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THE IMPACT OF THE LATEST (2008-) ECONOMIC CRISIS ON ICT PRODUCTS

Katarina Rojko, School of Advanced Social Sciences, Slovenia, katarinarojko@hotmail.com
Dušan Lesjak, University of Primorska and School for Social and Business Studies, Slovenia, dusan.lesjak@fm-kp.si

ABSTRACT

The present research confirms that during the most recent (2008-) economic crisis, ICT indicators showed deviations from the classical diffusion of innovation trends with regard to individual ICT components. The reason for the deviations should be sought in economic, but also social, cultural, political and other influence factors. During the latest crisis (2008-2011), we thus observed the following deviations from the classical diffusion of ICT innovations: a slower process of diffusion and a smaller population adopting innovation, a delayed adoption of innovation by the majority, a faster adoption of innovation due to the incentive impact of the crisis, and a longer-lasting use of innovation. Our research, therefore, enabled us a critical evaluation of certain theories, while it also allowed us to develop an alternative view, in particular of the impact of individual technologies on the economy, society, etc., and vice versa.

Keywords: Diffusion of innovations, Information and communication technology (ICT), Latest (2008-) economic crisis, ICT spending, ICT products

INTRODUCTION

During the latest (2008-) economic crisis, changes in the ICT field, ICT use and ICT spending have been observed. There has been a decline in ICT spending and investment, including the reduced funding of development and innovations in this field. We have noticed certain characteristics and changes in the use of and attitude toward ICT, which we tried to investigate using the actual figures to provide explanations for our findings.

A reasonable approach to this issue was, therefore, to study the trends in ICT spending as a whole as well as the spending on individual ICT segments. Based on this, it was possible to make certain comparisons that provided us with an understanding of the ICT development in terms of identifying technologies on which the latest economic crisis had a different impact than on the others. We were thus able to present different directions and speed of diffusion of individual ICTs during this period.

We claim that economic and other ICT indicators show specific deviations from Rogers's diffusion of innovations by individual ICT segments during the latest economic crisis. The reason for such deviations lies in economic, and increasingly also social, cultural, political and other influence factors. This clearly indicates that we should take the mentioned influence factors into account in the interpretation of the observed deviations, as well as question the validity of the diffusion of innovations theory (by Rogers, [17]). Namely, during the latest economic crisis, spending on certain ICTs suffered a larger decline than spending on others. All this resulted in deviations from the expected curve of ICT diffusion and at the same time demonstrated a different speed of diffusion of individual technologies. These changes thus bear witness to the transformation of ICT during the latest crisis, as well as to the impact of various factors on the information society.

We should also consider that the cost of ICT purchase and maintenance varies in times of economic growth and economic crisis. For example, when comparing the ICT market with the commodity market, we find that short or crisis-limited price reductions are not possible due to the fast development of ICT. Also, the prices of ICT products, decreased due to the crisis, can be increased after the crisis, but only with great difficultly, as, due to the technological progress, there are already newer and more powerful products available. Conversely, the prices of raw

materials begin to rise again with the improved economic situation [8]. The reason for this must be sought in the fact that ICT development is very fast [15, 27], and continues even in times of crisis. However, a reduced investment in other areas during a crisis also slows down ICT development in some areas and increases it in others, especially those areas that have a potential to reduce costs and increase competitive advantages. Nevertheless, the specific nature of ICT investments is seen in their long-term or strategic planning, as well as the urgency of these investments, as in modern societies, the use of ICT has become a norm and a requirement (social, economic, cultural and legislative).

In addition to its negative impact, the latest economic crisis has also had a positive (especially for ICT users) effect on ICT use. It has led to further price reductions of ICT equipment and services (as well as many other products, materials and services), and a number of other attractive offers designed to stimulate consumption. At the same time, the relationship between ICT providers and ICT users has changed considerably [14].

The relationship between the effects of ICT and the effects on ICT is very difficult or even impossible to measure. Therefore, the present research focuses on measurable ICT indicators, although we used qualitative research methods for the interpretation of certain research results, which are presented in the following section. The research methodology chapter is followed by the research findings, providing answers to the research questions, and by the conclusions, presenting also our alternative view of the addressed theoretical basis.

ICT in theory

ICT is primarily understood as a socio-technological system for information processing, the use of which, in addition to its direct technological impact, also causes specific social changes [11]. Influenced by its surroundings, ICT also affects society, as well as the economy, policy-making, culture, globalisation, etc. In the modern sense of the word, ICT has spread across business and administrative processes since the early 70s, when the widespread use of computers began. The introduction of the internet in the 80s further enhanced the role of ICT. In the 90s, ICT reached a significant peak, when (with the help of communication technology) personal computing and web technology combined, thus creating a powerful tool for business and general development [3].

ICTs have also facilitated and promoted the emergence of a global society, global communications, a global market, the globalisation of capital, and a new global division of labour [22]. Furthermore, they contribute significantly to economic growth, productivity, efficiency and performance at macro- and microeconomic levels [19]. At the same time, the impact of ICT increasingly penetrates the economic, political and social spheres [2], and vice versa, given that ICTs are increasingly imbued with social, economic, cultural and other aspects.

Although ICTs actually represent a technological achievement, their social implications go far beyond a mere technological functionality [20]. Until recently, discussions about the impact of ICT focused primarily on the issues of economic growth and productivity. But it is becoming increasingly apparent that the effect of ICT is much broader and covers all spheres of economic and social life. The expansion of ICT use, thus, has a strong impact on our everyday life, work and communication [3], as ICTs have become part of every individual's life since the explosive growth of ICT use in the 90s [13].

However, critics claim that since new technology is used within the existing political and economic framework, it increases the impact of existing stakeholders and, therefore, preserves or even increases the existing social inequalities. IT, as all technology, has been selected and designed in accordance with the interests and determinants of society and politics [12]. Beniger [1] also argues that technological and economic origins of the information society lead to a revolution of control, available to countries, companies and individuals. The information society is therefore a global phenomenon with technological, economic, historical, cultural and political dimensions, which change over time.

Harper and Leicht [6] also exposed that researchers in this field did not yet have sufficient understanding of the basics for concrete predictions regarding social implications of ubiquitous innovation. This is particularly interesting in view of understanding and interpreting the ICT role, especially in economic crisis circumstances.

ICT diffusion

ICT-related changes in society are often discussed in the framework of the concepts of the diffusion of innovations. Since the 1930s, more than 1,500 studies [6] have dealt with the diffusion of innovations. They include numerous empirical sources dealing with social change processes [17, 25].

ICT diffusion is a process by which individual ICTs expand within the potential market. In a certain time frame, the rate of acceptance varies depending on economic and social parameters, different preferences and abilities [16]. The extent and intensity of the use of individual ICTs are measured using various indicators of ICT demand, ICT investments and the extent of ICT use [21]. Thus, upon the acceptance of the diffusion of ICT theory as valid, caution and further study of the diffusion of individual ICTs are required, as ICT represents a heterogeneous, dynamic and constantly changing set of technologies.

At the same time, it is clear that it is not possible to predict the impacts of technology on society, and vice versa, because society does not automatically accept technological innovation, rather, people form the social framework that enables technological development.

The understanding of innovations from the perspective of social technologies design [24] sees technologies design as a contradictory and uncertain process, which is not only a rational, technical problem solving process, but also includes an economic and political process of building alliances of different interests, resources and technical expertise.

The diffusion of innovations (especially ICT) is therefore a wider social phenomenon, where the attitude towards innovations plays an important role [26] because besides already above mentioned reasons, given the increasing integration of ICT into the lives of individuals, organisations and businesses, there is increased variety of factors that affect the diffusion of an individual ICT.

In its definition, Rogers's [17] theory of diffusion coincides with the life cycle of a technological revolution, as it defines diffusion as a process when the market reaches saturation, i.e. when innovation is adopted by the following five groups of people: innovators (2.5 percent), early adopters (13.5 percent), early majority (34 percent), late majority (34 percent) and laggards (16 percent).

However, the adoption of innovations is also influenced by other (not just technological) factors. Thus, during the recent economic crisis, we recorded at least four deviations from the Rogers curve:

- a slower process of diffusion and a smaller population adopting innovation (Deviation 1);
- a delayed adoption of innovation by the majority (Deviation 2);
- a faster adoption of innovation as the economic crisis may work as an incentive (e.g., in the case of innovation reducing costs) (Deviation 3);
- a longer-lasting use of innovation (Deviation 4).

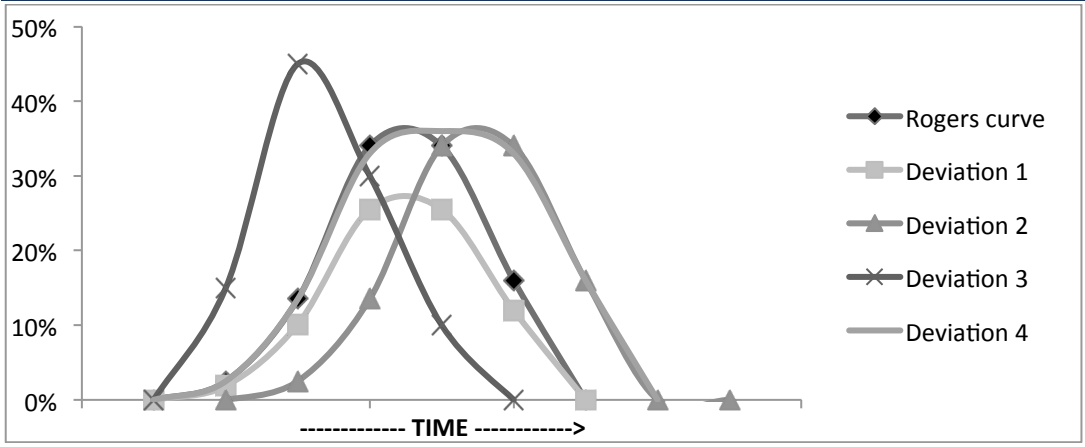

Figure 1: Rogers's process of diffusion of innovations and some deviations during an economic crisis (modifications of Rogers [17])

During the latest economic crisis, an increased number of additional influence factors (compared with previous crises) can be observed due to a rapid technological development, the growing ubiquity of ICT, as well as differences in culture and policies, etc. Innovation is therefore an important element of socio-economic change, with complex factors shaping its expansion, acceptance or rejection. Even purely technological innovations have some socio-cultural dimensions, and complex and often uncertain effects [6].

RESEARCH METHODOLOGY

This study is methodologically divided into quantitative and qualitative parts or three inter-connected phases of the research process. The first phase includes a systematic analysis of sources and a review of literature, which provided us with the theoretical basis and data for the empirical analysis.

Based on the defined goals of our study, we compared the available data, in particular the impacts of the crisis on ICT over time. The basis for the analysis were different macroeconomic data and quantitative ICT indicators – variables that show ICT spending, and with data mining this allowed us identification of various dimensions of the crisis impacts such as discovering so far not obvious connections and differences.

For the purposes of empirical analysis, we were thus obliged to address ICT primarily as a precise set of individual technologies. For this purpose, we used the definition by IDC (International Data Corporation), an international company, founded in 1964, which analyses global, regional and national ICT spending. We thought it made the most sense to position ICT spending indicators at the centre of our research, because they provide a comprehensive and very detailed overview of ICT purchases. It is a financial cost, paid by private and commercial users for the purchase of ICT equipment or services. ICT spending, therefore, differs from ICT investment, including financial costs of the capital appreciation of ICT.

For the purpose of analysing ICT diffusion deviations, we initially compared global ICT spending during the latest crisis by individual ICT segments (hardware, software, IT services and telecommunications services), and then by individual sub-segments. We explored which ICT segments' and sub-segments' spending fell more, which less and which grew, so we could identify different deviations from Rogers's diffusion of innovations (see Figure 1) for individual ICTs.

The main aim of benchmarking as the core of the study was to identify parallels and deviations, and to verify the new rules in the field of ICT during the latest economic crisis, in particular the deviations from Rogers's diffusion of innovations by individual ICT segments.

Furthermore, based on qualitative data collected during the literature review and numerous interviews (when collecting and analysing ICT spending data in 2008-2013) with ICT service providers, ICT users, and other research analysts in this area - we further deepened our understanding of the influence factors and the perceived changes in the ICT field. This chronological and comparative analysis of quantitative data thus served us as the basis for our critical assessment of sources and theoretical conceptualisations, and moreover for credible explanation of our research findings.

RESEARCH FINDINGS

The crisis has not had such a strong impact on the world as a whole as, for example, on the EU, since ICT spending in some countries (e.g., Brazil, India, China and Australia) continued to grow even during the latest economic crisis (specifically, in the period 2009-2011). For this reason, smaller declines in ICT spending are expected for the world as a whole than for the EU, where all analysed countries (24 countries for which data was available) decreased their ICT spending at least one year during this period. Globally, a lower volatility of ICT spending is expected in general, because it represents a set of even more different countries and regions. Nonetheless, the comparison of EU and global ICT spending during the latest economic crisis has identified many similarities.

Based on the insight into the actual numbers and indicator trends, we have found that our predictions were justified. Namely, ICT indicators show deviations between individual technologies. This suggests that the explanation of these deviations must take into account not only technical but also economic, political (various policies of nations, communities and countries), social and other influence factors. In addition, the latest economic crisis proved that ICT spending on certain technologies declined more than on others. For example, during the latest crisis, mainly urgent investments were made in IT hardware (due to the extended cycles of replacing old equipment with new), which resulted in this segment reaching the maximum fluctuations in spending. Also, buyers' decisions to buy less expensive equipment affected the largest drop in spending on hardware, which caused an even greater decrease in the value than in the volume of sold ICT. This also resulted in deviations from the expected diffusion curves, and showed different directions and speed of diffusion of individual segments or technologies, as well as, in most cases, a partially inhibited "maturation" of the ICT market.

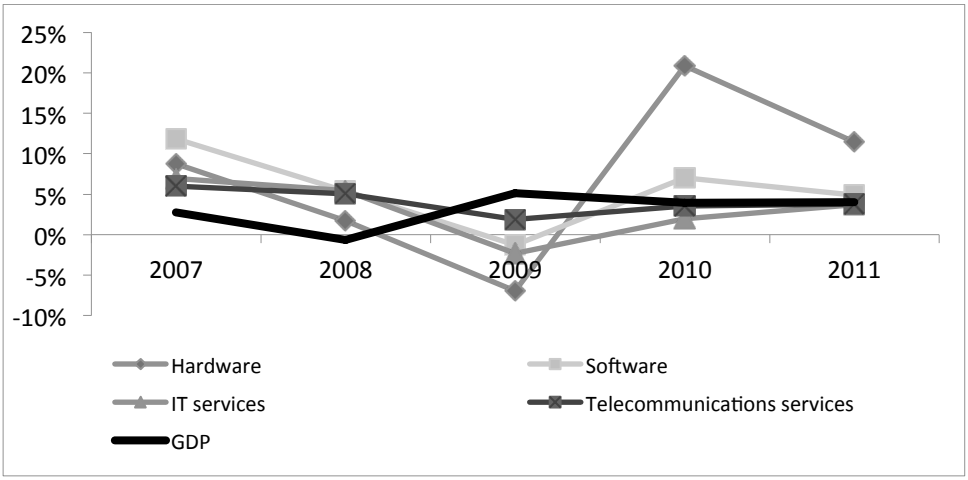

Figure 2: Percent change in global ICT spending by ICT segment (the rate applied excludes exchange rate fluctuations = constant USD) [7, 9]

From the Figure 2 we can see that spending on telecommunications services continued to grow in 2008-2011 period, but spending on hardware and software grew faster in 2010 and 2011. The lowest growth in spending among ICT segments in 2010 and 2011 was recorded by the IT services segment, due to a delayed and longer-lasting impact of the crisis (pre-arranged, usually multi-annual projects) on this segment.

Percent changes in ICT spending also affected the change in the shares of individual ICT segments. Thus, from 2008 to 2011, the share of spending on IT services and telecommunications services declined, while the share of spending on software and hardware increased. These changes in shares indicate a partially inhibited development of the global ICT market as a result of the latest crisis, and suggest the transformation of ICT as well as the change in the behaviour of the modern society.

On the other hand, the percent change in GDP shows that a decline in GDP was recorded already in 2008 (i.e. -0.7 percent in constant prices). This indicates a delay in the crisis impact on ICT, while ICT spending also grew with a delay, varying between different technologies.

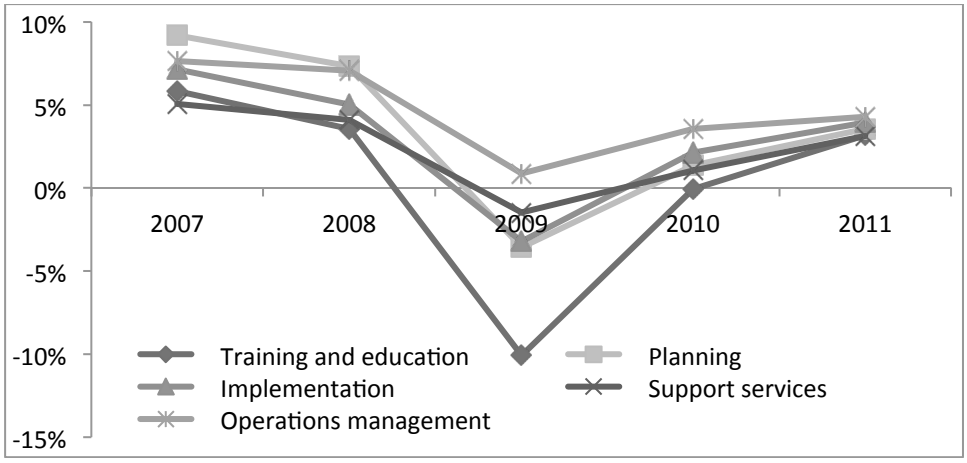

Figure 3: Percent change in global ICT spending by the sub-segments of IT services (constant USD) [7]

Figure 3 shows that in 2009 global spending on IT training and education decreased more than spending on consulting, training and support services, while spending on operations management (in particular, on outsourcing and cloud computing) grew also in 2009. The increase in spending on operations management services was also observed in the EU, as these services allow for the conversion of capital expenditure into operational expenditure (CapEx to OpEx), and, thus, represents the third (see Figure 1) deviation from Rogers's diffusion of innovations curve. In 2010 and 2011, operations management spending continued to grow (the most among the IT services sub-segments), while spending on IT training and education recorded a slight decline also in 2010. Nonetheless despite an overall increase in spending on IT services in 2010 and 2011, the impact of the crisis was still reflected in smaller growth rates than in the years before the crisis.

The percent changes in IT services spending during the latest crisis also affected the changes in the shares of spending on individual sub-segments. Thus, from 2008 to 2011, the share of spending on deployment, support services, planning, and training & education declined globally. On the other hand, the share of spending on operations management remained the same considering total ICT spending. These changes in shares indicate a blocked "maturing" of the global IT services market (in the EU, only a slowed "maturing"), as the share of spending on operations management remained at the 2008 level, beside only a modest decline in spending on support services.

IT support services declined only modestly because IT system renewals were suspended, reduced or fragmented into phases (smaller-scale projects) during the period 2009-2011. The decrease in the investments in renewing IT systems has thus exerted pressure on the prices of IT services, as well as resulted in an increasingly fierce battle between IT service providers for earnings since 2008.

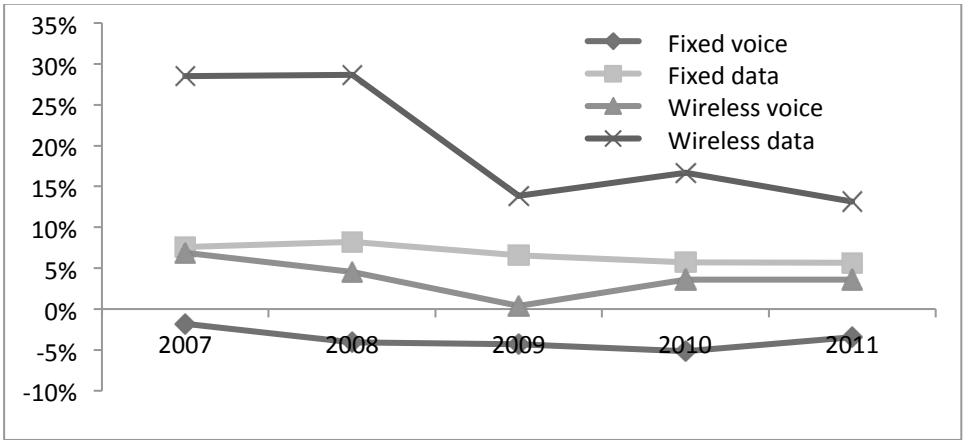

Figure 4: Percent change in global ICT spending by the sub-segments of telecommunications services (constant USD) [7]

In terms of telecommunications services, Figure 4 shows different percent changes globally than in the EU. Namely, in 2009, global spending on fixed telephony decreased, while global spending on mobile telephony and on wireless and fixed data transfers increased. In the EU, spending on mobile telephony declined the most in 2009, followed by the decline in spending on fixed telephony services, while spending on wireless and fixed data transfers grew. The data also demonstrates the transformation of ICT, as spending on wireless and fixed data transfers did not decrease (neither in the EU, nor globally) during the 2009-2011 period. These changes in spending shares indicate a further "maturing" of the global and EU telecommunications services markets. Besides a more moderate decline in spending on fixed telephony services may be understood as the fourth recorded deviation (a longer-lasting use of innovation) from Rogers's diffusion of innovations theory (see Figure 1).

On the other hand, despite a smaller reported growth in spending on data transfers from 2009 onwards (both fixed and wireless), growth was still visible during the latest crisis, which indicates a growing need for "connectivity" due to the rise of mobile devices and cloud services. We further conclude that fixed data transfers actually grew faster than they would have had there been no crisis (a longer-lasting use of innovation – the fourth expected deviation, presented in Figure 1), as fixed data transfers are cheaper than mobile data transfers for comparable speeds, despite some market saturation and users' transition to mobile devices.

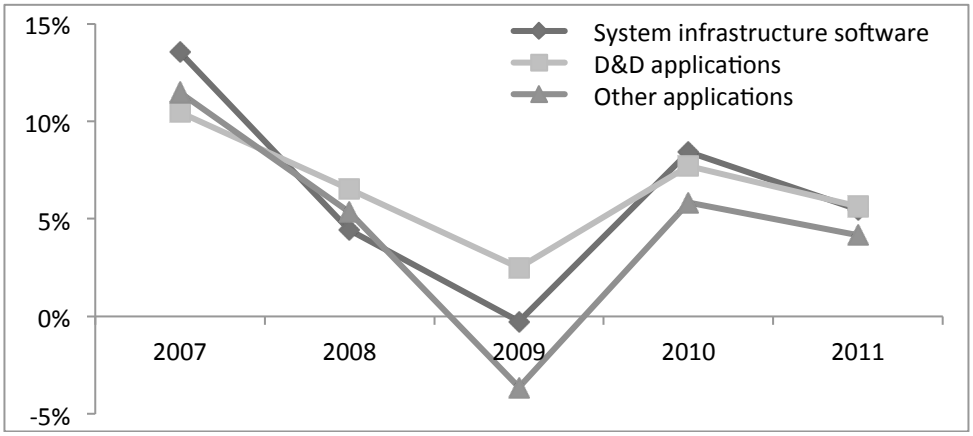

Figure 5: Percent change in global ICT spending by software sub-segments (constant USD) [7]

Figure 5 shows that global spending on other applications and system infrastructure software declined in 2009 (as in the EU), while spending on design and development applications grew also in 2009 (same in the EU), since these applications allow for further development and adaptation of IT systems. Such applications can also reduce the impact of the crisis because they allow for adjustments, a better management and analysis. Thus, we can conclude that in this case this can be considered as the third deviation from Rogers's theory, presented in Figure 1 (a faster adoption of innovations, since the economic crisis may work as an incentive).

In 2010, a growth in spending on all software sub-segments was recorded again. Globally, growth in all sub-segments was also recorded in 2011, although more moderate than in the EU. From 2008 to 2011, the global share of spending on two of the three software sub-segments increased, i.e. the share of system infrastructure software and the share of design and development applications, while the share of other applications remained the same. These changes in shares indicate a further "maturing" of the global software market, although a slower one than in the EU.

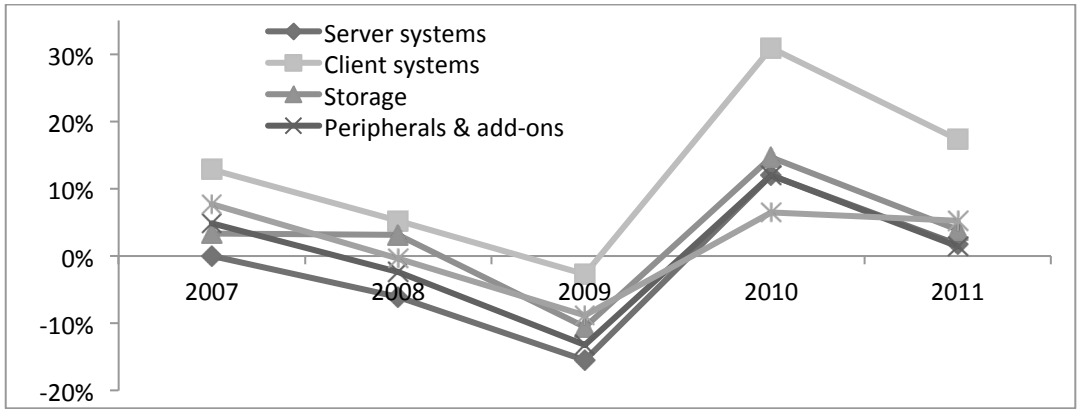

Figure 6: Percent change in global ICT spending by hardware sub-segments (constant USD) [7]

Figure 6 shows that in 2009 global spending on servers decreased more than spending on peripherals, storage, networking equipment and client systems. In 2010 global (and the EU) spending on all IT hardware sub-segments grew. In 2011, global spending on all hardware sub-segments again recorded more modest growth, while in this same year EU spending on two sub-segments (servers and peripherals) declined.

In 2008, global spending recorded a decline in three (four in the EU) IT hardware sub-segments, suggesting that the crisis started already in 2008 and was first observed in the hardware segment. However, the analysis of global ICT

hardware spending also indicates that the effect of the latest economic crisis forms a "W", since its growth eased in 2011.

During the latest crisis, the percent change in hardware spending affected also the change in the shares of individual hardware sub-segments. Thus, from 2008 to 2011, the share of spending on certain hardware sub-segments fell globally, i.e. on servers and peripherals. On the other hand, the share of spending on client systems and networking equipment increased, while the share of spending on storage remained the same. These changes in the shares also indicate a further development of the global IT hardware market during the latest economic crisis (same in the EU, where growth in client systems share and a decline in the share of networking equipment were recorded).

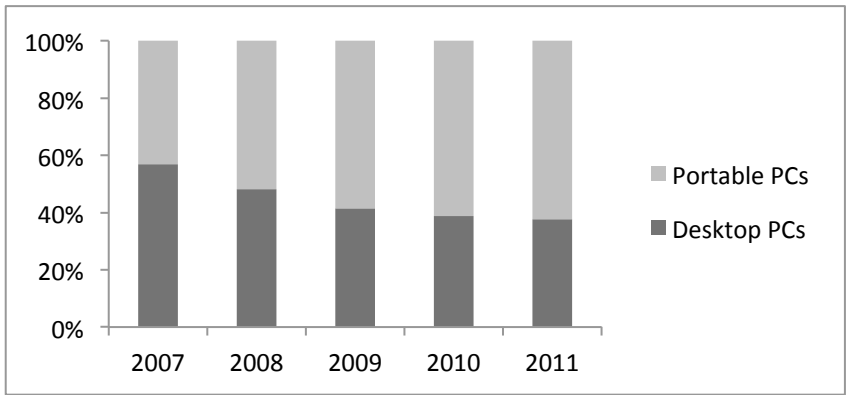

Figure 7: The share of personal computers sold globally [6]

Figure 7 shows that the global sales of laptops surpassed the sales of desktop computers for the first time in 2008, specifically, in the third quarter of 2008. This trend has been observed globally since 2008, exactly one year later than in the EU. In 2011, the share of laptops sold globally stood at 62.3 percent, or more than 140 million units. Over the period 2007-2011, the highest number of sold laptops (just over 141 million) was recorded in 2010, but the share was still lower (i.e. 61.2 percent) than in 2011.

It is also worth mentioning that the share of desktop computers sold globally once again increased during the latest crisis – the crisis stimulated the sale of cheaper (desktop) computers. For example, in the first quarter of 2010 when there was an increase in the share of sold desktop computers, the average sales price of all desktops sold globally was 426 EUR, while the average sales price of laptops was 519 EUR [6]. The re-boosted sales of desktops indicate the fourth deviation – a longer-lasting use of innovation – from Rogers's diffusion of innovations theory (see Figure 1).

It is also possible that the latest crisis had an impact on the diffusion of laptops, as presented in Figure 1 with the first deviation (a slower process of diffusion and a smaller population, adopting this innovation). This can be considered at least for conventional laptops that are being increasingly displaced by cheaper tablets and smartphones.

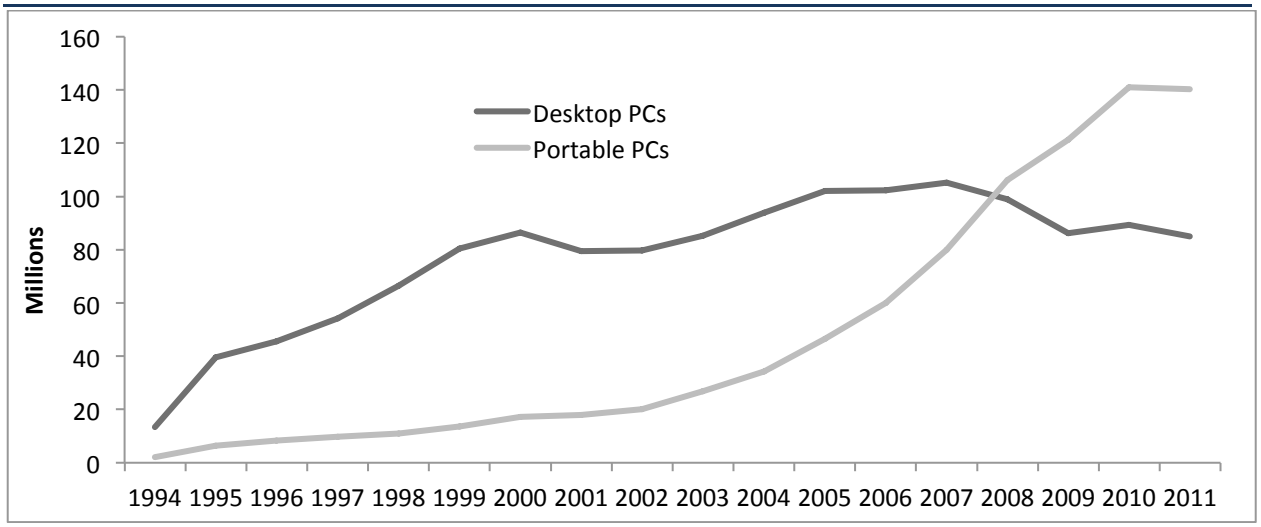

Figure 8: The number of personal computers sold globally in the period including the latest (2008-) and previous (dot-com) global crises [6]

Figure 8 further illustrates (see also Figure 1) another deviation from Rogers's diffusion of innovations curve (as in the EU), both during the latest crisis and during the previous (dot-com) crisis. Thus, in the period 2001-2002, a smaller number of sold desktop PCs was recorded, while in 2011, a decline in the sales of portable and desktop computers was recorded; both mentioned observations represent the second marked deviation from the expected diffusion of individual ICTs.

CONCLUSIONS

As during the past economic crises ICTs weren't adopted on such a massive scale (e.g., mobile telephony and broadband internet), they were not under such a direct impact of the crises as since the beginning of the latest crisis [10]. We have shown that, in addition to economic and technological factors, what is undoubtedly very important is the factor of the increasing integration of ICT into society, which allows and requires new trends and the adaptation by ICT users in a crisis.

However, since an economic crisis has, in addition to other associated risk factors, a direct impact on reducing the demand for ICT, many experts from the ICT field warned that in times of crisis we should not forget about the essential ingredients for a successful business and cut costs everywhere (e.g., for ICT security and for human resources in the ICT department). Thus many ICT users realised that certain technologies (as operations management and applications for design and development showing third deviation from Rogers' curve) deliver savings, a more rational allocation of costs, a detailed costs control and a competitive advantage, if are deployed. In addition, a crisis requires rationalisation, consolidation and a quest for more relevant and effective solutions that at the same time also further accelerate the transformation of ICT.

We also believe that any subsequent global economic crisis will have a strong impact on the ICT sector, which will, therefore, be further transformed and adapted, and will also encourage the rise of new mainstream technologies. This expectation is confirmed, inter alia, by a further decline in prices of ICT products and also the search for and the acceptance of alternative ICT solutions and services during the latest crisis (cloud computing, social business, big data analytics and mobility). On the other hand, an increasing rate of development, and in particular an increasing integration of ICT into business and everyday life, demand and promote deviations from Rogers theory.

At the same time, the presented research findings confirm that it is not possible to predict the impacts of technology on society, and vice versa, because society does not automatically accept technological innovation, rather, people form the social framework that enables technological development. And as ICT has an increasing impact on society, culture, etc., and due to higher rates of diffusion, the present analysis was able to identify some new crisis-characterised deviations in the use of and the attitude to ICT. Therefore, we also assume that the technological and economic impact on ICT will gradually decrease, while social, cultural and other influence factors will gain in importance.

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