICT play important role in promoting innovations and innovation activities in the Republic of Macedonia.

Keywords: *ICT, innovations, economical growth, innovation activities.*
Classification JEL :*O3*

1. Introduction and context of the study

It is widely accepted that innovation has central role for growth of production and productivity. As the world economy develops, the process of innovation becomes increasingly important. Globalization has led to dramatic increases in access to information and the emergence of new markets for companies. This resulted in greater international competition and emergence of new organizational forms in order to manage global supply chains. Due to the advancement of ICT and the increasing information flow, knowledge is increasingly seen as a central instigator of economic growth and innovation. However, it has to be fully analyzed how these factors affect innovation.

2. ICT as a factor for stimulation innovativity

Some of the recent changes in the innovation process could not have happen without ICT. The way ICT has the potential to complement, integrate and fit a wide range of technologies and knowledge from different areas into a traditional production environment, enables innovation to be the main driver for stimulation productivity in companies.

Recent research highlights the need to emphasize the approach of the innovative use of already established technology (mobile phones, television), not just to establish a new technology.

The development of ICT is characterized with a number of innovative applications that provide a wide range of benefits in different areas (including education, healthcare, trade, etc.), such as: Mobile banking (M-banking), E-government, E- commerce, E-learning, M-learning (mobile

learning), E-education, E-health, Electronic business (e-business), Electronic payment, Electronic banking (e-banking).

Eurostat project shows that, ICT (on average) usage has a positive relationship with efficiency of the company. However, differences in individual country results and between ICT use types suggest that the impact of ICT use has had a varying impact according to activities of the company.

OECD findings support the hypothesis that ICTs act as an enabler of innovation, particularly for product and marketing innovation, in both manufacturing and services.

A lot of studies indicate that the introduction of ICT is related to the transformation of the company, investments in intangible assets, and a change in relations with suppliers and customers. Electronic public procurement, for example, increases inventory control and reduces the cost of co-ordination with suppliers, and ICT offers flexibility for production, etc. it can be: just in time management system, integration of sales with planning production, etc.

Also, many studies have shown that they have noticed the value of the relationship between innovation and ICT. In one survey in Australia is found that different ICT technologies are related to different types of innovations. For example, connecting to the Internet via a cable modem is related to product innovation, while the wireless Internet connection is more important for organizational / managerial operations and is related to organizational innovation.

ICT's are major factor in carrying out business activities and a major catalyst for fundamental change in organizations today. Information technologies are closely related to communication technologies in terms of their development, application and utilization. ICT's are considered as major promoters of development in modern societies and economies, and their use is an important component of all development strategies in modern societies based on the digital economy and the broadband technology and e-business models.

3. ICT influence on innovation

ICT influence on innovation can be considered, by determining the needs for new technologies that can be achieved through various aspects:

- internal development (vertical transfer of technology) - means development of own technology by applying own resources, capacities and readiness for innovation. Companies decide For this way of development because of to the high level of independence and the high scale of imitation protection.
- external sources (horizontal transfer) - buying and transferring technologies from other companies, region, countries, etc. This can be done through the procurement of equipment, licensing, and etc.
- combination of internal and external sources - the most useful model, because in practice their self-use did not prove to be effective.

One of the most famous concepts in innovation is the technology S-curve, the technology life cycle. This framework is used to determine performance in regards to time and effort. It assists in determining the level of maturity of the industry / product and where it is in relation to the innovator's dilemma concept and the product's adoption curve. Today, more than half of industrial production and more than 80% depend on modern ICT applications. More than 80% of the innovations in the automotive industry, medical technology and logistics are driven by ICT. ICT forms the technological foundation of our information and knowledge society. It permeates all aspects of our lives and has become the primary driver of innovation. Science and industry must cooperate even more closely in the future in order to exploit this potential to the full.

Today, the goal of companies is not the acquisition and deployment of technology, but the ability to use technology on innovative way. "Companies must be able to innovate globally. They must create and commercialize a stream of new products and processes that move the edge of

technology, to develop so quickly that their competitors cannot reach them". The main benefits from the impact of ICT on innovation are:

- ICT has a key role for increasing innovation, creativity and competitiveness in all industrial and service sectors.
- ICT use will open up many new opportunities for the citizens, such as a wide range of applications including providing health care, transport systems as well as innovative interactive entertainment and learning systems.
- Today in our economies almost half of the productivity is from ICT. Benefits in the economy arise from the production of innovative products and services and from improving business processes through the diffusion, adoption and application of ICT.

The benefits of ICT's impact on innovation are notable, both for business and users, as well as for the whole society. For companies, they are not just an image and a trend for following new technology, but a real tool for reduce costs, for increases profitability and gain greater competitiveness on the market.

For consumers this means reducing the time for purchases, buying at any time and from any place, but also the possibility of interacting and buying products adapted to their preferences. In this way competitiveness of price is ensured, and thus attracting a wider range of consumers, as well as the possibility to buying certain products, which with the traditional way of buying would not be available for the population with a lower standard. It also provides interactive communication with local and state institutions and authorities, in order to obtain necessary information about ongoing activities and transformation of the role of these institutions in centers that will be in function of the citizen.

4. Empirical research

The main research problem is ICT and its role in promoting innovation with particular emphasis on the application of innovations and the need to adopt proactive strategies, creating the necessary ambience and connectivity with ICT and information society in the Republic of Macedonia. The research aim is to explore what is the role of ICT in promoting innovations in the Republic of Macedonia.

Also can be defined the main research hypothesis: „*ICT play an important role in the promotion of innovation and innovation activities* ".

Besides main hypothesis, have been defined individual hypothesis.

Using the methodological instruments is measured:

- **Dependent variable:** Innovation; ICT
- **Independent variables:** Types of innovation; Number of accepted patent; Profit increase; Employees in the company only for R&D; Investing in innovative activities in the company; Technological and non-technological innovation; Innovation drivers in the company; Innovation barriers in the company; Company export; Company competition; Company cooperation with other subjects; Participation of the company in tenders for public procurement; Use of standards; Difficulties finding domestic services for certificates of standards; Government innovation policies; Company web page and profile on social networks; Founds invested for ICT in the company; Use of ICT tools in the company; Use of ICT tools in different departments in the company; Use of innovative software solutions in the company.

The survey ran from January 1st to December 31st 2014. Most of the companies participating in the survey belong to the processing and manufacturing industry, according to the number of employees, most of them belong to the category of micro and small enterprises, and have private domestic property. The data analysis was accomplished using IBM® SPSS Statistics® v20 statistical software.

To analyze the hypothesis, Pearson χ^2 (Chi-Square) test for independence has been carried out. The number of companies that participated in the survey are 103 (n = 103), and a margin of error is given of 5 %, ie $\alpha = 0,05$.

The main research hypothesis will be tested by both, the innovation and the ICT. For that, individual hypotheses have been tested in two ways where the dependent variable is *company innovation* and where the dependent variable is *ICT use in the company*. Because of the data volume the results are presented in the table (Table no1 and Table no 2).

From the research analysis of the all individual responses and from the testing of the hypotheses, (accepted or rejected), the following results are obtained:

Individual hypothesis Q1: *Activities in the company have an impact on the company's innovation –* ***is accepted.***

Individual hypothesis W1: *Innovation drivers and barriers have an impact on the company's innovation –* ***is accepted.***

Individual hypothesis P1: *Company cooperation with other business entities and among the companies themselves have an impact on the company's innovation –* ***is accepted.***

Individual hypothesis S1: *Measures to support innovation in the company have an impact on the company's innovation –* ***is accepted.***

Individual hypothesis D1: *ICT innovations in the company have an impact on the company's innovation –* ***is accepted.***

Individual hypothesis Q1.1: *Activities in the company have an impact on the ICT use in the company –* ***is accepted.***

Individual hypothesis W1.1: *Innovation drivers and barriers have an impact on the ICT use in the company –* ***is rejected.***

Individual hypothesis P1.1: *Company cooperation with other business entities and among the companies themselves have an impact on the ICT use in the company* ***is accepted.***

Individual hypothesis S1.1: *Measures to support innovation in the company have an impact on the ICT use in the company -* ***is accepted.***

Individual hypothesis D1.1: *ICT innovations in the company have an impact on the ICT use in the company* ***is accepted.***

***Dependent variable*: Company innovation**

Table no 1: Individually testing hypothesis

Individual hypothesis	Variables	Value	df	Asymp. Sig. (2-sided)	Individually testing hypothesis
Q1	q1	113,783	15	0,000	is accepted
	q2	46,572	6	0,000	is accepted
	q3	70,438	18	0,000	is accepted
	q4	70,438	3	0,001	is accepted
	q5	6,972	15	0,958	is rejected
	q6	109,982	33	0,000	is accepted
W1	w1	28,778	15	0,017	is accepted
	w2	28,778	15	0,017	is accepted
P1	p1	40,908	12	0,000	is accepted
	p2	290,513	9	0,000	is accepted
	p3	52,894	30	0,006	is accepted
	p4	4,237	3	0,237	is rejected
S1	s1	20,154	3	0,000	is accepted
	s2	9,831	3	0,020	is accepted
	s3	6,742	15	0,964	is rejected
D1	d1	209,272	9	0,000	is accepted
	d2	51,863	15	0,000	is accepted
	d3	14,015	3	0,003	is accepted
	d4	36,187	18	0,007	is accepted
	d5	35,971	30	0,209	is rejected

***Dependent variable*: ICT use in the company**

Table no 2: Individually testing hypothesis

Individual hypothesis	Variables	Value	df	Asymp. Sig. (2-sided)	Individually testing hypothesis
Q1.1	q1.1	15,508	6	0,017	is accepted
	q2.2	17,960	4	0,001	is accepted
	q3.3	15,546	6	0,016	is accepted
	q4.4	52,359	1	0,000	is accepted
	q5.5	10,780	6	0,095	is rejected
	q6.6	60,657	12	0,000	is accepted
W1.1	w1.1	1,920	5	0,860	is rejected
	w2.2	1,920	5	0,860	is rejected
P1.1	p1.1	31,919	5	0,000	is accepted
	p2.2	16,749	3	0,001	is accepted
	p3.3	41,125	11	0,000	is accepted
	p4.4	0,684	1	0,408	is rejected
S1.1	s1.1	68,073	1	0,000	is accepted
	s2.2	7,913	1	0,005	is accepted
	s3.3	6,863	5	0,231	is rejected
D1.1	d1.1	11,276	3	0,010	is accepted
	d2.2	9,420	6	0,151	is rejected
	d3.3	14,015	3	0,003	is accepted
	d4.4	10,350	6	0,111	is rejected
	d5.5	20,127	10	0,028	is accepted

From the results obtained by the research, we can see that, in general, all individual hypotheses are accepted. Only W1.1 individual hypothesis is rejected, that means that innovation drivers and barriers don't have an impact on the ICT use in the company. But that don't means that innovation drivers and barriers are isolated from the ICT and its application, but one should bear in mind that there are many other factors that have a major impact on innovation drivers and barriers (for example, lack of financial assistance for ICT advancement, initiative of company managers for ICT promotion, etc.).

Acceptance of individual hypothesis lead to acceptance of **Main research hypothesis**: "*ICT play an important role in the promotion of innovation and innovation activities* " – ***is accepted.***

The results of this research provide the following conclusions:

- Usage different types of innovations in companies impact of the company's innovation. Therefore, the company can make many kinds of operations changes like: introduction of new or significantly improved products or services, implementation of a new or significantly improved production process or delivery method, introduction of significant changes in the product design or packaging, implementing new techniques for products promotion, usage of new methods for product sale and sales channels, and implementation of new organizational method in the company, workplace organization or external relations.
- More and more managers are aware for the importance of innovation and they are focused on managing innovation in their organizations.
- Companies that use innovations are innovative organizations that improve themselves in competitiveness, and improve their processes or their products and / or services.
- Companies that use innovation are gaining more profits and growth from companies that don't accept innovation. In practice it has been shown that the production of the same standard product in the same way for decades couldn't make the same profit.
- ICT is the technological area with the highest innovation rate measured through registered patents. The data of patents point out to the innovative capabilities of the company. Intellectual property that is not patented allows other companies to copy and therefore it is necessary to remove the barriers of entrepreneurs for the realization and patenting of their ideas.
- External sources of financing are significant and encourage companies to innovate.
- Each company at every level should have employees who will be trained for the innovation principles, skills and tools with highly developed capabilities to apply ICT tools and to generate new business ideas. They have a major impact on the company's innovation and the of ICT use in companies.
- Companies should have employees, money, and talent and management support, to realize their ideas in successful market stories.
- Most of the surveyed companies have their web page (although they do not have quality content and use outdated technology and design, some are still under construction), have their own email and have a profile on social networks. However, the question here is why they would use and invest in advanced ICT technologies. However, companies that cooperate with foreign companies are aware of the advantages of using ICT, how much they reduce communication costs and increase the quality of business. ICT has become a basic need, whose increased use can be reliably identified.
- It is necessary to improve the competitiveness of the ICT sector on one hand, and to facilitate the efficient take-up and application of ICTs in companies.
- It is important for companies to collaborate with all market participants in order to implement new ideas, create dynamic products or improve the existing services. They can be a catalyst for the growth and success of a business and help in adapting to the market. In this way they will be able to adapt to the changes occurring in the environment and contribute to better economic growth.

- For companies it is of particular importance to base their process of operation on knowledge, the links between universities and the business sector are weak, and the research shows that their relationship should be strong because it is needed for successful and innovative operation of the companies.
- Several institutions have been established in the Republic of Macedonia in order to help companies to undertake innovative activities.
- The application of quality standards is one of the basic rules that should be applied and respected by companies in order to be competitive both on the domestic and the world market. Because buyers (consumers) are able to see and recognize the quality of products and services, and on the basis of that, companies will advance. By applying the standards, all other certification and accreditation processes are simplified, also is simplified their implementation, thereby reducing the cost of them.
- The disadvantages of business practice cause new needs and risks for companies. The needs require technological improvements through the use of new ICTs, such as eliminating papers in the form of paper, better and more efficient communication between business subjects, etc. New ICTs provide a new business practice that will again demonstrate deficiencies and new opportunities, because this has provided a new starting-point for improvement. The new business practice and the application of new ICTs should always be in place, with monitoring and continuous measurement of the performance of new systems and practices being constantly present in this process of innovating business practice in organizations and companies.
- Of particular importance for companies is the introduction of an innovation strategy. Innovation strategies create growth strategies, new types of products, services or business models that change the way they work and generate significant new value for consumers, customers and the company. Without an innovation strategy, efforts to improve innovation would be focused on collecting the best practices.
- The capacity of the innovation organization arises from the innovation system.
- A company without an innovation strategy will not be able to make the exchange decisions and choose all the elements of the innovation system. There is no one system that suits all companies or works equally well in all circumstances. However, there's nothing wrong with learning from others, but it's a mistake if we believe that what works, let's say Apple will work in another organization. A clear and accurate innovation strategy helps design a system that suits the specific competitive needs of the company. Without a strategy, a conflict of priorities can easily come to light, even if there is a clear business strategy for innovation. Mainly businesses are focused on their target markets and towards achieving profits and reducing losses. R&D researchers and engineers want to see the possibilities of new technologies. The different perspectives are crucial for successful innovation.
- The role of ICT in advancing the innovation process is extremely detailed and complex. Companies that want to be successful must have a certain kind of innovation that they will know and follow the company. In this way, there will be persons employed precisely for the R&D and will be coordinated in making innovative decisions. Cases of the past indicate that one of the main reasons for the failure of the development of new products is the lack of staff and a certain kind of innovation that the company can follow.

5. Conclusion

A lot of innovation surveys, studies and analyzes are carried out on national and international level, and they have an impact on the business performance of companies in the sections in which they operate and on the country economy. The traditional approach for measuring innovation is based on a small number of individual indicators but the modern approach for

measuring innovation is based on the application of complex indicators that unite a greater number of individual innovation parameters. The use of complex indicators reflects the time and level of development and is the result of changes in society that aim to achieve a higher level of knowledge, skills and competences. In this way, there are is a need for more complete and real way to measure the impact of the innovative activities that exist in society and modern economy.

The paper identifies the need of ICT as the main driver for new innovations, the development of the economy, since innovations have become a very important factor of production in the leading economies. ICT and innovation bring new opportunities for companies in the country. Their impact is significant, as proved by this research.

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