

# An overview of research on technological and telecommunication development

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**Budimir, Marina**

*Source / Izvornik:* **Ekonomski vjesnik : Review of Contemporary Entrepreneurship, Business, and Economic Issues, 2014, XXVII, 171 - 182**

**Journal article, Published version**

**Rad u časopisu, Objavljena verzija rada (izdavačev PDF)**

*Permanent link / Trajna poveznica:* <https://um.nsk.hr/um:nbn:hr:145:906592>

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*Download date / Datum preuzimanja:* **2024-04-26**



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*Marina Budimir*  
Ljudevita Gaja 92, 35224 Sikirevci  
marina.budimir@sb.t-com.hr  
Phone: +38598519849, +385917807649

*UDK 007: 654*  
*Review article*

*Received: April 10, 2014*  
*Accepted for publishing: May 22, 2014*

# AN OVERVIEW OF RESEARCH ON TECHNOLOGICAL AND TELECOMMUNICATION DEVELOPMENT

## ABSTRACT

The scientific and professional research on technological and telecommunication development started in the second half of the 20<sup>th</sup> century as the use of new media and technologies began to cause structural business and social changes. A review of research published in the early 1980s revealed that the focus was mainly on the acceptance, usefulness and impact of new media and information technology on the information society, whereas research conducted at the turn of the century was mostly interdisciplinary and related to the effect of technological and telecommunication development on various scientific and professional fields.

The focus of this paper is an overview of published research on information technology since the 1980s to date, as well as technological and telecommunication development in recent years based on the latest official published data. On the basis of previous research, it can be concluded that more attention needs to be directed to monitoring trends of ICT products and services in order to increase benefits and reduce the costs for active users, as well as improving infrastructure and providing information to attract passive users in order to reduce technological and telecommunication gap between developed, developing and underdeveloped countries.

**Keywords:** information technology, technological development, telecommunication development

## 1. Introductory considerations

Initial steps in the scientific and professional research on technological and telecommunication development were taken in the second half of the 20<sup>th</sup> century as the use of new media and technologies began to cause structural business and social changes. A review of research published in the early 1980s revealed that the focus was mainly on the acceptance, usefulness and impact of new media and information technology on the information society, whereas research conducted at the turn of the century was mostly interdisciplinary and related to the effect of information technology on different scientific and professional fields.

The focus of this paper is an overview of published research on information technology since the 1980s to date as well as technological and telecommunication development in recent years based on the latest published data. The paper is intended to clarify the significance and benefits of new technological and telecommunication solutions in business processes and social activities. On the basis of previous research, it can be concluded that targeted marketing policies need to focus more on monitoring trends and profitability of ICT products and services in order to identify regulatory price reductions, reduce the costs and increase the benefits for active users, as well as improving infrastructure and providing information to attract passive users in order to decrease technological and telecommunication gap between developed, developing and underdeveloped countries.

## 2. An overview of previous research on information technology – terms and controversies

Since the 1980s extensive research has been conducted on information technology. The use of new media and technologies has caused significant changes in business as well as social activities, which motivated further scientific and professional research. It should be mentioned that, at the turn of the century, globalization started to accelerate technological and telecommunication processes in almost every country in the world that had the necessary infrastructure.

As mentioned above, a number of recent research publications have focused on the global information society, but mainly on acceptability, affordability, usefulness and benefits of new technologies in everyday business and private life, as well as the costs and disadvantages of such changes. The influence of information technology is reflected in technological and telecommunication development on the local, national, regional and global levels. Geographical distances no longer represent an obstacle to technological and telecommunication development on the international and national levels, causing the world to become truly global.

### 2.1. An overview of research on information technology since 1980's till the end of the 20<sup>th</sup> century

As mentioned in introductory consideration, the focus of research in the late 20<sup>th</sup> century was mainly on the acceptance, usefulness and impact of information technology on the information society as the use of new media and technologies began to cause structural business and social changes. As can be seen from Table 1 showing an overview of research on information technology from the 1980s, the initial aim at the time was, inter alia, to inform the general public on the advantages of new media and technologies in everyday personal and business life, but also to raise awareness about the development of new information society.

Broader use of new information technology continued in the 1990s as well as the research of changes in market trends and social consequences of these changes brought about by the ICT development. A number of studies from that period proved the advantages of information technology. For instance, by publishing *The Rise of the Network Society*, Castells (1996) predicted the impact of social and economic changes on the emergence of the new information age. According to Castells, the basic difference between the information society and informational society is that in the information society the information itself plays an important role, while in the informational society information and transfer of information are the main sources of productivity and power.

**Table 1. An overview of research on information technology published in the 1980s**

deal with the global information society; broadband mobile and fixed telecommunication; evolution of

AUTHOR	YEAR	RESEARCH
Burt, R. S.	1980	Models of network structure
Bagdikian, B. H.	1983	The media monopoly
Perez, C.	1983	Structural change and the assimilation of new technologies in the economic and social systems
Rice, R. E. et al	1984	The new media: Communication, research and technology
Johansen, R.; Bullen, C.	1984	What to expect from teleconferencing
Meyrowitz, J.	1985	No sense of place – the impact of electronic media on social behavior
Beniger, J. R.	1986	The control revolution: Technological and economic origins of the information society
Bijker, W. E.; Hughes, T. P.; Pinch, T. J.	1987	The social construction of technological systems: New directions in the sociology and history of technology.
Marvin, C.	1988	When old technologies were new: Thinking about electric communication in the late nineteenth century
Davis, F. D.	1989	Perceived usefulness, perceived ease of use, and user acceptance of information technology

Source: Author

Authors Williams and Edge (1996) in *The social shaping of technology* analyzed previously published research studies on the impact of information technologies on the social processes caused by a range of social, economic and technical factors, while authors Silverstone and Haddon (1996) in *Design and domestication of information and communication technologies: Technical change and everyday life* emphasized the new role of technological innovation in everyday business processes and engineering systems. Finally, Lucas (1999) in *Information Technology and the Productivity Paradox: Assessing the Value of Investment in IT* explored the relationship between productivity and information technology. By defining key social and cultural factors that influenced the emergence and development of the Internet, Abbate (1999) in *Inventing the Internet* clarified the importance of the Internet for the development and popularization of network technology, especially computers as a new communication medium.

## 2.2. An overview of recent research on information technology

A number of recent research studies on information technology, published in this century, mostly

the Internet and new Internet trends; impact on society in different cultures; future projections; acceptability, affordability, usefulness, benefits, costs and disadvantages of information technology, etc. A literature review conducted by Katz et al. (2003) in *Machines that Become Us - The Social Context of Personal Communication Technology*, focused on the social aspects of technology while Ling (2004) in *The Mobile Connection: The cell phone's impact on society* emphasized the impact of mobile connectivity on society.

In *Internet society: The internet in everyday life*, Bakardijeva (2005) deals with personal computers and the Internet, while authors Koskinen and Kurvinen (2005) in *Mobile multimedia and users: On the domestication of mobile multimedia* focused on multimedia messages, the use of which was increasing at the time. Authors Licoppe and Smoredab (2005) in *Are social networks technologically embedded? How networks are changing today with changes in communication technology* scrutinized network changes caused by development of communication technology, while Berker et al (2006) published *Domestication of media and technology*. According to Drucker (2006, 211) in *Managing in the Next Society*, information technology will neither dominate, nor shape the society. He argued that the central features of the future society, as well as its predecessors, would be the new institutions, new theories, new ideolo-

gies, and new problems.

Literature reviews in Katz et al. (2003), Ishii (2004), Campbell (2007), Schroeder (2010) and Baron (2010) focused on the cultural influence of information technology. Although many cultural studies focused on the differences between cultures, some studies on the impact of mobile communication across cultures proved that there were more coincidences than differences in the social acceptance and usage of mobile communication technologies. According to Castells (2009, 416 – 421) in *The power of communication*, the development of multimedia networks provided numerous business opportunities, such as access to global communication networks, free communication, product sales, customer services, advertising, etc.

Due to the increased use of Internet services accessed by mobile telephones, authors Meeker, DeVito and Wu (2010) in *Internet trends* forecasted that in the following five years more people would access the Internet through mobile phones than through personal computers. Vuojarvi et al. (2010) presented a case study devoted to notebooks in *Domestication of a laptop on a wireless university campus: A case study*. According to authors Humphreys, Von Pape and Karnowski (2013) in *Evolving Mobile Media: Uses and Conceptualizations of the Mobile Internet*, the evolution of the mobile Internet will depend on understanding and acceptance of technological innovation by the users and the supply of different services for different user needs, whereas ways of accessing information via the network depend on the situation at hand and the devices used. It is important to mention that the changes brought about by information technology in recent years have affected the technological and telecommunication development on the local, national, regional and global levels as described below.

### **3. An overview on technological and telecommunication development**

Technological and telecommunication development are highly interrelated. Technological development has facilitated telecommunication development through investments in infrastructure, availability, affordability and supply of telecommunication products and services via fixed and mobile broadband networks, which, as a result, raised global connectivity of users. The main advantage for subscribers, besides networking, is the availability of applications and services. The speed of fixed and mobile broadband telephony has grown, which caused the cost of services to fall, and made them more accessible to the general population.

According to recently published reports for 2011 and 2012, positive breakthrough was recorded in the technological and telecommunication development in almost every country in which measurements had been made. The gap between developed, developing and underdeveloped countries in ICT sector has remained almost unchanged in comparison with the previous reports. Special attention needs to be devoted to the availability of networks, distribution of products and services and provision of information to future subscribers in order to reduce this gap.

As indicated above, research on information technology and telecommunications conducted in the 20<sup>th</sup> century, as well as more recent research, focused on the new information trends on global, regional and national levels. It can be concluded that countries in which economic development is well coordinated with an appropriate level of usage and benefits of information and communication technologies have an advanced technology and telecommunications. Monitoring market demand, supply and profitability of technology and telecommunication products and services has become a priority in order to reduce the gap between the number of users in developed, developing and underdeveloped countries.

### 3.1. Indicators of technological development

International Telecommunication Union (ITU) is an organization established by the United Nations, inter alia, to monitor and process data in order to identify key technological and telecommunication trends, changes, benefits and costs in 157 member countries. The organization is committed to connecting people across the world as well as to protecting and promoting a fundamental human right – the right to communication. For the fifth year in a row, statistical and descriptive data on key global trends that create the modern information society have been published in an annual report *Measuring the Information Society*. One of the most important comparison criteria is ICT Development Index (IDI), an indicator of development, infrastructure availability and use of information and communication technologies in member countries, which is also an indicator of global technological competitiveness.

According to the official 2010 ITU report, over five billion mobile phone users worldwide have made mobile phones the most popular and fastest-adopted information and communication technology in history. According to the official 2011/2012 ITU report, positive results were recorded in the ICT development in almost every country in which measurements had been made; however the gap between developed, developing and underdeveloped

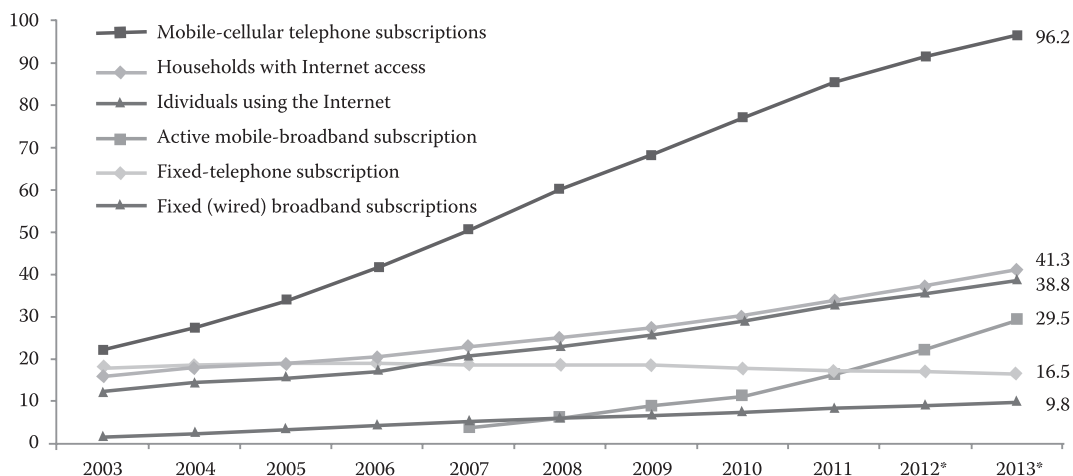
countries in this respect has remained almost unchanged.

**Table 2. ICT Development Index rankings (2011/2012)**

COUNTRY	RANK 2012	IDI 2012	RANK 2011	IDI 2011
Korea (Republic of)	1	8.57	1	8.51
Sweden	2	8.45	2	8.41
Island	3	8.36	4	8.12
Denmark	4	8.35	3	8.18
Finland	5	8.24	5	7.99
Norway	6	8.13	6	7.97
Netherlands	7	8.00	7	7.85
United Kingdom	8	7.98	11	7.63
Luxembourg	9	7.93	9	7.76
Hong Kong (China)	10	7.92	10	7.66

Source: ITU, *Measuring the Information Society 2013* (2013, 24)

**Figure 1. Global ICT developments (2003 – 2013)**



Source: ITU, *Measuring the Information Society 2013* (2013, 2)

As it can be observed from Table 2 showing ICT Development Index rankings (2011 and 2012), the Republic of Korea ranked first among the top ten countries in 2012 with a score of 8.57, as it did the year before. On the second place, with a score of 8.45, is Sweden followed by Iceland (8.36), Denmark (8.35), Finland (8.24), Norway (8.13), Netherlands (8.00), United Kingdom (7.98), Luxembourg (7.93) and Hong Kong, China (7.92). Minor changes are evident in the ranking of countries compared to the year before as well as an increase in IDI index scores in all countries.

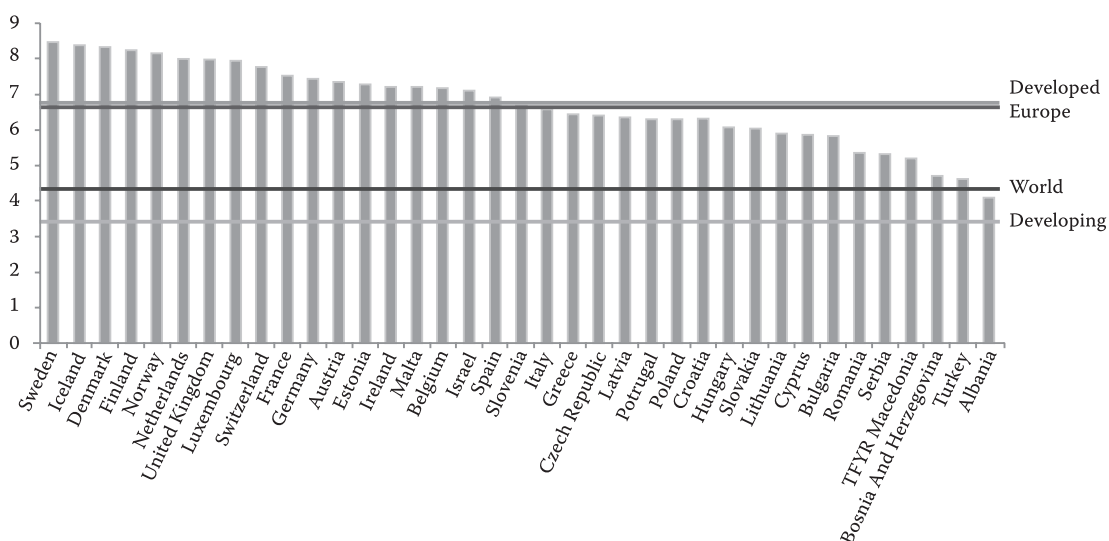
An annual report *Measuring the Information Society 2013* revealed that over 250 million people around the world have Internet access and over 40 percent of the world's population are using the Internet.

As can be observed from Figure 1. Global ICT developments (2003-2013), information technology and awareness of technological advancement have increased globally. Indicators show an increase in mobile telephone subscriptions to 96 percent at the end of 2013, with an average increase of about 40 percent per year between 2010 and 2013.

However, indicators show a 10 percent slower growth in fixed telephone subscriptions annually between developed and developing countries. The strong growth of mobile Internet users reflected on the growth in fixed access to the Internet, which has accelerated in the past three years mostly in developing countries reaching a global increase of over 40 percent at the end of 2013.

According to the official 2013 ITU report on IDI by region, Europe had the highest indicator of regional development of information and communication technologies in 2012 (6.73). In all European countries, except Albania, an indicator of development of information and communication technologies was above the world average (4.35), and in about half of the countries, this indicator was above the developed-country average. Eight European countries ranked in the top ten of the IDI 2012, as can be observed from the previous table and Figure 2 showing IDI values compared with the global, regional and developing/developed – country averages, Europe, 2012.

**Figure 2. IDI values compared with the global, regional and developing/developed – country averages, Europe, 2012**



Source: ITU, *Measuring the Information Society 2013* (2013. 67)



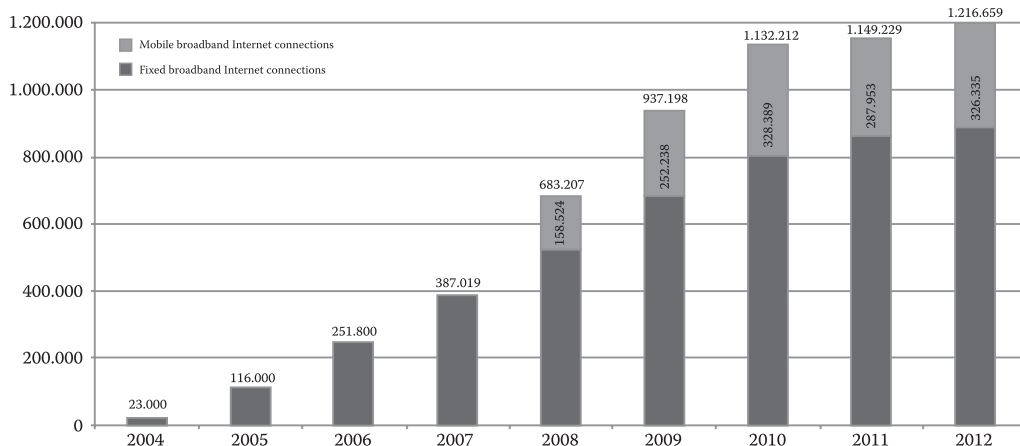
### 3.2. Indicators of telecommunication development

Significant progress has been made globally in terms of costs and benefits of fixed and mobile telephony. Fixed telephony prices have decreased globally by 82 percent in the period from 2008 to 2012 with major differences in the ranges of decrease in individual countries. Unlike in developed countries, where fixed telephony is profitable, it is still not profitable in countries with low standard. Mobile telephone services are still relatively expensive in many developing countries. Young people are the most active users of telecommunication products and services, as they account for 30 percent of all users. It is expected that the number of young users in developing countries will double.

According to the official ITU report *Measuring the Information Society 2013*, mobile technology and mobile telephone services continue to be key drivers of the information society with an increase of approximately two billion mobile broadband subscriptions. Significant positive developments have been observed in recent years in developing countries where double – digit growth rates have been recorded in fixed telephone subscriptions while in developed countries, this growth has slowed down.

Global progress in the development of mobile telecommunication networks is evidenced by two billion subscribers and a global coverage rate of 29.5

**Figure 3. Fixed and mobile broadband Internet connections in the Republic of Croatia (2004 - 2012)**



Source: HAKOM (2013)

percent in 2013, the fact that the number of subscribers in developing countries has doubled in the past two years and a global coverage rate of 50 percent of third generation mobile service users.

### 3.3. Indicators of technological and telecommunication development in the Republic of Croatia

According to the above rankings, the Republic of Croatia ranked 26<sup>th</sup> by region. Compared to other countries on a global level, the Republic of Croatia ranked 38<sup>th</sup> with an IDI score of 6.31. In 2011, Croatia ranked 34<sup>th</sup> with an IDI score of 6.14 which means that its ranking dropped by four places. Although, in relation to other countries in the region and in the world, the Republic of Croatia IDI value is below the regional average and the average of developed countries, the data proves that its IDI value is above the world average and the average for developing countries.

It is important to mention that significant breakthroughs were achieved in the technological and telecommunication development in the Republic of Croatia at the turn of the millennium in particular in terms of gaining its independence, as well as in the recent years, particularly in terms of Croatia's activities and responsibilities related to its access to the European Union. Accession to the European Union means that Croatia will probably undergo certain changes, i.e. improvements in the ICT sector.



As can be observed from Figure 3 showing fixed and mobile broadband Internet connections in the Republic of Croatia (2004 – 2012) according to the latest official data published by Croatian Post and Electronic Communications Agency (HAKOM) for 2012 indicating that the number of mobile telephone subscriptions was 4,971,351 and the number of fixed telephone subscriptions was 1,454,133. If we look at more recent data, Figure 3 also shows that the number of fixed broadband Internet connections is considerably larger than the number of mobile broadband Internet connections.

#### **4. Emerging challenges in technological and telecommunication development**

A large number of countries worldwide have recognised the potential of technological and telecommunication development. Furthermore, new communication trends have imposed global collaboration as the Internet has become a means for accumulating information. While more and more users become a part of the global information society, fast growing communication networks have become an essential infrastructure, while monitoring and measuring the changes in technology and telecommunications has become extremely significant in view of the future trends.

According to the assessment made by the ITU in relation to technological development, at the end of 2013, 2.7 billion people worldwide use the Internet, which also means that 4.4 billion people do not. Furthermore, at the end of 2013, 6.8 billion people worldwide were reported to be phone users, almost the entire world population. While telecommunications infrastructure capabilities for mobile phone services enable 100 percent signal coverage, not every single person has or uses a mobile phone. Therefore, a challenge for many international institutions is to identify non-users with the purpose of providing them with information, raising their awareness and removing other obstacles in order to maximize the utilization of existing telecommunications infrastructure capacities and facilitate global communication as the basis for strengthening connections and relationships in the modern information society.

The Internet is profitable if it is increasingly used and if the basic features of interactivity and unfettered communication remain important in the future. The focus has to be on technological and telecommunications literacy with the aim of achieving successful global communication connections and uniting the global information society. The priorities of policy makers should be advantages, activities and opportunities to improve access to broadband Internet services for potential future users and their awareness of the importance and benefits of using the Internet, particularly in the areas of health, education and job creation. On the basis of previous research it can be concluded that, in order to identify regulatory price reductions and increase subscriptions, targeted marketing policies should focus on monitoring the profitability of telecommunications and offering telecommunication products or services in order to reduce the gap between developed, developing and underdeveloped countries.

#### **5. Concluding remarks**

In order to explain the ongoing process of the development of new information society under the influence of information technology, it is important to mention that changes in social and economic spheres have affected new technological trends, telecommunication trends and economic development in many countries in the world. In order to further clarify the features of modern technological and telecommunication development, it was necessary to establish the historical origins of technological and telecommunication development stages. Although the origins go back further into the past, when many years ago technological and telecommunication development started, this paper focused on research published since the 1980s until the end of the millennium, as well as research published in the 21<sup>st</sup> century based on statistical review of recent official data.

Economic development has brought about new ways of private and business cooperation, cultural and intergenerational changes, new market trends, networking, improved competitiveness, tangible and intangible benefits, business and private development on local, national, regional and global levels.

Modern technological and telecommunication development is closely connected to the globalization processes that have significantly accelerated social and business changes. The global open market offers high standards of quality, efficiency, technological progress, striving for open world markets, deep international integration, knowledge economy and labour transparency, which has affected economic structure in the majority of countries worldwide. Under the influence of globalization and new trends in technological and telecommunication development, the new information age will have a direct impact on the global economic activity the benefits and consequences of which will be impossible to avoid and the only option will be to adjust to the changes.

As technological development entails the development of telecommunications, it was necessary to clarify the basic features of modern processes the aim of which is to establish a global information society by increasing awareness of the need to reduce computer illiteracy and improve the level of use of information technology and telecommunication products and services, mostly in developing and underdeveloped countries. Statistical measurement has its importance because statistically credible data confirm the discrepancy between developed, developing and underdeveloped countries.

Although the ICT development index (IDI) shows an upward trend, the discrepancy between individual countries is still evident. Technological development, mobile telecommunication infrastructure and technological capabilities are sufficient to reduce this discrepancy; however non-profit organizations need to develop new programmes and policies and implement systematic actions to enable individual countries to attain major improvements in the future.

Considering the unstoppable trend of changes in individual processes of technological and telecommunication development, the priority now is to raise awareness of the importance of investing in information technology. This will facilitate new economic trends which will create numerous business opportunities and possibilities for social progress, cultural and intergenerational changes bearing in mind that those countries in which economic development is well-coordinated with an appropriate level of usage and benefits of information and communication technologies have advanced technology and telecommunications. The focus has to be on increasing technological and telecommunications literacy in order to achieve successful global communication, establish new connections and unite the world in one global information society per se.

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Marina Budimir

## TEORIJSKI OSVRT NA TEHNOLOŠKI I TELEKOMUNIKACIJSKI RAZVITAK

### SAŽETAK

Mnogi će se autori, počevši od sredine druge polovice prošloga stoljeća pa nadalje, znanstveno i stručno početi baviti izučavanjem tehnološkoga i telekomunikacijskoga razvitka s pojavom promjena u poslovnim procesima i načinima svakodnevnoga privatnog i poslovnog ophođenja uvjetovanih posredovanjem i upotrebom tadašnjih novih medija i novih tehnoloških inačica u praksi. Tehnološki i telekomunikacijski razvitak u vrlo će kratkom vremenskom razmaku potaknuti značajne i sustavne promjene porastom potreba za prilagođavanjem kako bi se uhvatio korak s vremenom i konkurencijom, a što će potaknuti ozbiljnije bavljenje tom tematikom i problematikom s obzirom na prihvata, upotrebu, koristi i posljedice za svjetske ekonomije i društvo, ali i interdisciplinarni karakter međusobno isprepletenih područja uvjetovanih, uzrokovanih ili zahvaćenih tim promjenama.

Tehnološku i telekomunikacijsku prednost imaju one zemlje u kojima je uspješno usklađen gospodarski rast i napredak s odgovarajućom razinom upotrebe i koristi od informacijskih i komunikacijskih tehnologija, a što vrlo jasno statistički i deskriptivno prikazuju odgovarajući pokazatelji. Stoga će se u prvom dijelu rada pojasniti osviještenost potrebe izučavanja naslovne teme rada s osvrtom na objavljena istraživanja iz prošloga stoljeća i u novije vrijeme, dok će se u drugome dijelu rada pozornost posvetiti suvremenim tehnološkim i telekomunikacijskim trendovima u svijetu, Europi i domicilno, a biti potkrijepljeno statističkim pokazateljima objavljenima u najnovijim službenim izvještajima. Praćenje tržišnih potreba i profitabilnosti tehnoloških i telekomunikacijskih usluga postaje prioritet sa svrhom smanjenja raspona između broja korisnika razvijenih, zemalja u razvoju i nerazvijenih zemalja.

**Ključne riječi:** tehnološki razvitak, telekomunikacijski razvitak, informacijske i komunikacijske tehnologije