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Road Safety Management Model

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Abstract Traffic accidents are a serious problem in every society. Traffic safety is a science that analyzes road accidents with material damage, lightly injured, severely injured and killed persons. This paper proposes that road safety investment can be optimised by the development of a road safety management model. Road safety strategies typically include a basket of engineering, enforcement and education/training measures but there does not appear to be any management model which permits the optimisation of road safety investment. The proposed model utilises linear programming to predict changes in road safety resulting from safety interventions. It is mainly based on research in the areas of engineering and enforcement since there is little published research on the correlation between education and accident reduction. The model output provides the accident reduction and associated costs resulting from feasible road safety strategies. This should benefit policy makers when allocating resources. This example will be good experience for Traffic safety management system in the Republic of Macedonia.
Keywords Management, Model linear programming, Road Safety

JEL R42

1. Introduction

Traffic safety management is a systemic approach to reducing traffic accidents and the consequences of them. In any case, the positive experiences from the developed countries that have achieved a high level of traffic safety as the draft models for traffic safety management should be used. The three countries with the safest roads in Europe, Sweden, the United Kingdom and the Netherlands, implement comprehensive road safety strategies that involve local authorities, road users, emergency services, enforcement agencies, etc. Such strategies require a management system to optimize road safety levels. This paper proposes a linear programming technique to assist in the optimization of resources. Safety countermeasures that could be implemented in a road safety strategy are first examined. The selection of safety performance indicators is then discussed. Both safety countermeasures and performance indicators are then used in a linear programming model.

2. Road safety countermeasures

The three main approaches normally applied in road safety management are engineering, enforcement and education. It is considered that the success of road safety campaigns is increased through the implementation of countermeasures from all three approaches [1].

2.1. Engineering countermeasures

In the continuation will be shown separately in three tables countermeasures from the three subgroups.Engineering road safety interventions primarily relate to measures that involve the treatment of the roadway. These vary from new warning signs to road realignment or the installation of traffic calming schemes. The majority of Ireland's road network comprises of undivided two lane roads. This type of road presents the greatest accident risk to motorists; a recent study has shown that the fatal accident rate on undivided roads in Ireland is 9 times that on motorways [2]. Obviously it is not possible to upgrade all roads to motorways but there are many other engineering safety measures available. For example, if a considerable number of accidents involve vulnerable road users, traffic calming measures which reduce vehicle speeds and provide additional footways may be appropriate. A 'before and after' study of traffic calming schemes on Irish inter- urban routes found that the average accident rate reduced from 8 accidents per annum to 3.5 accidents per annum [3]. Typical accident reductions resulting from engineering measures are shown in Table 1.

Table 1. Typical reductions in accidents from engineering measures [4]

Countermeasure	% accident reduction
Installation of general warning signs	25
Upgrading of roadway delineation	15
Installation of no passing zone through delineation	40
Lighting of at grade intersections (overall)	30
Lighting of at grade intersections (night)	50
Installation of right-turning lanes	35
Installation of rumble strips	25
Improvement of road surface	25
Installation of crash barrier (fatal accidents)	65
Sight distance improvements	30
Improvement of horizontal alignment	40
Construct grade-separated interchange	55

2.2. Enforcement countermeasures

Enforcement has been shown to significantly reduce traffic accidents. Research in Ireland indicates that a 1% increase in the number of hours spent on police surveillance could yield a 2.6% reduction in the number of serious injury accidents [5]. The European Transit Safety Council estimates that 50% of traffic accidents could be avoided if road users complied completely with road traffic regulations [1]. If traffic violations were eliminated, it has been estimated that fatalities could be reduced by as much as 63% [6]. Three specific violations contribute considerably to accident fatalities, speeding, drink driving and seat belt use [7].

Table 2. Effects of manual and automatic speed enforcement.

Effect	Manual enforcement	Automatic enforcement
% Reduction in accident frequency	2 – 4	20 – 24
% Reduction in no. KSI* accidents	14 – 58	17 – 38
% Reduction in mean speed	3.6 – 4.5	4
Average speed reduction (km/h)	3.6	2.9 – 6.9
Distance halo (km)	1.6 – 3.5	1 – 10
Time halo (days)	1 – 63	not applicable

*KSI = Killed and Seriously Injured.

Excessive speed is by far the most prevalent traffic offence [1]. A considerable reduction in fatalities resulted from the introduction of penalty points for speeding in Ireland in late 2002. Unfortunately, this effect has since diminished due to a lack of enforcement. A number of studies have investigated the impact of enforcement on traffic accidents including the use of fixed and mobile speed cameras. Table 2 summarises the researched effects of both manual and automated speed enforcement.

2.3. Education countermeasures

Education including driver training is considered an essential component of road safety management and advertising forms part of most road safety campaigns. However, it has proved difficult to apportion accident reduction figures to education countermeasures.

3. Road safety performance indicators

Road safety can be assessed in terms of accident frequency and resultant costs but simply counting crashes or injuries can produce an imperfect indication of the level of road safety. For example, the under reporting of traffic accidents, as high as 50% for minor accidents and 25% for serious injury accidents in Ireland [2], can produce an apparent change in the number of reported accidents.

Accident counts need to be supplemented by other measurements that are causally related to crashes or injuries in order to indicate performance [10]. These additional measurements are referred to as safety performance indicators. Regular monitoring of such performance indicators can improve the understanding of road accident trends by providing a more complete picture of the level of road safety and by pointing to the emergence of new problems at an early stage. Some EU member states have shown that safety performance indicators can be used efficiently for monitoring the progress of road safety policies in meeting their desired targets and for permitting interventions where necessary [10]. The most commonly used safety performance indicators for road transport in Europe include speed measurement, seat belt and crash helmet usage and drink driving incidence.

Table 3 suggests performance indicators for the evaluation of Irish road safety. It should be noted that these performance indicators require further refinement.

4. Linear programming model

One of the central components of the road safety management process is the allocation of resources. It is suggested that linear programming can be used to optimise the road safety countermeasures. The objective of this model is to provide a system of road safety management whereby different road safety measures/strategies (inputs) are analysed and the resultant effects (outputs) are quantitatively estimated.

4.1. Scope of the model

The safety situation on a specific route is first quantified. The level of safety achieved through the implementation of selected engineering and/or enforcement road safety interventions is then estimated. The output generated by the model represents the expected magnitude of road safety in terms of accident severity and cost. Ideally, the model should also indicate if the proposed road safety measures are cost effective.

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4.2. Formulation of the model

The model operates on the basis of estimating the effectiveness of the selected input variables (road safety measures).

Table 3. Suggested safety performance indicators for Ireland.

Category	Subject	Indicator
Primary indicator	Distance travelled	Accidents/million vehicle kilometres of travel
	Fatality rate	Accident fatalities/100,000 population
Behaviour	Speed	% cars above legal limit % HGV's above legal limit Standard deviation 85th percentile
	Alcohol	% accidents between 21:00 and 03:00 % above legal limit
	Seat belts	% car occupants using seat belts
	Enforcement	No. of surveillance hours
Vehicles	Primary safety	% compliance with headlight and tyre tread depths
	Secondary safety	% cars achieving Euro-NCAP standards
Road	Road design and construction quality	% road network achieving Euro-RAP standards % motorways, dual carriageways and 2+1 roads % network safety audited No. of high accident locations
Vulnerable road users	Road construction	No. of traffic calming schemes
	Speed	% motorcyclists above legal limit
	Drivers	% learner drivers; % drivers under 25 % foreign drivers
Trauma management	Arrival time	% achieving response times

The effectiveness estimation apportions the expected accident reduction benefits to the road safety measures. These benefits are correlated with performance indicators so that outputs can be produced in relation to different road users and/or road categories.

A linear programme typically consists of two parts, an objective function and constraints. The objective function is an equation that defines the quantity to be optimised. In the case of road safety management, linear programming is used to maximise the average cost saved by preventing road traffic accidents (objective function) subject to the implementation costs, geometrical constraints imposed by the road and resource constraints.

The hypothesis is that a linear programme can represent the magnitude of the road safety situation by defining the effects of the implemented road safety measures. In combining the effects of different road safety measures and their corresponding constraints, a representation (model) of the level of road safety may be attained. Linear programming assumes that a problem can be approximated by linear functions. Therefore, the objective function and the constraints are assumed to be linear. Since the real situation seldom corresponds exactly with the model due to uncertainties and assumptions, sensitivity analysis of the optimal solution can indicate the quantitative effects of changing the constraints. Thus, the constraints which have the greatest effect on the optimisation of the objective function (minimising the cost of road traffic accidents) can be identified.

5. Conclusions

The above simple example was selected to illustrate the use of linear programming as a road safety management tool. Rather general assumptions were made regarding the effectiveness of the road safety countermeasures and the costs of the countermeasures were omitted. The simplex linear programming method was also used to determine the optimum combination of interventions, which can be expanded to include for further safety interventions. Sensitivity analysis can also be carried out to investigate the implications of increasing the level of countermeasure implementation. In conclusion, the proposed linear programming approach allows different road safety measures to be combined and their collective effect to be examined. This should be very useful in getting the best return from road safety resources.

The Republic of Northern Macedonia is a candidate country for the European Union. With the reforms made in all spheres and significant development, my country expects a date for negotiations in the near future. This means that more attention needs to be paid to reducing traffic accidents as a social problem. For this purpose it is necessary to establish a system of Traffic Safety Management.

Experiences from developed countries that are processed in the paper represent only one roadmap for implementing the model of linear programming shown. Certainly this model can not be used in full with the same countermeasures and parameters, but it should be adapted according to the conditions in the Republic of Macedonia.

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The Interested Parties in the Relationship "Business – Education" - Strategic Aim of the University of Telecommunications and Post

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Abstract This report examines the nature and specificity of the higher education interested parties. Systematized needs, expectations and interests of the University of Telecommunications and Post (UTP) interested parties are also presented. Particular attention is paid to the relationship "Business - Education", which has been very strong in the recent years. The need for partnership between the higher school and various business organizations - future users of staff is emphasized.

Keywords stakeholders, business partners, higher education

JEL M14

1. Introduction

Every organization, including in education, is an open system operating in a dynamically changing environment under the influence of many factors.

Powered by digital technologies [1], the requirements related to workplaces are becoming more flexible and complex. The ability of people to be enterprising, to process complex information, to think independently and creatively, to use intelligent resources, including digital, to communicate effectively and to be sustainable, is more important than ever [2].

In the context of the information society and the dynamic environment in which the higher education institutions are located is necessary to improve the educational process and the opportunities for introducing new models, methods and technologies in the education. This, on the one hand, is a prerequisite for the development of new curricula and programs and, on the other hand - creation of a practical environment, through the establishment of training centers in the educational establishments to take account of the changes in the labor market and to provide students with knowledge and competencies necessary for their professional realization.

It is essential for the educational institutions to properly identify their interest parties. Continuous collaboration and social dialogue between all participants in the training process allows the maintenance of adequate information on the labor market situation and the achievement of high results.

Integrating the interested parties into Governance and Strategy at the University of Telecommunications and Post (UTP) is a continuous process consistent with its goals.

2. Organization's Interested Parties

Interested parties (stakeholders) are individuals, groups of persons or organizations that affect and / or could be affected by the organization's activities, objectives, and policies [3].

Stakeholders may:

- ✓ affect the business of the organization;
- ✓ be affected by the business of the organization;
- ✓ be simultaneously affected by the business and affect the organization's business [4].

Integrating stakeholders into the organization's management, strategy, and activities requires their participation to be used systematically and regularly. Stakeholder engagement should be consistent with the organizational goals to improve organizational efficiency, results such as improved products and processes, better risk management, better reputation of the organization [5, 6].

Each organization has its interested parties (stakeholders), regardless of its size, nature, structure and purpose. They are classified into two main groups, internal and external stakeholders.

Internal stakeholders are those parties, individual or group, who are involved in managing the organization. They can influence and can be influenced by the success or failure of the organization, they know all internal issues, solutions, problems of the organization [7].

Internal stakeholders directly influence the organization's activities.

External stakeholders are those parties that are not part of the organization's leadership but indirectly affected by its

work, are not involved in the day-to-day activities of the organization [8].

3. Stakeholders of the University of Telecommunications and Post

The success of any organization, including higher education institutions, depends on proper communication with stakeholders and the ability to maintain long-term relationships with them.

Higher education institutions must meet the needs of the different stakeholders. The importance of external stakeholders increases when public funding for higher education is reduced. In this case, educational institutions should look for external funding from different national and international sources and thus cooperate more with external stakeholders. In such cases, they are responsible for a larger number of stakeholders [8, 9, 10].

Higher education institutions need not only to identify their stakeholders [10] but also to classify them to be linked to the strategic management of the educational institution. It is necessary to cooperate with partners and clients, which are important for the mission and future success of the higher school. Therefore, stakeholders should be described through the framework used in the institution's strategic planning [8, 11].

The internal and external stakeholders of the University of Telecommunications and Post are shown in Figure 1.

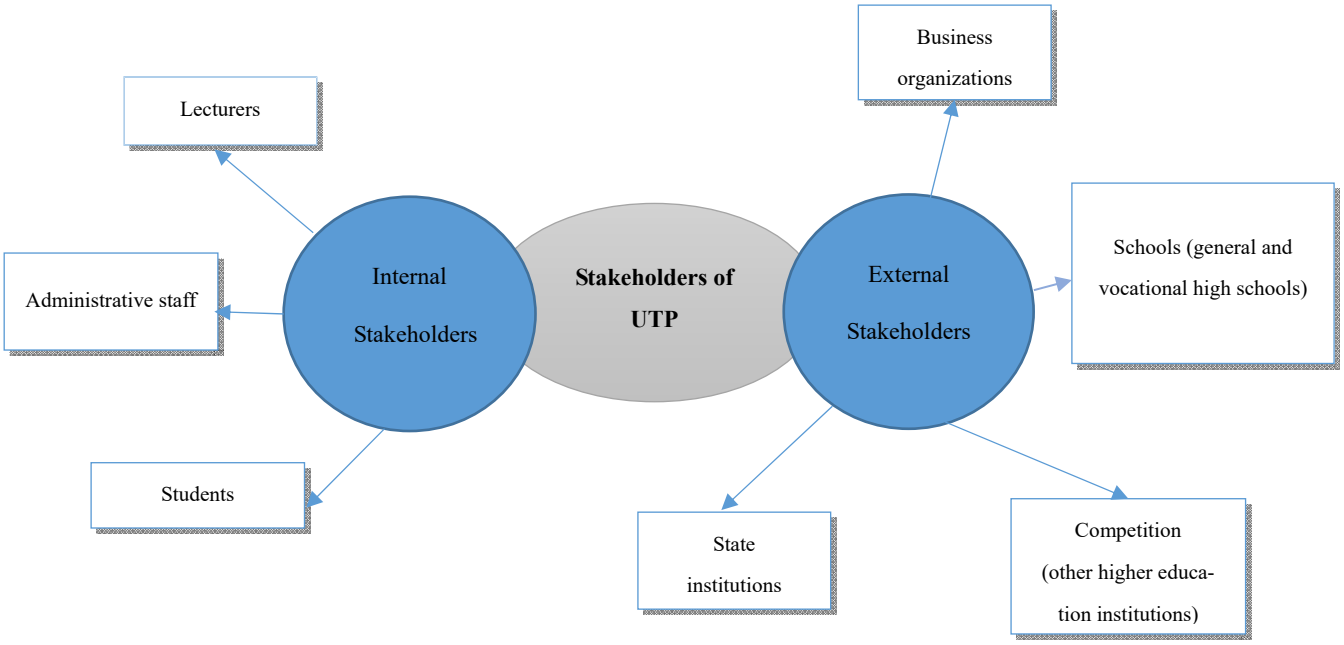

Figure 1. Stakeholders of the University of Telecommunications and Post

3.1. Needs, Expectations and Interests of Internal Interested Parties Involved in the UTP

✓ ***Students*** - The basic needs, expectations and interests of the students are: obtaining high quality education; continuous improvement of the material and technical environment necessary for the training; highly qualified lecturers.

One of the main highlights of each educational institution, including the UTP is the practical relevance of the learning process (during seminar and practical exercises) and knowledge in a real work environment. The aim is to increase the quality of the scientific and lecturing activity by engaging students in practical tasks and case studies, developing their analytical and managerial competencies for decision-making in practice situations.

This is achieved in two main ways:

- *the first way is*: conducting seminars with external lecturers (proven practitioners) with qualified lecturers in the field of science, through practical demonstration of processes and activities during the sessions, training on a program, developed by companies / institutions, creative training with business partners, etc.

- *the second way is*: an organization to involve students in practical activities and to build up knowledge and skills in a practical environment, by participating in the implementation of research projects and supporting their appearances in international forums.

In addition to receiving high-quality education, other expectations and interests of students as major internal stakeholders is the assessment of their achievements. Each educational institution needs to use mechanisms for organizing and conducting activities that stimulate the interest of the students in the research activity as well as dynamic and transparent feedback between teachers and students, including their professional realization.

✓ ***Teachers*** - the needs and expectations of the teachers are expressed in the following directions: ensuring healthy

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and safe working conditions; promotion of the professional development of the professional qualification and the academic career of the teaching staff by announcing competitions for different positions; creation of organizational, economic, moral and psychological conditions for active involvement of each lecturer in the process of development of the academic, scientific, research, applied and international activities of the higher school; achieving a level of educational, research and applied-applied activity consistent with both European and world standards and traditions in Bulgarian higher education; promoting innovative teaching methods.

✓ ***Administrative personal*** - improving of the internal processes, ensuring healthy and safe working conditions; use of appropriate forms of stimulation (tangible and intangible); creating sufficient and equal opportunities for professional development and qualification enhancement; organize training seminars to improve the qualifications of employees.

3.2. Needs, Expectations and Interests of External Interested Parties Involved in the UTP

✓ ***State institutions*** - compliance with the statutory state requirements; maintaining regular contacts with the institutions; compliance with legislative changes.

✓ ***Secondary schools*** - all general and vocational secondary schools, which are the main source of students. The main needs and expectations of these stakeholders are related to the support of the learning process in these schools, which is expressed in the possibility of practical exercises in the laboratories in the Faculty of Medicine; Continuous exchange of highly qualified lecturers between the two parties - Higher education and Secondary school; opportunities for realization of joint research projects; conducting educational and qualification courses for secondary school teachers.

✓ ***Competitors (other higher education institutions)*** - These are other organizations that are considered rivals and compete for the resources and the market. Competition between higher education institutions is expressed not only in the specialties in which they are trained but also in the process of attracting students, training fees, reception conditions. Specifically: Each university try to attract more university students. Each one of them should look for suitable methods for doing so. In the recent years, however, in the context of a demographic crisis on the one hand, and the increased interest of the graduates in the foreign universities on the other hand, it has become even more difficult for the Bulgarian higher education institutions. This necessitates the introduction of new models of education in the education system.

One way to do this is to create a research infrastructure, provide state support for participation in major international projects, encourage the participation of scientists from different institutions in joint projects [12].

✓ ***Business Organizations (personnel users)*** - the dynamic development of the society calls for an ever closer link between business and education. In this respect, today's expectations of the business organizations are far more different than 15 years ago.

Today, they include: Involvement of the business in the educational process, which is expressed in several main directions: participation in the learning process, transfer of expertise and practical experience; participation in curriculum discussions and curricula. The goal is to maintain an effective link between science, education and business in order to build quality professionals who are competitive on the labor market.

The main prerequisites for this are:

- dynamic development of information and communication technologies;
- continuous improvement and the generation of new knowledge and skills needs for the users of staff - private partners, and in higher educational institutions - the source of this staff;
- new opportunities and flexibility in joint initiatives with the business.

3.3. Benefits of Partnership between the UTP and Business Organizations

<u>For the high school</u>

✓ Obtaining advanced technology equipment and training materials and highly qualified business experts;

✓ Opportunities for the lecturers and students to get acquainted with the state-of-the-art service management systems, in particular in the "Messaging" sector, and to improve their knowledge in this area;

✓ Providing professional higher education, a good theoretical base and practical skills necessary for the future professional realization of the students.

<u>For the Business Partner</u>

✓ Close connection with future staff;
✓ Quick adaptation of new staff to business conditions.

<u>For both sides</u>

✓ Negotiation of internship programs and practical lessons in a real working environment;
✓ Creating a new training methodology, opportunities for co-innovation and scientific research developments;
✓ Conducting workshops and setting common goals and objectives;
✓ Development and implementation of joint scientific and educational projects;
✓ Continuous participation of companies in each of the stages in the development and updating of educational programs;
✓ Risk distribution between higher school and business organizations;
✓ Distribution of funds between higher education institutions and business organizations.

The relationship between the UTP as a source of staff and business organizations - users of staff is presented in the following figure (Figure 2).

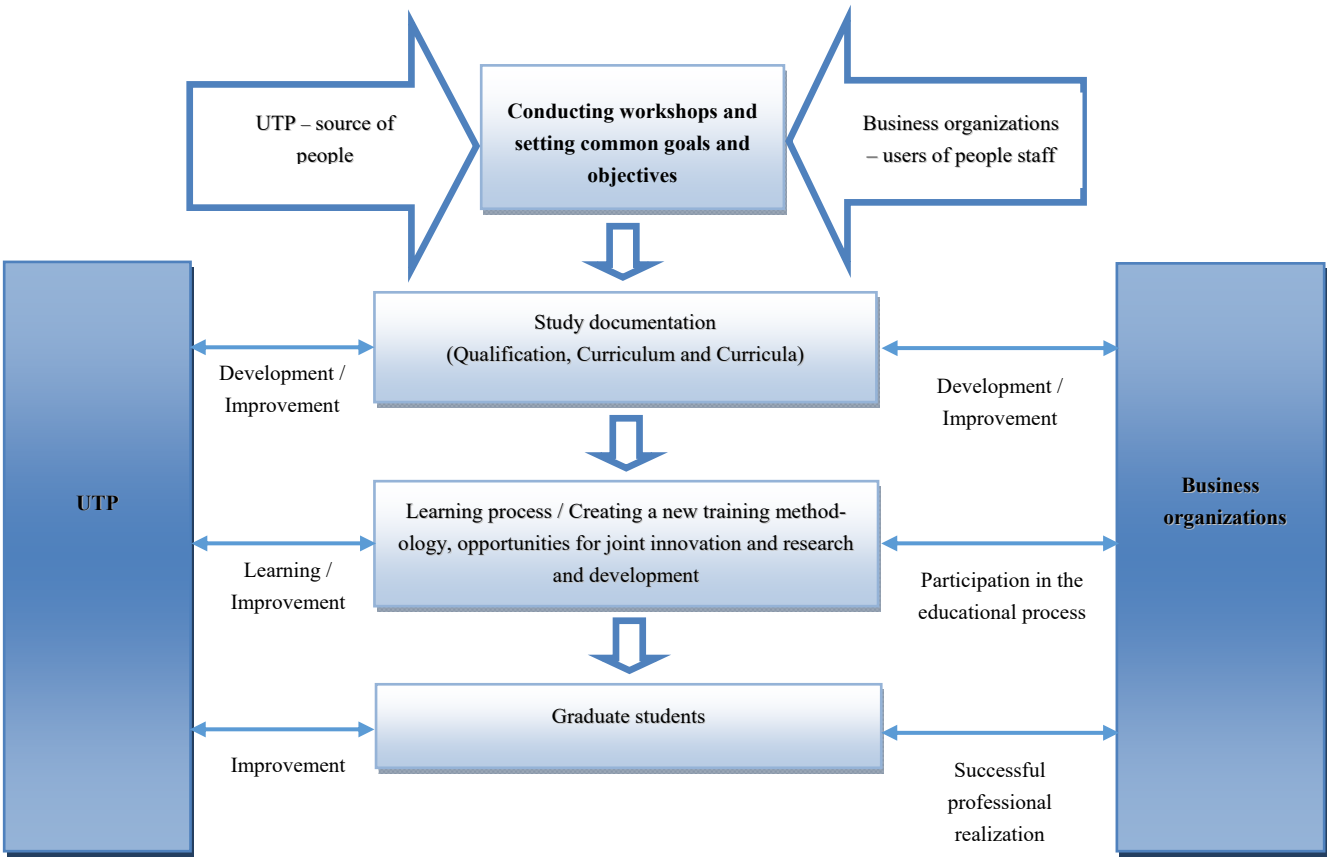

Figure 2. "Business – education" relationship at the University of telecommunications and Post

Particular attention is paid to the market-oriented education of students in all specialties and educational-qualification degrees.

An integral part of this training are the analyzes of the competitive environment, the multi-criteria assessments of the competitive environment on the basis of data on the learning process for each semester in specialties and so on.

A large part of the analyzes is devoted to the study of the interests of the students in the specialty as a whole, to elective disciplines and others. This is done on the basis of periodic surveys among students, lecturers, employees and staff members.

Part of the UTP's strategy is to study the business partners' views on the preferred forms of partnership between the two parties. In conducted surveys among organizations in the communications sector (financial institutions, courier operators, logistics companies, telecommunication companies), the business's desire for close contact with students is noted throughout the training period in various forms (Table 1). During the period considered, the following were investigated: 2016 - 13 organizations 2017 - 21 organizations; 2018 - 16 organizations.

Table 1. Forms of partnership between the UTP and the business[1]

What forms of partnership between business and university would you suggest?	2016	2017	2018
Paid student internships during the last two years of training	5	9	8
Annual "Open Days" in the professional organization for students	3	8	4
Annual meetings with graduating students for professional perspectives and job positions	3	3	7
Provide mentoring during practical training and student internships	2	3	4

It is essential for the higher education institution that the various business partners periodically give their knowledge and competence request to graduating students according to the contemporary needs on the market in the management, information and communication technologies (Table 2)

[1] It is possible to indicate more than one answer

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Table 2. Current of the educational content

Do you think that the disciplines studied and their content are adequate to the contemporary requirements of the practice?	2016	2017	2018
Yes (%)	50,0	76,9	90,5
No (%)	10,0	7,7	0,0
I can not decide (%)	40,0	15,4	9,5

The results of the conducted surveys clearly show the high level of interest of the employers, as well as their high assessment of the level of training of the young specialists from the UTP, compared to that of the graduates of related higher schools.

These results serve as a guide to improving the quality of the learning process and the educational documentation in the higher school.

4. Conclusions

The business-education relationship at the University of Telecommunications and Post is strong, allowing adequate information on the state of the labor market to be maintained.

The constant development of contacts with business organizations in turn allows higher pragmatism of education and successful realization of staff.

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Entrepreneurship Skillset Build-up in the Conditions of the Fourth Industrial Revolution

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Abstract In the conditions of fourth industrial revolution, it is very difficult to find new entrepreneurship ideas and windows. This paper delves into the modern ways to do entrepreneurship like digital, green, medical, educational, social, creative or art. Some creative and critical thinking techniques for entrepreneur windows are discussed and their implementation in education has been drawn. They include lateral thinking, the six thinking hats, simplify and their suggested usage for classes as role-playing games, puzzles and quizzes. A connection between leadership, entrepreneurship, innovation and creative thinking has been drawn. On that basis, a conclusion about usage of creative thinking techniques in educational centres to build up entrepreneurship and leadership skills has been done.

Keywords Entrepreneurship, critical thinking, leadership, education.

JEL I25, O31, L26

1. Introduction

In modern age society, it is very difficult to find new ideas for entrepreneurship or to start up business. New technologies and researches in every field make it very hard to find something new or to exploit the given resources with new methodology. As it has been considered entrepreneurship to be the fourth main resource in the economy with land, labour and capital being the other three. Nowadays, entrepreneurship has become more and more difficult and it has moved to pivot role for economic growth.

According to some researchers, Entrepreneurship is the ability to search and exploit the changes, create, innovate and be willing to take the risk, which can make old industries obsolete [1, 2].

Some of the key personal attributes for it are:

- ✓ Creativity as the spark that drives the development of new products or services, or ways to do business;
- ✓ Dedication as what motivates the entrepreneur to work hard, more than 12 hours a day;
- ✓ Determination as the extremely strong desire to achieve success;
- ✓ Flexibility as the ability to move quickly in response to changing market needs;
- ✓ Leadership as the ability to create rules and to set goals. It is the capacity to follow through to see that rules are followed and goals are accomplished [1], [3].

These attributes come from a different background – cultural, historical, economical status of the country and so on, but they can also be acquired which means skillset buildup.

The main goal of this paper is to create a framework for entrepreneurship skillset buildup for the purposes of educational institutions and to provide them with some ideas and insights about teaching techniques and methodologies. They include lateral thinking, the six thinking hats, simplify and their suggested usage for classes as role-playing games, puzzles and quizzes, digital skills.

2. Material and method

2.1. Methodological framework

The attributes required for entrepreneurship very often come from personal background, but it is not enough just to have them, you need to develop and deploy them. To do it you need to start from early age development. This is possible with the right education, which is the core for the methodology – a framework for building some key entrepreneurship skills by facilitation in classrooms or educational centers.

The main skills to build up with this methodology are as follows (see fig. 1):

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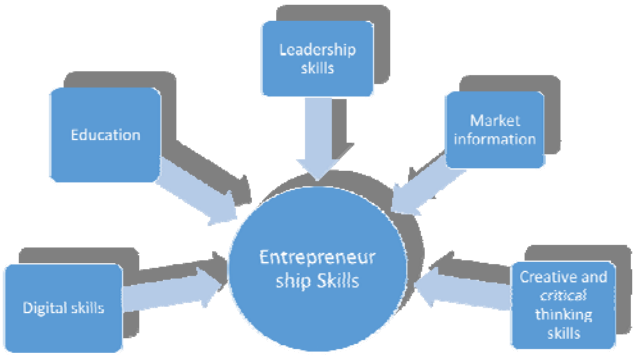

Figure 1. Entrepreneurship skills

As evident from figure, there are five entrepreneur skills considered to be build up – digital skills, education, leadership, market information, creative and critical thinking.

On the one hand, Education seems a bit odd here, but it is actually the connection between them. The main idea is presentation and implementation of the other skills via change in the educational pattern, introduction of some creative or critical thinking games, puzzles and emphasizing on digital and leadership skills.

On the other hand, same goes for market information but its importance is in possibility to gain new ideas for starting up small business or entrepreneur windows. In more detail it would be described in the following section.

2.2. Market information

As mentioned market information could be the source of new ideas for entrepreneurs so it is very important such information to be distributed to students especially in business management classes or innovations. There are many examples, like [4]:

- ✓ Digital Entrepreneurship - a combination of traditional entrepreneurship with a focus on new technologies, opportunities created by these technologies and new business forms. Digital startups are characterized by the use of a variety of new technologies, social media, big data analytics, mobile cloud services, predictive analytics;
- ✓ Social entrepreneurship - this is a different way of doing business that mixes the ingenuity of business with a social mission (Non-profit), skillfully combining and balancing social and economic goals (for example Private rehabilitation center);
- ✓ Green entrepreneurship or "eco" entrepreneurship is an economic activity that deliberately addresses an environmental problem and / or need by implementing an entrepreneurial idea that has a positive effect on the environment and at the same time is financially sustainable. Green entrepreneurship is directly linked to social entrepreneurship in view of the fact that it is working for a social cause in the field of ecology.
- ✓ Entrepreneurship in the field of education is the start and development of a business related to the learning process of children, young people or adults. Well-known examples of such entrepreneurship are learning centers where a teacher conducts a course to a small group of students. Recently, many innovative companies and associations have emerged based on informal learning methods.
- ✓ Creative or art entrepreneurship is in the fields of music, theater, fine arts, dance, animation, cinema and other creative industries. For example, "Grozen Entertainment" is a Bulgarian cultural organization, a 2D & 3D animation and comics, a publishing house and an educational center, whose activity is focused on popularizing the quality of Bulgarian art world-wide and the best Bulgarian authors of comics, illustrators, designers and animators.

This type of information about the market and the examples of successful entrepreneurs could inspire young people to put their own ideas into practice. It is advisable to use examples from your own country so it is easy to relate to them. If possible - invite entrepreneurs into classes to explain about their idea and how they put it into practice.

2.3. Digital skills

Each According to some researchers, in the near future 65% of the existing jobs will be very different as a result of technological developments, and individuals should develop their skills and competences in order to remain competitive in the digital economy [5]. Furthermore, in the European Union the need for IT professionals with competences to sustain innovation and competitiveness in the world market is growing rapidly. They will have to face the challenges of the fourth industrial revolution and the high-tech economy, which can be described as: the combination of interrelated digital technological decisions assisting the development of the automation, the integration and the exchange of data in real time in the production processes, delivering several times higher norm of added value compared to the traditional economic system [5].

On the other hand, digital skills is essential in supporting management in the following areas [5]:

- ✓ analysis and processing of big data and real-time decision-making using information and analytical systems with in-built artificial intelligence, which leads to a greater flexibility in process management, reduction in the time needed for managerial decisions, and as a result to reduction in the cost of the produced items;
- ✓ dynamic organization of business processes in terms of quality, time, risk, durability, price, and environmental impact, which leads to reducing the cost of production of each item as a result of reduction in expenses for resources, energy, labor, and time needed for production;
- ✓ continuous optimization and adaptation of the production capacities with in-built artificial intelligence, leading to reduction of the expenses for resources, energy, polluting emissions, and thus of the costs of the production;

✓ handling individual and specific orders reflecting customer requirements in terms of design, configuration, order, planning, production, functioning, deadlines and changes in deadlines, which is linked to increases of production of specific individual orders, thus leading to a greater competitiveness and market stability for the business organization.

These are the reasons for digital skills to be considered as very important asset to the entrepreneur's skillset and they should be involved more in the education. Moreover, universities should imply more computer based courses for Business management, Public administration and Economics curriculums. Thus, leading to mixture of IT engineering and management which is necessity in modern age education.

2.4. Leadership skills

Leadership skills, which a co-related to the entrepreneurship as mentioned, are the ability to set goals, create rules and follow through or in other words to plan, organize and control assets and management of business processes. This is familiar to us leadership which takes place from inside outward, but today the conceptual doctrine of leadership is changing radically due to global challenges and increased competition. The new type of leadership is digital and it evolves in the digital environment, does not require communication face to face and appears from the outside to the inside environment [5]. It is based on three core skills (see fig. 2):

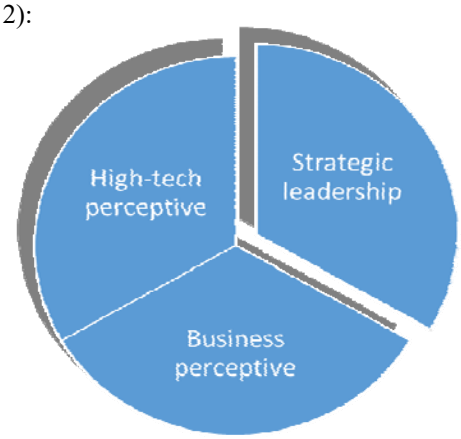

Figure 2. Core digital leadership skills

Firstly, strategic leadership involves leading international team and influencing employees, customers, suppliers, investors, shareholders, society. To comprehend it, you need knowledge for: management, controlling, finances, logistics and abilities for: searching and analyzing data, planning, finding optimal solution, communication, motivation [5], [6].

Secondly, the business perceptive includes ability to innovate business and operating models to realize high added value for the company. This requires knowledge for: market and marketing strategies, business analysis, innovations and abilities for: analyzing the environment, processes and operations, building and maintaining customer relationships, process optimization and so on [5], [6].

Finally, High-tech perceptive is the ability to envision and drive change for business performance, exploiting the innovation opportunities in high-tech trends. To fulfill it you need knowledge of: information technology tools, complex business systems, artificial Intelligence, Internet of Things, Cloud technologies, virtualization and so on [5], [6].

All of the core digital leadership skills should be developed and implemented in the educational system so pupils would be able to satisfy labor market needs. The implementation might be by interdisciplinary or/and multinational group tasks from cooperating universities or educational centers which would allow students to participate in dynamic environment and to train their digital communication, project management and problem solving skills.

Another way is by creating more competitions on national level for e-commerce business models with the condition of mixed teams between universities or educational institutions which will allow collaboration between students with different background.

2.5. Creative and critical thinking skills

Creative and critical thinking are very important for finding solutions or puzzle solving which is co-related to entrepreneurship with the skill for finding new market opportunities and designing new products. Moreover, organizations and their leaders need not to allow success to blunt the drive for innovation, a never-ending race. Managers in every organization have a responsibility for initiating and directing change in addition to their regular objectives. Everyone has the shared responsibility of changing the organization to make it better equipped to meet the needs of its customers, and of keeping finding innovative ways to deliver its products or services [7]. Thus, leading to necessity to improve creative and critical thinking skills.

One way to do it is by the so-called "Lateral thinking" a term created by E. de Bono in 1970's which corresponds to methods and techniques for new approaches to problems [7]. There are many related to this type of thinking skills puzzles, which could be implemented in schools, educational centers or universities as part of entrepreneur courses. For example (the subway problem) [7]: "A large city in the United States had a problem with thefts of light bulbs from its subway system. Thieves would unscrew the light bulbs, leading to cost and security issues. The engineer who was given this challenge could not alter the location of the light bulbs, and he had very little budget to work with, but he came up with a very lateral solution. What was it?"

Sometimes lateral puzzles could be solved as a group game in which the facilitator gives small piece of information to the participants (main puzzle idea) and then gives the opportunity to each participant to ask him/her questions related to the puzzle with "yes" and "no" or "not related" answers. At the end all the questions and answers should reveal the puzzle. This game could benefit students' critical thinking, out of the box thinking and problem solving skills.

Another approach is the so called "six thinking hats", it can be used as role-playing interactive game for students. The basic idea is to distribute different roles to a small group

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for a project or problem solving via the color of their hat and they have to focus their thinking on specific threat, like:

- ✓ White hat, concentrate on the information. Decide what information you have and what you can learn from it. If you find any gaps try to fill them;
- ✓ Red hat, look for a solution using intuition, instinctive reactions and emotions. Try to think about how others will react emotionally and seek to understand the intuitive reactions of people who are not fully aware of your considerations;
- ✓ Black hat has pessimistic, cautious and defensive view. You are trying to understand why ideas and approaches may not work. This is important because it reveals the weaknesses of the plan or its implementation;
- ✓ Yellow hat suggests an optimistic view that helps you see all the benefits of the solution and its value, and discover the opportunities that flow from it;
- ✓ Green hat, think creatively and develop creative solutions to the problem. Thinking is free and ideas are not criticized;
- ✓ A blue hat is related to process control. It is worn by the group leader. This person can direct group to think in one way or another, change the hats of the others and so on depending on the needs [8].

The six hats could be implemented in classrooms for group tasks which would help students build critical and creative thinking skills.

The other possibility is the method "Simplify" - a process aimed at turning the complex solutions into simple and clear ones, by creating the right order of things.

This leads to the following results:

- ✓ Identifying and stopping things that are no longer needed;
- ✓ Eliminating unnecessary duplication and complexity;
- ✓ Challenge every aspect of the organization in constructive and effective way;
- ✓ Reducing unnecessary duplication of effort to increase return on investment (ROI);
- ✓ Removing barriers to increase the satisfaction of employees and customers;
- ✓ Empower employees to think through new ideas faster, leading to faster market innovations [8].

In educational field, this technique could be implemented by individual or group complex tasks and with the guidance of the teacher or trainer, the students would have to simplify it. Moreover, it could be combined with lateral puzzles because some of them are related exactly with simplifying.

3. Results and discussion

The aforementioned methods are not something new in terms of brain trainings for creative, critical and out of the box thinking. Moreover, they are familiar to educators, but not taken so much into consideration for preparing classes, especially in Bulgaria. They should have higher role in the educational system for changing the paradigm from passing and repeating information to more interactive way of doing it. Creativity and open mind are crucial for developing entrepreneur ideas and critical thinking is useful for putting it into practice so having more such of kind interactive classes in the educational system would benefit students and help them build entrepreneur skills or to be more willing to express their own ideas.

Besides critical and creative thinking, digital and leadership skills are also considered to be very important part of the entrepreneur's skillset. On one hand, digital skills are already considered to be one of the top priorities in education due to the rapid increase of the market requirement. This changes the focus of Business and management curriculums not only in their field but also involving more IT based classes. Thus, leading to the higher demand of educational institutions to open more computer labs in which IT business classes could take place. That kind of labs could find some support for the private sector. According to the European commission report from 2017, around 48% of the experts agree that private sector should initiate effort to improve high-tech skills in their employees and managers and 44% are willing to fund such kind of training courses [6].

On the other hand, the fourth industrial revolution demands new type of leaders – ones with business and high-tech savviness in addition to their leadership skills. According to the European Union agenda for digital leadership there is a need for:

- ✓ Integration of high-tech savviness in formal education (nearly 60% of experts participating in the survey agree);
- ✓ Promotion of training course for high-tech skills for managers (about 53% of respondents agree) [6].

This is enough evidence to prove the necessity of collaboration between leadership and digital skills build up in the formal education system.

For many years, entrepreneurs have been considered as the important link for every community's economic growth and as the world changes the set of skills needed for entrepreneurship changes, as well. Nowadays, as evident it is necessary to have good and creative ideas alongside leadership qualities, business knowledge and high-tech savviness. All of these skills could be built up or enhanced in the educational system. In addition, market information could serve as guideline for entrepreneur ideas and business startups. However, in many cases entrepreneurs fail sustain their business in the market, but they don't give up and try again which is also considered as part of being a good leader. This type of failure should be included in entrepreneur classes as a symbol of being more determined in following business path and striving for success, because it won't come easy. Good examples inspire and bad ones teach important lesson.

4. Conclusions

In the conditions of the fourth industrial revolution, being an entrepreneur and successful business owner requires

many qualities, but the main attributes are creative and critical thinking, digital skills and leadership. Building up such kind of skills in formal education would be crucial for generating the new wave of entrepreneurs, who will lead the economy growth and the future stability of each country. Every educational institution should focus on the ways of developing those skills with a collaboration with private organizations.

Despite being known for many years, the creative and critical thinking techniques like the six thinking hats, lateral puzzles and simplify could be implemented successfully in modern education.

Collaboration between digital skills and business training is the future of Business and administration curriculums towards the development of the digital leaders for the conditions of the fourth industrial revolution.

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Digital Transformation of Postal Operators – Challenges and Perspectives

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Abstract The postal operators are facing unavoidable digital business transformation in the era of the digital economy, Industry 4.0 and innovations. The rise of digital technology over the last 30 years has created both threats and opportunities for the postal industry. Digital transformation of companies and correspondence is having an impact on the core business activity of postal operators. Nowadays, electronic communications impact all of postal operators businesses. The volumes of physical letters have been decreasing substantially, particularly in the last couple of years. Obviously, this leads to loss of revenue. At the same time digital innovations, e-commerce, data collection, and digital identity have been at the heart of postal operators' efforts to propose new services, spawn efficiencies, and adapt their organizational culture and strategy to the needs of the digital economy. These tendencies require a different postal infrastructure as well as different skills and patterns of employment for postal operators. Hence, the digital transformation has become a strategic priority for postal operators. Although postal services play a vital role in connecting people, businesses and government across the world, the postal industry is grappling with its greatest challenge yet: digital disruption.
This article dealt with the opportunity and challenges faced by postal operators in age of digital transformation. It focusses on main drivers of digital transformation and the dimensions of digital transformation in postal services sector. Based on own study a penetration rate for postal e-services in Bulgaria is presented. The results show that extent to which postal operators in Bulgaria are offered e-services is far from fully exploited across the entire network. Based on the results digital strategy priorities of postal operators are proposed.

Keywords Digital Transformation, Postal Services, E-postal Services, Digital Business Strategy

JEL L81, L86, L87

1. Introduction

Digital transformation of postal operators refers to the adoption of digital processes and tools to achieve strategic business goals. Digital transformation can be defined as a complex, multifaceted process that represents a massive cultural shift in the workplace and changes that affect every part of an organization. The process of digital transformation is different in every organization.

The postal operators are facing unavoidable digital business transformation in the era of the digital economy, Industry 4.0 and innovations [1]. The rise of digital technology over the last 30 years has created both threats and opportunities for the postal industry. Digital transformation of companies and correspondence is having an impact on the core business activity of postal operators. Nowadays, electronic communications impact all of postal operators businesses [2].

The volumes of physical letters have been decreasing substantially, particularly in the last couple of years. Obviously, this leads to loss of revenue. At the same time digital innovations, e-commerce, data collection, and digital identity have been at the heart of postal operators' efforts to propose new services, spawn efficiencies, and adapt their organizational culture and strategy to the needs of the digital economy. These tendencies require a different postal infrastructure as well as different skills and patterns of employment for postal operators. Hence, the digital transformation has become a strategic priority for postal operators.

Although postal services play a vital role in connecting people, businesses and government across the world, the postal industry is grappling with its greatest challenge yet: digital disruption.

This article dealt with the opportunity and challenges faced by postal operators in age of digital transformation. It focusses on main drivers of digital transformation and the dimensions of digital transformation in postal services sector. Based on own study a penetration rate for postal e-services in Bulgaria is presented. The results show that extent to which postal operators in Bulgaria are offered e-services is far from fully exploited across the entire network. Based on the results digital strategy priorities of postal operators are proposed.

2. Postal Services in the Age of Digital Transformation

Postal services have existed for over two thousand years and have a significant role in the economic development of all countries. Postal services are of crucial importance to businesses and citizens alike. Postal services around the world play a critical, daily role in keeping countries, economies, and people connected.

The postal sector is viewed in the European Union (EU) as an important means of communication and trade, particularly important from the economic perspective. The postal sector is a key contributor to the European economy. Nowadays postal industry in Europe employs more than 2 million people and connects more than 800 million people daily. Postal sector generates turnover of more than 150 billion euros and about 1% of the European Union Gross Domestic Product [3].

During the last three decades, the postal sectors in the EU member states have faced two main trends. On the one hand, markets have been fully liberalized. On the other hand, traditional postal services have been subject to an increasing competition from electronic substitutes. Nowadays the advance in Information and Communications Technologies (ICTs) are blurring boundary between the delivery of communications via physical and electronics means. Digitalization has impacted the development of postal markets across the world [4]. Digitalization has changed the role of the postal sector as letter volumes decline and parcel volumes grow. Whereas letter volume decline has shaped the postal market and continues to drive changes, the advances in ICTs create new opportunities and demands for the postal market. The combination of strong letter volume decline and growth in parcel volumes has important operational and economic implications for postal networks.

In response, postal operators have diversified into a broad range of new service areas. In fact, revenue from non-letter activities such as parcels, financial services, logistics and retail exceeded that of traditional letter revenue for the first time in 2014. In 2018 letter mail accounted 42% of postal industry revenue, at the same time the growth in parcels revenue is more than 14% [5]. New postal services revenue opportunities span government services, authentication, freight, customs brokerage, data collection, payments, etc.

E-commerce trade is one of the major drivers of the global postal services industry. Today, postal operators are an integral part of the overall e-commerce experience, as the delivery services are a critical element of the e-commerce customer experience. Postal operators offer a vast range of services to meet the needs of all customers, embracing online and mobile technologies to provide competitive and convenient postal services.

E-commerce has grown at significant rate at all EU member states. Average growth rate was 14% per year for the last five years. Dynamic growth was facilitated by technological development, harmonization efforts within the EU, sopping software in different languages, international online payment services, etc. At the same time increase in e-commerce creates new jobs in postal industry. The overall employment in postal sector was more than 2 million in 2018, and annually increased by 0,5% on average between 2013 and 2018.

The continued growth of e-commerce is fuelling growth in parcels in postal networks both domestically and internationally as well as in the networks of the integrators and increasing number of private postal operators.

The changes in the postal market require that the postal operators have to develop their postal networks into different directions. Many of the postal operators have replaced their traditional post offices by outsourcing and franchising of post offices to third parties, and leveraging their post office infrastructure to enter new markets, e.g., financial services, insurance services, or high value retailing.

Postal sector has the largest integrated distribution network (with more than 660 000 post offices) in the world and can physically connect everyone around the world. At the same time postal sector is the second largest contributor to financial inclusion. In many countries the postal network is the largest network in the rural areas and it ensures the provision of financial, communication, logistics and other retail and government services [6].

Electronic substitution of traditional postal services is accelerating as both consumers and businesses adopt electronic processes across multiple domains. Now customers are attracted to greater convenience, faster service, and lower cost [7]. In the conditions of digital economy postal services need to modernize theirs role to accommodate for the digital age. Postal operators should offer new products and services that reflect the evolving mandate to bind the nation together in a new world where people are increasingly communicating digitally.

In the conditions of digital economy it is important to understand how the sector has evolved historically. There are four main phases in the process of digitalization of postal sector (Figure 1).

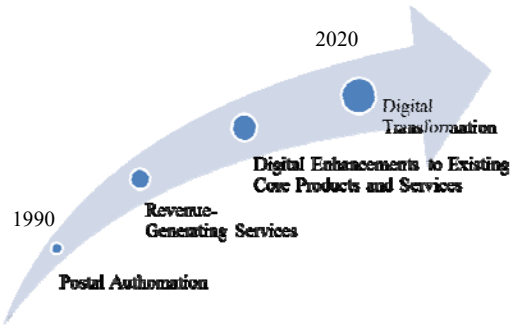

Figure 1. Phases of Digitalization of the Postal Sector

In early 90`s the efforts of postal operators were mainly focused on rationalizing and automating sorting centres.

The second phase was the phase of creation of new revenue-generating digital services. Most postal operators started to offer trust-based services like certified electronic communications, online identity verification, secure electronic mailboxes, online payment, government services platforms etc.

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As broadband penetration, Internet and ICTs use increased in the early 2000s in the third phase the core postal business was changed. The objective of postal operators was to expand customer access to postal services and to create new services at the intersection of physical and digital. Some of the so called core-enhancing digital postal services are support to e-commerce, e-finance and payment solutions and other support services.

The last phase is the phase of Digital Transformation. Digital transformation is not about any particular function. It is a fundamental organizational change that comes from advances in technology, process, culture, and business model. It is about converting an organization wholesale into an information enterprise, where connectivity, cloud, and analytics can enable faster innovation and more informed decision-making.

The impact of digitization is not new, but the digital economy is entering a new phase that presents new challenges and opportunities. Digital tools are changing how postal operators are structured and how they communicate, and sell. This has triggered the digital transformation of the postal industry. The drivers of digital transformation in postal sector are summarized at Figure 2. Some of them, such as broadband Internet, mobile and social networks are long-term trends that started at the turn of the century. Others, such as the Internet of Things or Big Data, embody a new phase that will increasingly impact postal strategies in the coming years [8].

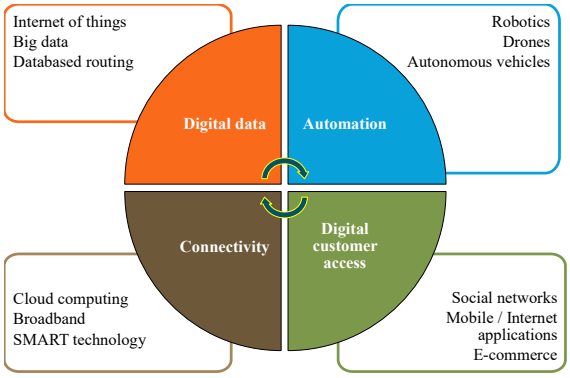

Figure 2. Drivers of Digital Transformation in Postal Sector

The impact of digital transformation in postal sector is summarized in Figure 3.

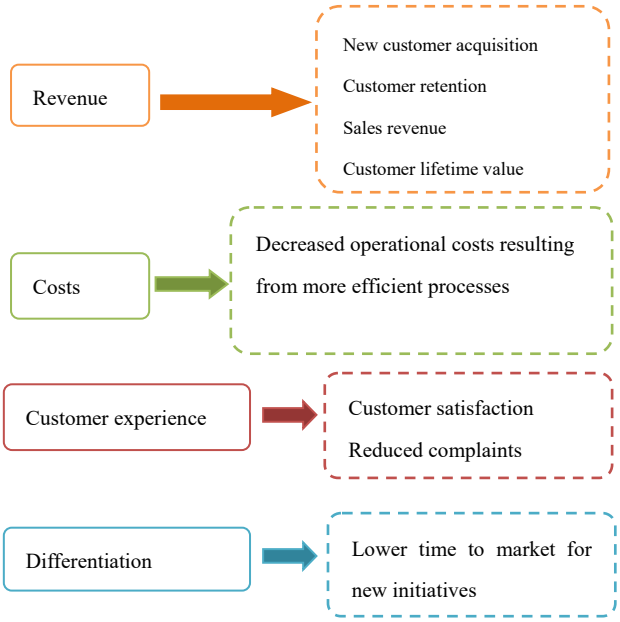

Figure 3. Impact of the Digital Transformation in Postal Sector

Thanks to digital transformation, postal networks are becoming increasingly complex, as are the services delivered by them. Customers expect a postal network that scales to their needs, offers innovative digital services and is highly engaging. To meet this challenge, postal operators must embark on the journey to be a fully digital.

3. Penetration Rate for postal e-services in Bulgaria

The postal electronic services (e-services) are services delivered by postal operators to their end-customers (individuals, businesses or governments) through digital channels. By the end of 2018, 93% of postal operators worldwide provide e-postal services, either directly or in partnership with other companies [9].

Universal Postal Union (UPU) classifies the electronic postal services into four groups: e-post and e-government, e-finance and payments solutions, e-commerce, and support services.

E-post and e-government services are communication, business and government services delivered to customers via ICTs means. This group encompasses the following services: Postal electronic mailbox, Online direct mail, Postal registered electronic mail, E-cards, Online bureaufax, E-invoicing, Hybrid mail, Reverse hybrid mail, Online facilitation of hybrid mail, Electronic postal certification mark, Digital signature, Digital identity services, Credentialing services, Digital archive, E-health, E-administration: online ordering/applications/ registrations.

E-finance services are financial services provided by postal operators to end-customers using ICTs. This group encompasses the following services: Online account management, Electronic remittances, Online bill payment, Payment solutions, Escrow services for e-commerce.

E-commerce services consist of buying and selling products and services using ICTs. It involves processing and delivering items purchased physically or electronically. This group encompasses the following services: Online philatelic and postal products shop, Online postal shopping portal, Online customs declaration, Integration of postal web services with merchants' sites, Performance reports and analytics, Virtual international address, Calculation of estimated total landed costs, Online management of documents/merchandise delivery options.

Support services consist of widely available services provided by postal operators to end-customers using ICTs. They imply added value and in most cases are free of charge. This group encompasses the following services: Public Internet access point in post offices, Online information on services and tariffs, Online lookup, Online contact and customer service, Track and trace, Electronic notification, Online change of address, Holding of mail delivery online, Online address cleansing services, Electronic postal invoicing, Digital postage, Digital personalized postage, Pick-up service [8].

The penetration rate for e-post and e-government services in Europe is presented in Table 1. The results show that hybrid mail (59%) and postal electronic mailbox (33%) are the leading e-post and e-government services, followed by postal electronic registered mail (29%).

Table 1. Penetration Rate for E-post and E-government Services in Europe

E-post and E-government services	Penetration Rate
Hybrid mail	59%
Postal electronic mailbox	33%
Postal electronic registered mail	29%
E-cards	27%
Digital signature	24%
Online direct mail	23%
Digital identity services	22%
Online facilitation of hybrid mail	21%
Digital archive	20%
E-invoicing	20%
E-administration	18%
Electronic postal certification mark	18%
Reverse hybrid mail	13%
Credentialing services	11%
E-health services	7%
Online burofax	7%

As it is shown in Table 2, e-finance services widely seen as important components of modern core postal offerings are still underdeveloped in Europe.

Table 2. Penetration Rate for E-finance services in Europe

E-finance services	Penetration Rate
Electronic remittances	59%
Payment solutions	27%
Online bill payment	24%
Online account management	21%
Escrow services for e-commerce	5%

E-commerce services, although widespread, have not yet reached their potential of use (Table 3).

Table 3. Penetration Rate for E-commerce Services in Europe

E-commerce Services	Penetration Rate
Online philatelic and postal products shop	53%
Integration of postal web services with e-merchants sites	53%
Online postal shopping portal (shopping mall)	41%
Online management: documents/merchandise delivery	21%
Calculation of estimated total landed costs	21%
Performance reports and analytics	21%
Online customs declaration	15%
Virtual international address service	11%

Support services are widely developed and most used postal e-services (Table 4).

Table 4. Penetration Rate for Supportive E-services in Europe

Supportive E-services	Penetration Rate
Online lookup (postcodes, addresses, post offices)	94%
Track and Trace	88%
Online information on services and tariffs	88%
Online contact and customer service	82%
Electronic notification	77%
Pick up service	50%
Public internet access point in post offices	47%
Online change of address	35%
Holding of mail delivery online	24%
Digital postage	23%
Electronic postal invoicing	22%
Digital customized postage	11%

The fastest-growing services in Europe (in terms of the percentage of countries providing them) are e-notification (from 22% in 2010 to 77% in 2018), online postal shopping portal (from 25% to 41%), online change of address (from 6% to 35%), holding of mail delivery online (from 0% to 24%), and e-administration (from 6% to 18%) [9].

Tremendous technological changes forced the Bulgarian postal operators to adjust their services to needs of the information society, use emerging business opportunities and pay more attention to a rapidly growing direct and indirect competition. Market liberalization had a major impact on the postal business in the EU, and the process brought steadily growing competition from private operators. Bulgarian postal market was fully liberalized in 2011. The postal service market in Bulgaria has evolved rapidly in the past decades, mainly due to the changing market conditions and the development of consumer needs, which in turn results in a change in demand for postal services [10].

Postal services industry in Bulgaria is highly competitive. Currently more than 170 postal operators are operating in Bulgarian postal services market. Moreover the existence of foreign players likes DHL, TNT and UPS in the postal sector in Bulgaria pressures the local providers to be more innovative in order to compete aggressively in the development of services in the same market.

Based on the own web survey it was found that more than a half of the registered postal operators in Bulgaria provide e-services. Each operator, however, provides a different combination of services.

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The results of the survey related to the provision of e-services and e-government in Bulgaria are presented at Figure 4. The figure shows which services are offered and how many of the registered postal operators offer them (as a percentage).

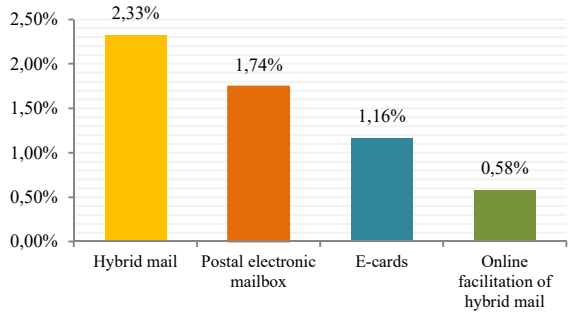

Figure 4. Penetration Rate for E-post and E-government Services in Bulgaria

The results indicate that the services of this category are not widely distributed in our country. In Bulgaria the portfolio of e-post and e-government services is built around a core of three products: hybrid mail, postal electronic mailbox and e-card.

Electronic financial services are also very limited in Bulgaria (Figure 5.). The electronic remittance, a service pertaining to the traditional core business of most postal operators worldwide, is the most developed digital financial and payment service in Europe and in Bulgaria also.

Figure 5. Penetration Rate for E-finance Services in Bulgaria

Some of services from the e-commerce segment are widespread in Bulgaria (Figure 6). The most widespread services in this group are the services: Integration of postal web services with e-merchants sites and Calculation of estimated total landed costs. Postal operators' efforts to grow their e-commerce business revolve mainly around integration with websites and shopping portals.

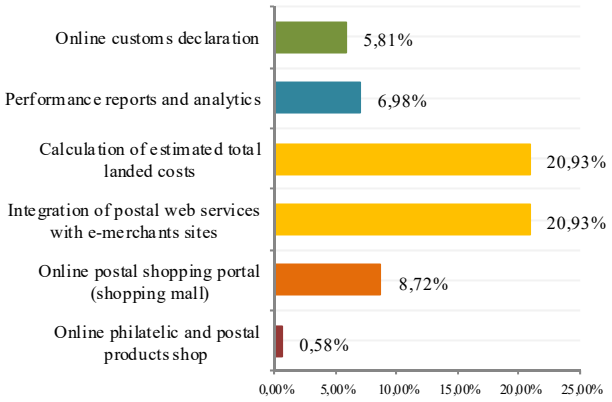

Figure 6. Penetration Rate for E-commerce Services in Bulgaria

According to Communications Regulation Commission annual report (2018) revenue from the delivery of parcels generated by e-commerce accounts nearly 40% of the total amount of postal services revenue. Most of the postal operators are working on updating the software they use to achieve the highest possible speed of information exchange and convenience for customers as well as integration with Internet marketers.

Both in Europe and in Bulgaria, the most widespread are the so-called supportive services. More than a half of the Bulgarian postal operators provide full variety of supportive e-services (Figure 7).

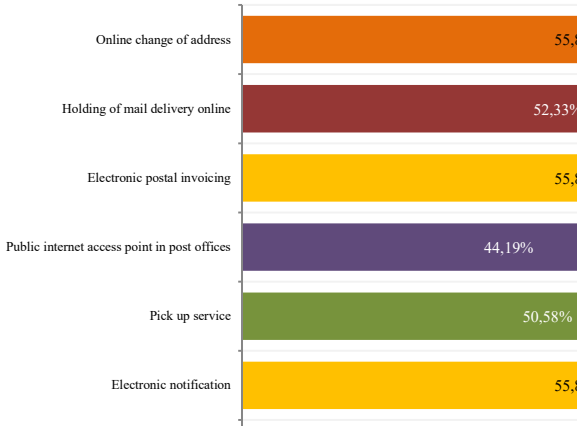

Figure 7. Penetration Rate for Supportive E-services in Bulgaria

The results show that extent to which postal operators in Bulgaria are offered e-services is far from fully exploited across the entire network.

According to last report of UPU (2017) Digital postal services capacity index (DPSCI) of Europe is 0,33 of maximum 1. The index illustrates postal operators' potential to provide digital inclusion. The leaders in Europe are France and Germany with average score 0,81. The DPSCI of Bulgaria is 0,19 [9]. Bulgarian postal operators are therefore at a turning point: they need to adapt in order to remain relevant, competing with digital native companies in different areas of their product portfolio. To be able to

compete effectively, postal operators need to speed up the digitalization of their products. This means that postal operators that have not fully digitalized need to do so urgently, or risk being excluded as digital service providers.

New reality in the sector is a challenge for the Bulgarian postal operators. In order to limit the shrinkage of its business, postal operators have to develop areas of activity in the digital space. Bulgarian postal operators' strategies need to be adapted to new digital needs.

The main strategic landmarks should be targeted at:

- Increasing funds for the development of an electronic infrastructure;
- Inclusion of the management structures of postal operators a new business department for e-services;
- Recruitment of individuals with specific know-how in relation to the digital world;
- Organization of specific training programmes;
- Creation or strengthening of internal innovation capabilities (research team, innovation lab);
- Building partnerships with other companies in order to be agile, share risk and reduce financial burdens;
- Encouraging third parties such as developers, startups etc. to propose new digital postal services.

3. Conclusions

Based on this study following conclusions can be formulated:

(1) The main trend in postal sector in EU is the increasing competition from electronic substitutes. The digitalization has changed the role of the postal sector.

(2) There are four main phases in the process of digitalization of postal sector: postal automation, phases of revenue-generating digital services, phase of core-enhancing digital postal services, digital transformation.

(3) There are four main drivers of Digital Transformation in Postal Sector: automation, digital customer access, connectivity and digital data.

(4) Calculated penetration rate for postal e-services show that extent to which postal operators in Bulgaria are offered e-services is far from fully exploited across the entire network. Digital postal services capacity index of Bulgaria is far below the European average level.

(5) Bulgarian postal operators' strategies need to be adapted to new digital needs.

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Growth and Opportunities in Mobile Internet Market in Bulgaria

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Abstract Nowadays, Internet and mobile technology have changed our way of both doing business and dealing with our daily routine activities. Mobile Broadband Internet represents the fastest growing segment of the European broadband market. Currently, mobile Internet services represent the most promising revenue stream for mobile operators. The present article discusses Bulgaria's performance against each dimension of the Mobile Connectivity Index (MCI), highlighting the country's challenges and achievement. The results show that Bulgaria is seriously lagging behind both the leading countries and European Union (EU) Member States.

Keywords Mobile Internet, Mobile subscribers, 4G and 5G

JEL L81, L86, L96

1. Introduction

Use of the Internet has exploded in recent years. Rapidly evolving network and computer technology, coupled with the exponential growth of the services and information available on the Internet enable hundreds of millions of people to have fast access to a huge amount of information from anywhere and everywhere.

According to the last report Digital in 2018 more than 4 billion people around the world are using the Internet. Over half of the world's population is now online, with the latest data showing that nearly a quarter of a billion new users came online for the first time in 2017. Much of 2018 year's growth in Internet users has been driven by smartphones and mobile data plans. More than 200 million people got their first mobile device in 2017, and two-thirds of the world`s 7.6 billion population now have a mobile phone [1].

The Internet and mobile technology have changed our way of both doing business and dealing with our daily routine activities. There is no doubt that the mobile Internet service is moving toward the new generation on which enables mobile users to enjoy a variety of new and upgraded multimedia mobile services.

The global mobile Internet industry comprises consumer spending to access Internet through mobile phones, smartphones and tablets via 3G, and higher network.

Mobile Internet services are defined as the wireless access to Internet content via mobile devices that enables people to access information, products, and services available on the Internet without temporal or spatial restrictions.

Mobile Internet technology has two main characteristics:

- Mobility, which refers to the ability to communicate, inform, transact and entertain at any place at anytime on the move without fixed Internet access;
- Personalization - the mobile device is personal in that it is always available on a person and retains its personal identity [2].

Nowadays, mobile Internet diffusion is far outpacing fixed Internet access. In late 2010 the number of broadband Internet subscriptions over mobile technologies overtook the number of subscriptions over fixed technologies [3]. Mobile subscriptions rose from 61% of all broadband connections in developing countries to 84% in 2016. Moreover, "mobile only" subscribers account for a large percentage of the growth. According to latest data, there were approximately 792 million mobile-only subscribers in 2017. This is of special concern because mobile is the primary means by which new Internet users - particularly those with lower incomes and/or in developing countries - are getting online [4]. This is an incredibly positive development, given that, for many users, mobile Internet access currently represents the only viable and/or affordable means of getting online. In such cases, some form of Internet access is better than none. There is compelling evidence across a variety of contexts that mobile Internet access can provide those without traditional forms of Internet access with opportunities to become better integrated into social, economic, and political life [5].

Experts portend a promising future for mobile Internet usage, as global mobile data traffic is expected to increase nearly sevenfold till 2021. According to the Statistical Postal Data for 2018, the global mobile population

amounted to 3.7 billion users. Mobile devices accounted for 49.7 percent of web page views worldwide, with mobile-first markets such as Asia and Africa leading the pack. Kenya registered the highest rate of Internet traffic coming from mobile devices; followed by Nigeria, India, Singapore, Ghana, and Indonesia. The Americas and Europe have the highest mobile broadband subscription penetration rate, around 78.2% and 76.6% respectively [6].

The rapid progress in mobile technologies, the growing affordability of smart devices, and the increasing use of mobile application stores are acknowledged as the main drivers of mobile Internet growth. Mobile broadband Internet represents the fastest growing segment of the European broadband market. Currently, mobile Internet services represent the most promising revenue stream for mobile operators [7].

Hence, the objective of this article is to examine the current conditions in the Bulgarian Mobile Internet Market and to emphasize its most characteristic aspects that can attribute to a stable and profitable Mobile Internet Market. The article discusses Bulgaria's performance against each dimension of the MCI, highlighting the country's challenges and achievements.

2. Mobile Internet Usage. Global Perspective

Mobile technology must be highlighted as an outstanding phenomenon that has forever changed society. 2017 was a milestone year for the mobile industry. The number of people connected to mobile services exceeded 5 billion globally. This means that two out of three people in the world had a mobile subscription at the end of 2017. According to experts forecasts in 2025 the mobile industry will reach new major milestones across key indicators – unique subscribers, Internet users and 4G/5G connections. The number of mobile subscribers will reach 5.9 billion by 2025, equivalent to 71% of the world's population [8].

Mobile Internet market will add 1.75 billion new users over the next eight years, reaching a milestone of 5 billion mobile Internet users in 2025.

Mobile Internet adoption will increasingly become the key metric by which to measure the reach and value created by the mobile industry, including its contribution to the sustainable development. Mobile Internet also contributes to developments in the wider digital ecosystem, as mobile Internet users are target market for e-commerce and a range of digitally delivered services and content [9].

According to the latest report of GSMA Intelligence in 2019 4G will become the leading mobile network technology worldwide by number of connections - more than 3 billion. At the same time, the mobile industry continues to make progress with 5G. A number of mobile 5G commercial launches are expected over the next three years in North America and major markets across Asia and Europe. China, the US and Japan will be the leading countries by 5G connections in 2025, while Europe as a whole will continue to make progress with 5G deployments [9].

The Global Internet subscriber penetration rate for 2017 by types of technology is presented at Figure 1.

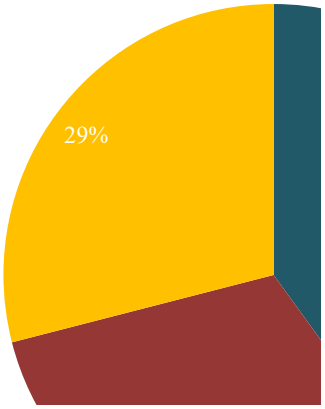

Figure 1. Global Internet Subscriber Penetration Rate for 2017

According to the forecasts in 2025 the Global internet subscriber penetration rate will be 71%. Which represents a growth with 5% as it compared to 2017 (Figure 2).

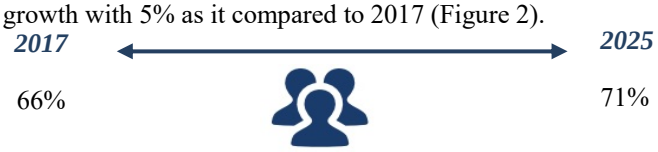

Figure 2. Global Internet Subscriber Penetration Rate 2017-2025

The distribution between the types of technology is presented at Figure 3.

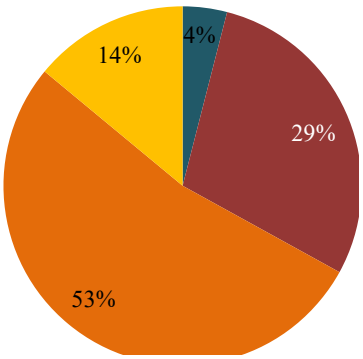

Figure 3. Global Internet Subscriber Penetration Rate for 2025

Internet subscriber penetration rate in Europe for 2017 is the highest (85%) and the experts predict that this tendency will remain till 2025 (88%). The Europe region is expected to hold a significant market share in 5G, because countries like the United Kingdom and Italy are making efforts to test 5G networks in 2018 and launch 5G smartphones by next year (Figure 4).

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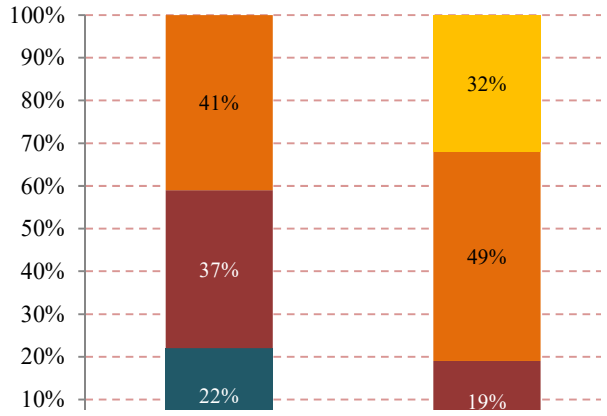

Figure 4. Internet Subscriber Penetration Rate in Europe

In terms of mobile penetration rate it is expected that the rate will reach 61% globally and 82% in European countries (Table 1).

Table 1. Mobile Internet Penetration Rate

Region	2017	2025
Global	43%	61%
Europe	72%	82%

In 2017 the number of people connected to mobile services surpassed 5 billion globally. Looking out to 2025 mobile subscribers is expected to reach 6 billion, with 1.2 billion 5G connections (Figure 5).

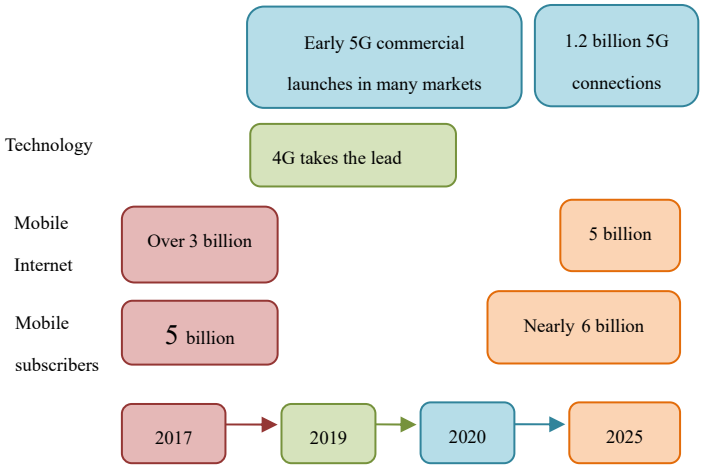

Figure 5. Major Mobile Milestones over the Period to 2025

Most of the 1.75 billion increases in the number of mobile Internet users between 2017 and 2025 will come from China, India and Sub-Saharan Africa [9]. Key drivers of this growth are: increasing population coverage of 3G and 4G networks, more affordable smartphones and data tariffs, and an increasing willingness among users to consume social media and a range of services and content online.

In terms of number of mobile connections, 4G will become the lead mobile network technology in 2019 and will continue to dominate over the period to 2025. The 4G technology has been driving and enabling the transition from the connected consumer to the digital consumer during 2010-2020, the new 5G technology will play a key role in the transition to the augmented consumer in the near future.

In 2014 GSMA Corporation stared to calculate Mobile Connectivity Index. The Mobile Connectivity Index measures the performance of 150 countries, accounting for 98% of the world's population, against the four key enablers of mobile Internet connectivity: infrastructure, affordability, consumer readiness and content) (Table 2) [10].

Table 2. Mobile Connectivity Index

Infrastructure	Affordability	Consumer readiness	Content
• Mobile infrastructure; • Network performance; • Other enabling infrastructure; • Spectrum.	• Mobile tariffs; • Handset price; • Income; • Inequality; • Taxation.	• Basic skills; • General equality.	• Local relevance; • Availability.

The *Infrastructure* enabler includes improvements in 3G/4G/5G coverage, network quality and spectrum availability. *Affordability* is connected with mobile data plans and device becoming more affordable, especially for lower income groups (assisted by reduction in consumer taxes). *Consumer readiness* reports improvements in literacy and education levels. The *Content* enabler reports content being developed within countries in local languages, for example mobile applications, websites, social media and E-Government services.

The Mobile Connectivity Index Indicators are summarized in Table 3.

Table 3. Mobile Connectivity Index Indicators

Enabler	Dimension	Indicator
Infrastructure	*Mobile Infrastructure*	2G network coverage
		3G network coverage
		4G network coverage
		Years since 3G network launch
	Network performance	Mobile download speeds
		Mobile upload speeds
		Mobile latencies
	Other enabling infrastructure	International bandwidth per user
		Number of secure servers
		Access to electricity
		Number of Internet exchange points
	Spectrum	Digital dividend spectrum
		Other spectrum below 1 GHz
		Spectrum in bands 1–3 GHz
Affordability	Mobile tariffs	Cost of entry usage basket (100 MB)
		Cost of medium usage basket (500 MB)
		Cost of high usage basket (1 GB)

	Handset price	Cost of entry-level handset
	Income	Gross National Income (GNI) per capita
	Inequality	Atkinson Measure of Inequality in Income
	Taxation	Cost of taxation
		Cost of mobile-specific taxation
Consumer readiness	*Basic skills*	Adult literacy rate
		School life expectancy
		Mean years of schooling
		Tertiary enrolment rate
	Gender equality	Gender literacy ratio
		Gender years of schooling ratio
		Gender bank account ratio
		Gender labour participation ratio
		Gender GNI per capita ratio
Content	*Local relevance*	Top-level domains per capita
		E-government services
		Mobile social media penetration
		Mobile application development
	Availability	App accessibility in first language
		Number of apps accessible in first language
		Accessibility of top 400 ranked Google Play apps in any language
		Accessibility of top 400 ranked Apple Store apps in any language

The score fall within the range of 0 to 100. Countries are divided into five groups depending on the Index values achieved:

- 0-20 Discoverer;
- 21-40 Emerging;
- 41-60 Transitioner,
- 61-80 Advanced,
- 81-100 Leader.

According to the last GSMA report the global leaders are: Australia (88.9), New Zealand (87.8), Iceland (86.6), Singapore (86.5), Norway (86.4), Denmark (84.5), Sweden (84.3), Canada (84.3), Finland (84.2), United Kingdom (84.2), Netherlands (84.2), Ireland (83), South Korea (83.4), Switzerland (83.7), Austria (82.4), United States of America (81.7), Belgium (81.6), Luxembourg (81.4) and Japan (80).

The only two countries that have MCI below 20 are Niger and Chad.

The most improved countries for the period 2014-2018 are presented in Table 4.

Table 4. Improvement in Mobile Connectivity Index

MCI	Infrastructure	Affordability	Consumer readiness	Content
Montenegro	Morocco	India	Guatemala	Montenegro
Georgia	Turkey	Nepal	Guinea	Serbia
Ethiopia	Belize	Sierra Leone	Iran	Azerbaijan
Mongolia	Tunisia	Angola	China	Georgia
Serbia	Bhutan	Sri Lanka	Senegal	Bosnia

The results show that there is a strong positive correlation between index score and mobile Internet penetration. The index is therefore an effective tool to identify priorities to drive mobile Internet adoption.

3. Mobile Internet Growth in Bulgaria

Mobile telecommunications in Bulgaria are provided by three active operators: A1 (the first GSM operator, part of A1 Group), Telenor (the second-largest mobile operator, owned by Telenor) and Vivacom (the former fixed incumbent, Bulgarian Telecommunications Company). The privately owned Long-Term Evolution (LTE) operator, Max Telecom, although still operational, at the beginning of 2017 faced serious financial difficulties, and has shut down all its offices and stores. A fifth company, Bulsatcom, announced the deployment of a 4G network in 2015, and was expected to actively enter the telecom sector in 2017. However, it faced difficulties related to the launching of the first Bulgarian commercial satellite, which affected and has so far delayed its entry into the mobile services market. The leading three operators have 2G/3G network coverage exceeding 99 percent both in terms of population and territory. Package services experienced a considerable growth in 2015 and are now the second-largest segment immediately after data access [11].

The first 4G network in Bulgaria was launched in 2014 by Max Telecom, followed by Telenor, A1 and Vivacom at the end of 2015 and the beginning of 2016.

Mobile Data Speed (4G Speed) of operators across Bulgaria ranks 9th in the world, according to Global State of Mobile Networks Report. The average Smart LTE download speed across the country is 33.3 Mbps. Faster internet speed is delivered only in Singapore, Netherlands, Norway, Republic of Korea, Hungary, Belgium, Australia and New Zealand. The global leader's Smart LTE speed has topped the list with 44.31 Mbps, while world average smart speed is now 16.9 Mbps [12].

The 4G Availability metric tracks the proportion of time users have access to a particular network. The result of Bulgaria is 73.96%. The highest result has South Korea, with 97.49%. Bulgaria is ranking number 45th among 150 countries.

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According to Google Consumer Barometer the mobile Internet user penetration rate in the beginning of 2018 is highest in United Arab Emirates (96%), followed by Saudi Arabia (88%) and Netherlands (80%) [6]. The penetration rate in Bulgaria is 53% (Figure 6).

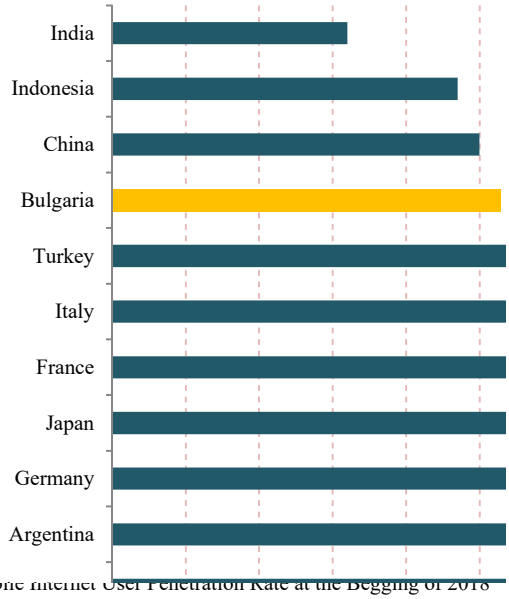

Figure 6. Mobile Internet User Penetration Rate at the Begging of 2018

The number of mobile Internet users in Bulgaria marked steady growth with more than 25% in comparison with 2015 and reached 3.88 million users at the beginning of 2018. According to Statista in 2022, the number of mobile Internet users is projected to reach 4.18 million individuals. This would be an increase of approximately one million new users (Figure 7).

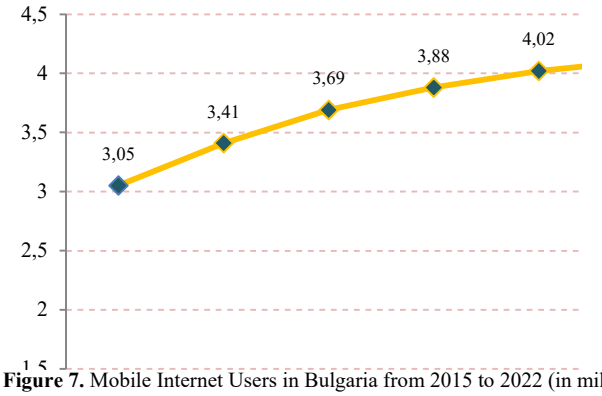

Figure 7. Mobile Internet Users in Bulgaria from 2015 to 2022 (in million users) [6]

According to National Statistical Institute of the Republic of Bulgaria 84.2% of individuals use mobile phones for access to Internet, 35.7% use portable computers and only 12% didn`t access to Internet via any mobile devise (Table 5). The percentage is calculated on the basis of individuals in Bulgaria who used the Internet.

Table 5. Individuals Using Mobile Devices to Access the Internet in Bulgaria for 2017

Type of mobile devices	2017
Mobile phone (or smart phone)	84.2%
Portable computer (e.g. laptop, tablet)	37.5%
Other devices	2%
I didn't access the internet via any mobile device away from home or work	12%

Despite the fact that mobile phone adoption is near saturated in Bulgarian market and data usage continues to grow exponentially, 12% of the population is not yet access to Internet via any mobile device. (Figure 8). The growth in mobile phone usage is more that 50%. The percentage of people that didn`t access the Internet via mobile devices in Bulgaria is still one of the highest in comparison with other EU counties.

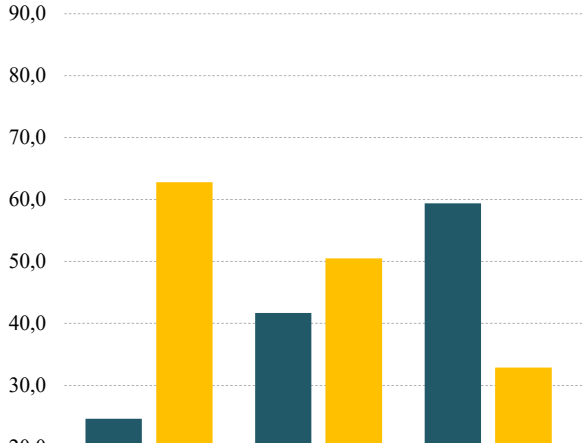

Figure 8. Individuals Using Mobile Phones to Access the Internet in Bulgaria 2013-2017

In terms of MCI, during 2017 Bulgaria ranks last among all European Union member states (Table 6). Bulgaria is seriously lagging behind both the leading countries and EU member states by the level of MCI as a whole.

Table 6. MCI Scores of European Union Member States [10]

Country	Infrastructure	Affordability	Consumer readiness	Content
Austria	82.4	74.5	86.0	86.1
Belgium	81.6	73.6	85.4	90.9
Bulgaria	**68.6**	**62.5**	**72.8**	**84.7**
Croatia	74.1	64.5	80.8	84.0
Cyprus	76.0	66.5	74.4	84.8
Czech Republic	76.3	70.4	84.5	86.4
Denmark	84.5	78.1	81.8	92.6
Estonia	77.7	74.9	79.8	89.1

Finland	84.2	81.0	85.4	92.5
France	79.9	73.0	79.5	86.1
Germany	81.8	75.8	82.3	89.1
Greece	72.4	67.3	66.8	88.3
Hungary	74.7	70.5	82.2	82.3
Ireland	83.0	68.3	85.4	92.3
Italy	74.9	68.4	71.6	82.6
Latvia	73.7	67.0	78.0	88.8
Lithuania	75.3	74.2	77.6	88.4
Luxembourg	81.4	76.2	88.5	78.1
Malta	76.3	66.1	76.0	79.7
Netherlands	84.2	79.3	83.3	88.8
Poland	76.7	66.7	82.8	87.8
Portugal	77.0	70.4	77.9	82.7
Romania	72.4	65.7	83.9	78.9
Slovakia	72.9	64.8	84.1	84.0
Slovenia	77.8	67.5	86.1	91.0
Spain	79.7	71.9	79.0	87.8
Sweden	84.3	77.0	85.2	90.4
United Kingdom	84.2	77.4	84.3	87.5

The results show that the main challenge for Bulgarian mobile operators is the Infrastructure. The score of Infrastructure component is 62.5, which is 8.73 less than the average level for all EU member states. This component measures the availability of high-performance mobile Internet network coverage. According to the results, the main problems of our country are spectrum, which reach only 16.0 scores and network performance with 44.7 scores.

The development of a dynamic and innovative digital economy will facilitate growth and productivity, allow the development of new services by generating additional social benefits and increase the number of jobs, all of which require an available ultra-high speed next generation Internet access. In this regard, the construction of new broadband infrastructure for next generation access, the facilitation of the use of the radio spectrum, and the promotion of the intensive and efficient use of both have to be the priorities of the country.

Affordability component reports mobile data plans and device becoming more affordable, especially for lower income groups i.e. the availability of mobile services and devices at price points that reflect the level of income across a national population. In 2018 affordability component of Bulgaria has 62.5 scores and the country occupies the last place among EU member states.

According to Europe's Digital Progress Report for 2017, packages including mobile broadband on handsets in Bulgaria are significantly more expensive than in the EU-28 on average, costing almost double the EU average [13].

The Consumer readiness element measures the gender equality and basic skills of the population i.e. citizens with the awareness and skills needed to value and use the Internet, and a cultural environment that promotes gender equality. Bulgaria has 72.8 scores and overtakes only Italy.

Content is Bulgaria's strongest MCI`s component. The component measures the availability of online content and services accessible and relevant to the local population. In terms of Content the result of Bulgaria is better than the results of Croatia, Slovakia, Romania, Portugal, Malta, Luxembourg and Hungary.

4. Conclusions

Based on this study following conclusions can be formulated:

(1) Mobile Data Speed (4G Speed) of operators across Bulgaria ranks 9th in the world.

(2) The 4G Availability of the country is 73.96% and mobile Internet user penetration rate in the beginning of 2018 is 53%.

(3) The number of mobile Internet users marked steady growth with more than 25% in comparison with 2015 and reached 3.88 million users at the beginning of 2018.

(4) The mobile phone adoption is near saturated in Bulgarian market and data usage continues to grow exponentially, 12% of the population is not yet access to Internet via any mobile device.

(5) Bulgaria is seriously lagging behind both the leading countries and EU member states by the level of MCI as a whole.

(6) The main challenge for Bulgarian mobile operators is the Infrastructure. The score of Infrastructure MCI component is 62.5, which is 8.73 less than the average level for all EU member states. In this regard, the construction of new broadband infrastructure for next generation access, the facilitation of the use of the radio spectrum, and the promotion of the intensive and efficient use of both have to be the priorities of the country.

(7) The affordability component of Bulgaria has 62.5 scores and the country occupies the last place among EU member states. Packages including mobile broadband on handsets in Bulgaria are significantly more expensive than in the EU-28 on average, costing almost double the EU average.

(8) In addition, deeper focus on deploying broadband in rural areas and on developing digital skills and digital services would benefit the country's overall connectivity.

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Handoff in Various Mobile Network Technologies

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Abstract Mobile cellular networks are an indispensable part of modern life, where the need for customer satisfaction in the use of many different services by consumers is constantly increasing. The requirements for higher transmission speed, lossless transmission, reliability, efficiency, low latency, mass connectivity, guarantee of high Quality of Service criteria are repeatedly increasing. All this requires the continuous development of the used technologies as well as the introduction of new generations of networks.

Handover mechanism is extremely important in cellular network because of the cellular architecture employed to maximize spectrum utilization.

To ensure the quality of service in wireless cellular networks, the report proposes the use of a Horizontal Handoff Priority Scheme. Simulation experiments have been carried out, the probability parameters of the scheme have been evaluated and the probabilities of losses occurrence have been classified as rare events.

The proposed material are various algorithms and techniques for the implementation of Vertical and Horizontal Handoff in 3G, 4G and fifth-generation networks to provide the required QoS for mobile users with Ultra-High Definition.

Keywords Handoff, 3G, 4G and 5G, Quality of Service

JEL L86, L96

1. Introduction

Mobile cellular networks are an integral part of modern life. In order to ensure high levels of consumer satisfaction, the requirements for high speed, reliability and efficiency, low latency and performance, energy savings, mass connectivity, lossless transmission and Quality of Service (QoS) guarantee are repeatedly increased. All this leads to the need for continuous development and improvement of the technologies used and the introduction of new generations of networks.

Mobility management is a priority issue in today's mobile networks. A high real-time loss rate compromises QoS. The challenge for all networks is data transmission to be carried out without loss [3, 12].

For these reasons, in order to meet the QoS criteria, it is necessary to classify losses as rare events. These events are described in the literature as events with a probability of occurrence much smaller than 10^{-6} [3, 4].

2. Third Generation Wireless Network

The third generation of digital mobile cellular systems provide a transition from narrowband to broadband mobile networks through voice, data and / or mobile Internet transmission.

Wireless Local Area Networks (WLANs) and third generation (3G) as broadband technologies, have their specific weaknesses that impede their full potential.

For example: Wireless networks are characterized by the limited capacity and small scope of Base Station (BS), while 3G systems are limited by the low bandwidth and high cost of building their infrastructure.

This requires the implementation of new standards for broadband access.

The application of WiMAX technology in wireless local networks, based on IEEE 802.16, 802.16a, 16d and 16e standards, successfully removes the gap between LAN and WAN technologies.

3G wireless technology represents the convergence of various 2G wireless telecommunications systems into a single global system that includes both terrestrial and satellite components. One of the most important aspects of 3G wireless technologies is its ability to unify existing cellular standards, such as CDMA, GSM, and TDMA. The speeds of 3G can be up to 2Mbps [1].

In the technologies described above, maintaining mobility of users is a priority, along with ensuring certain QoS parameters.

The process of transferring a signal when changing a cell or reducing the signal during an active user connection is known in the literature as Handoff (HO) [1, 3].

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In typical wireless cellular systems, the handover mechanism involves reassigning an ongoing session handled by one cell into another.

Handoff is a progression in mobile communications and telecommunications in which a connected a data session, or cellular call is transferred from one cell site (Base Station, BS) to another without disconnecting the session. It lets users create connect phone or data sessions calls on the move. This process keeps the calls and data sessions connected even if users move from one cell position to another.

There are different concepts for Handoff types [1, 16, 17].

For networks with adaptive protocols and set priorities, implemented and designed according to the IEEE802.16 and IEEE802.11 standards, two main types are considered: Vertical Handover (VHO) и Horizontal Handoff (HHO).

HHO is a symmetric process that occurs in the same access technology or a device that change/handover the cells within the same network technology to maintain its continuity. VHO is an asymmetric process that occurs between different base stations belong to different network.

Table 1 presents the types of HO across different generations of networks.

Table 1. HO across different generations of networks

Technology	2G/2,5G	3G	4G	5G
Service	Digital voice, Short messages/ Packetized data	Higher Quality audio, video, voice and data	Dynamic Information, Access, Wearable device	Dynamic Information, Access, Wearable device with IA capabilities
Handoff	HHO	HHO	HHO and VHO	HHO and VHO

When implementing HO different solutions are used (Figure 1):

- Hard Handover (HHO) - the connection between the device and the antenna is disconnected before connecting to a new cell;
- Soft Handover (SHO) - the connection to the new cell is made before the previous one is interrupted.

Soft Handover techniques include:

- Macro Diversity Handover (MDHO) and
- Fast Base Station Switching (FBSS) [16].

Figure 1 shows the Handoff realized through Relative Signal Strength (RSS).

In this scheme are measured over time and the base station BTS with the strongest signal is chosen to Handoff.

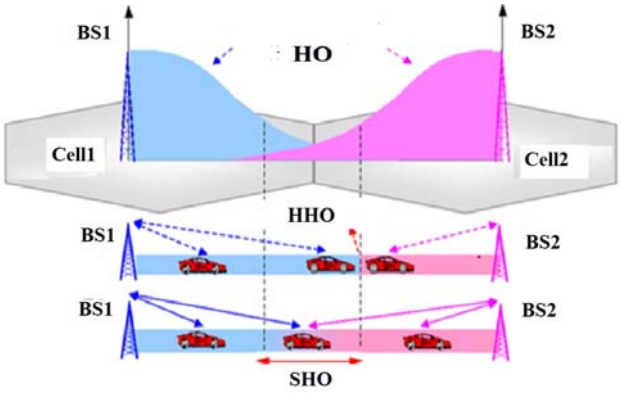

Figure 1. Types of Handoffs

Other methods for Handoff are described in [17]:

- Relative Signal Strength with Threshold,
- Relative Signal Strength with Hystersis and
- Threshold prediction Approaches.

HO initiation timing is not clearly defined and unnecessary neighbouring BS scanning and association are performed before and during HO process. These redundant processes cause a long HO operation time, which makes severe degradation in system performance. The following algorithms are offered to solve these problems [2]:

- Fast Handover Algorithm for IEEE 802.16e Broadband Wireless Access System - achieves a reduction in the loss of wireless channel resources and delays and increases system throughput and efficiency. This algorithm selects the Target Base Station (TBS) by performing Fast Synchronization, Association (FSA) and Optimized Handoff Initiation Time (OHIT), which increases the system throughput and verifies the efficiency of the proposed algorithm.
- Fast Base Station Switching in Soft Handover - one BS is selected from a wide variety of base stations. These stations can be selected as Target Base Station (TBS).

Many algorithms have been proposed for VHO mechanism based on a number of criteria, namely, the Received Signal Strength (RSS), available bandwidth, connection cost, Signal to Interference Noise Ratio (SINR), mobile station's velocity, handover delay, battery consumption and Quality of Service guarantee.

In [17] is discuss nonpreemptive and preemptive priority handoff schemes for a multiple traffic system, such as an integrated voice and data system or integrated real-time and nonreal-time systeme. The proposed traffic model was used in 3. The authors propose a methodology for estimating the probabilistic parameters of QoS. The signaling scheme is implemented with four priority two-queue scheme - for data traffic and voice calls. Based on this model, effective values of probabilities of occurrence of non-served voice calls and data loss due to overflow of the queues of the handover and channels of BS are determined.

This prioritization schemes for handover in GSM cellular wireless network provide improved performance at the expense of the increased call blocking probability.

Using the proposed methodology and programming environment, simulation experiments were conducted with different traffic systems.

During the simulation, experiments with a Non-Markovian type of traffic system were conducted.

With P_0 and P_R are marked probability of packet loss data and unserved voice calls under the following input parameters of the system: MN - data queue lengths, MR - voice calls, N - total cell counts in BS.

The results are summarized, processed and presented at Figure 2.

Qos probability parameters are found to be less than 10^{-8} , therefore they are classified as rare events (dark green sections of Figure.2 and Figure. 3).

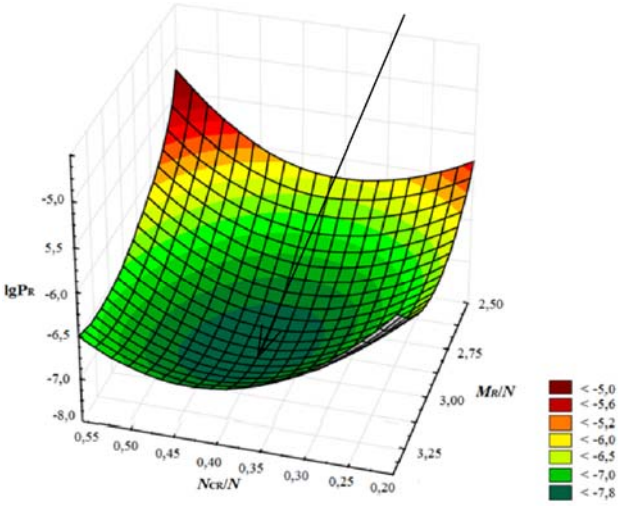

Figure 2. The probability of losing voice calls P_R

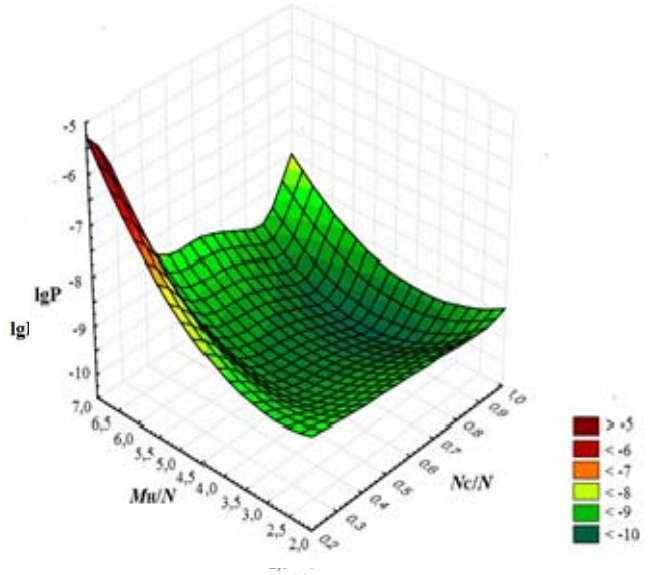

Figure 3. The probability of losing data packets P

With the development of new technologies, it has been found that traditional methods of implementing Handoff based on signal strength estimation (Figure. 1) are not sufficient.

3. Types of Handoffs in 4G Networks

The structure of 4G packet-based technology for data transfer allows call or online sessions to be routed to 2G (UMTS or GSM) and 3G networks, as well as easy and seamless integration with WI-FI and Internet networks.

4G can support at least 100 Mbps peak rates in full-mobility wide area coverage and 1Gbps in low-mobility local area coverage.

The challenge for these technologies is to meet different criteria and the level of QoS.

Mobility is a very important feature of these wireless networks. For this reason, Mobile Terminals choose the best network available, including WLAN, WiMAX and satellite systems, before performing HO.

4G technologies offer an adaptive and intelligent vertical transmission approach. The challenge for these technologies is to meet the different criteria and level of QoS arising from the requirements for cost, security, power consumption, latency and speed of the mobile terminal [4, 7].

Example: In order to minimize transmission delays and meet quality of service requirements, HO schemes are developed to be offered and analyzed by different standards - IEEE 802.16m, 3GPP, etc. [13, 14].

Different techniques of Handoff Parameter Optimization (HPO) are applied to achieve QoS:

- Load balancing (LB) - increases the rate of transmission of intermediate cells, increasing the possibility of interruptions of HO;
- Dynamic Hysteresis Adjusting (DHA) – Increases transmission efficiency and number of completed users on Long Term Evolution (LTE) networks.

LTE is a standard for 4G wireless broadband technology that offers increased network capacity and speed to mobile device users. LTE technology supports handover and roaming with second- and third-generation cellular networks, enabling their compatibility.

Figure 4 presents the VHO on the LTE Network, where ENodeB, MME and S-GW are common elements for the network, and S1 and Z2 are the used interfaces [5, 11,13].

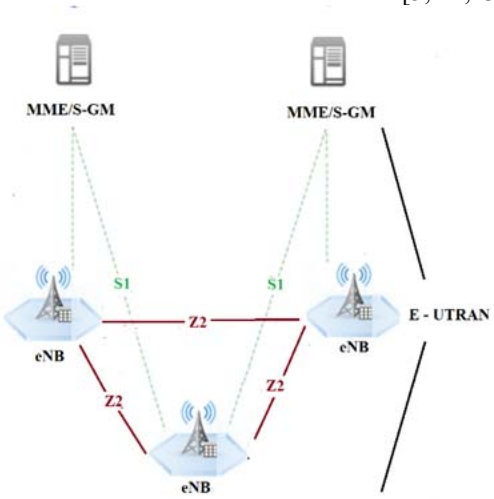

Figure 4. VHO, standard LTE Network

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The IEEE 802.21 Media Independent Handover (MIH) standard provides seamless roaming among various wireless technologies, consisting of GSM, UMTS, WLAN, WiMAX and Bluetooth [10].

To achieve successful Handovers in Mobile WiMAX, two serving base station (SBS) and one Target Base Station (TBS) are used.

Hard handover allows only low speed mobility. For higher speed mobility were FBSS and MDHO implemented. MDHO and FBSS belong to the group of the SHO.

The main difference between MDHO and FBSS is, that in MDHO is applied the selection diversity and diversity combining in uplink and downlink, respectively. In FBSS all data traffic is processed only in the anchor BS [6].

4. Types of Handoffs in 5G Technology

The rapidly growing number of mobile devices, the avalanche of ever-expanding data transfer, and services require the development of a new generation of heterogeneous networks integrating 3G, heterogeneous wireless 4G, Wi-Fi and other technologies. They implement applications for analysing, predicting traffic, and exploring the entire network in order to save time, ensure high efficiency and network intelligence [9].

The basic requirements for these technologies are [7]:

- Increasing data transmission and transmission rates - 1 Gbit / s for end user in each cell of the network and at any time (20 Gbit / s peak transfer rate).
- Reducing network latency (1ms radio latency one way from the base station to the user or 10ms end-to-end latency.
- Mass connectivity (density of 106 mobile connections per square kilometre).
- High lossless transmission reliability.
- High efficiency and performance (10 Mbps per square meter).

The architecture of fifth generation networks requires the construction of ultra-dense networks with huge numbers of heterogeneous cells (Het-Nets), which requires the introduction of an automated procedure for their management.

5G technologies face a number of challenges in providing Handoff - network compaction, high mobility, reduced interference level, zero latency, multi-RAT access, and inability to provide effective load balancing for BS in current cellular networks.

There are two types of Handoffs in the new generation of networks:

- Inter-Macrocell Handoff - transfer between two small cells operating under different mobile base station (MBS)
- Multi-RATs Handoff - can be optimized to the similar process with intra-frequency LTE HO.

In a 5G environment, the blend different wireless technologies and service providers that share an IP-based core network, will offer the possibility to the mobile devices of switching between providers and technologies, for maintaining a high level of Quality of Service. Fast Vertical Handoffand the general openness of the network make the devises susceptible to several vulnerabilities like access control, communication security, data confidentiality, availability and privacy. Furthermore, since the 5G environment is IP-based, it will suffer from all the vulnerabilities that are to IP-specific. Based on these findings, it is obvious that guaranteeing a high level of security and privacy will be one of important aspects for the successful deployment of 5G networks [8].

5. Conclusions

The challenge for new mobile networks is the provision of a wide range of applications and services with many different technologies, in parallel with different QoS requirements. Another problem is consumer mobility.

Handoff is the process of transferring connection of a mobile user from one node to another, when the previous node cannot provide proper service. Handover mechanism is extremely important in cellular network because of the cellular architecture employed to maximize spectrum utilization**.**

Handover is the key technology in the research of the next generation of wireless mobile communication systems. It can improve the validity and reliability of the whole communication system. In 5G application scenarios, the handover decision algorithm and handover executing mechanism are the key factors that affect the performance of handover technology.

Network compaction, high speed and mobility, zero latency, minimal interference and lossless transmission are challenges that require combining existing ones and developing new algorithms and standards for Handoff implementation.

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Organization value building on the basis of intellectual capital

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Abstract A very important part of the theoretical analysis of intellectual capital is the analysis of the organization value building on the basis of intellectual capital. The innovativeness of the organization and its ability to absorb innovations can to be a value of the organization. The investments in the intellectual capital during organization value building should lead to absorption of innovation. So the considerations connected to the organization value building on the basis of intellectual capital raised in this article might be of value for the future empirical work results.

Key words: Intellectual capital, environment, technology, economy

1. Organization value building on the basis of intellectual capital

All the definitions of intellectual capital proposed in the literature seem to have a common basis, but they differ in terms of composition. The nature of intellectual capital and the form it takes for organizations sometimes take a slightly different form. It can be a raw material/resource of the company, as well as manifest itself in the individual characteristics of the employees. Sometimes it includes only the non-physical zone, sometimes also material objects. However, all definitions agree that regardless of its form, intellectual capital is extremely important for the activity of organizations, especially in today's knowledge-based economy.

The aforementioned definitions characterize intellectual capital in different ways describing it both as knowledge, raw material/resource, data, nonphysical values or material values. It proves how complex this notion is and how subjective its perception might be.

Definitely, most often intellectual capital is defined as a resource, raw material or capital, created by knowledge, which is clearly manifested by skills, competences and abilities. It has the attribute of immateriality (non-physicality) assigned to it. This attribute is usually assigned to a company, an enterprise or organization. Less frequently the subject of the issue are people who perform this function mainly in the first definitions of the term. Specialists pay attention to the creative role of intellectual capital and emphasize its potential to generate additional benefits or goods in the form of profits, competitive advantage, additional knowledge, innovation, etc. The most important of these are people who play this role mainly in the first definitions of the concept of intellectual capital.

According to the above conclusions, in the further part of the article we will apply the most complex definition of the intellectual capital: „nonmaterial resources of organization knowledge that might be used in the future to achieve and maintain competitive advantages and increase the innovativeness of the organization".

In the further part of the article we assumed that intellectual capital consists of three elements: human capital, structural capital also known as organizational and social capital, also known as relation or client capital. This attitude is present mostly among the authors dealing with the topics of intellectual capital.

In recent decades, academic circles have become interested in the role of knowledge in business development. The general conclusion from the considerations was that organizational capacity is based on knowledge management, which is a source of organizational stability and competitive advantage [1]. The previously adopted definition of intellectual capital says that it can be used to create competitive advantage and also to increase the organization's value. In common opinion, value refers mostly to monetary valuation, but economists have developed a perception of this issue, so that it can be used in relation to the nonmaterial resources of the organization and in the environment typical for intellectual capital. While the concept of added value of an organization is understandable and means the difference between total income and the cost of expenses, the concept of value creation is no longer so easily definable [2]. P.H. Sullivan describes value as "the measure of the usefulness that owning an item brings to its holder" [3]. .

2. Importance of knowledge in the intellectual capital theory

In today's world, knowledge is seen as a strategic resource, as the fourth factor alongside land, labour and capital. Both knowledge and intellectual capital have been present in people's activities since the dawn of time, but knowledge

has never played such an important role as it does today. In the post-industrial era, in the information technology era, wealth is a product of knowledge. What counts is not only the scientific knowledge gained during studies, but also the knowledge resulting from professional experience, as well as scientific and technical information. Therefore, not only written knowledge, but also multimedia and information provided both orally and in writing are the "raw materials" of modern technology. Nowadays, companies have to learn how to manage their knowledge. Intellectual capital is a tool, knowledge, information, intellectual property and at the same time the basic factor of organization's wealth, it is also the power of the human mind [4].

P. Drucker claimed that we were entering the biggest change in the history of mankind. According to him, the new society will be the society of knowledge, knowledge will be its key resource, and "knowledge workers" will be the dominant group among all employees [5]. The economic challenge for post-capitalist society will be the productivity of knowledge-based work and the productivity of the knowledge worker. Unlike the economic theory of the 19th and 20th centuries, the value will be created by the productivity and innovativeness of knowledge in application to work [6].

I. Nonaka argued that especially in the economy where uncertainty is the only certainty, knowledge may be the only reliable source of a sustainable competitive advantage. In a situation of changing markets, constant appearance of new technologies, proliferation of competitors and aging of products almost overnight, only companies that consistently create new knowledge, disseminate it widely throughout the organization and quickly transform it into new products and technologies have a chance of success. They have been defined as "created by knowledge-creating company", whose only activity is continuous innovation [7].

Stating that the knowledge is an important value for the organization, T. Stewart divided it into three main categories:

- knowledge in the minds of employees – understood as skills, experience or way of performing their tasks,
- knowledge written in documents or other data storage device (video cassettes, software, other ways enabling fast access)
- knowledge that might be the subject to patent protection, property rights, trademarks or trade secrets [8].

The most important category is the knowledge in the minds of employees since only with its help one can create knowledge that is a subject to patent protection and knowledge written in the documents or other storage devices.

Following the steps of P. Drucker A. Toffler claimed that knowledge is not only the completion of power included in money and physical strength but it is a source of high quality strength, a source of power [9]. Toffler points out that the knowledge is the most democratic source of strength as it is flexible, nonfinite and can be used by many people in a continuous way [10].

Looking at the knowledge from the point of view of strategic resource, according to B. Wawrzyniak and M. Staniewski [11], we can distinguish three main research approaches appearing in the research of a knowledge-based organization. These approaches have been presented graphically in Table 1. presented below.

Table. 1. Research approaches concerning knowledge-based organization

Name of the approach	**1.Knowledge -based economy**	**2. Intellectual capital**	**3. Knowledge management**
Core of the approach	Transfer of knowledge and creating of learning processes in the societies	Intellectual capital building – human and structural, focused on creativity and innovativeness	Using or developing knowledge assets in the building and organization strategies' realization processes
Main research questions	What is the connection between knowledge and economy competitiveness and how are the processes in the economic policy organized, taking knowledge as a strategic asset	What is the value of the organization created by intellectual capital and how does it translate into the productivity of the organization?	How and to what degree is knowledge used in the organization from the point of view of organization strategy, including competitive advantage building

The first approach presented in the table above concerns the perspective of a country or a group of countries and refers to a knowledge-based economy. The other two approaches relate to the perspective of the enterprise or other organizations and these are: intellectual capital and knowledge management. The intellectual capital approach focuses on the study of the company's value and share of intellectual capital, while the knowledge management approach mainly refers to the organization's strategy and the use of knowledge as an important resource in the process of building and implementing the strategy.

A specific type of knowledge is knowledge about the links between technologies and needs, knowledge about existing problems and the organization of intermediary networks. It is the knowledge possessed by the employees, the knowledge of connections with their abilities and skills. R. B. Reich has recognized that almost all the resources of a high-value enterprise, together with their use, lose their value. The only exception is the ability of key employees to discover and solve problems. Machines wear out during use, raw materials run out, even patents and copyrights become obsolete. Meanwhile, abilities, skills and talents are not a typical resource, because the more they are used the more value they have. Engineers, mechanics or strategic organizers who have solved many key issues will be better prepared to solve even more complex tasks in the future. The value of these employees and in general the value of human capital increases with the acquired experience. In addition, the growing advantage of the experienced group of people translates into the next generations, because often additional earnings enable investments in education and training of children [12]. Reich notes that the value of intellectual capital as a

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key corporate resource is growing in comparison with physical capital. And because the true value of the organization is in the minds of employees, many assets will disappear with the departure of the most valuable employees. Of course, some assets will remain, for example patents and copyrights, but they will quickly lose value as they protect the discoveries made at a given moment [13]. At the same time, it is worth noting that patents do not cover knowledge about the existence of the market, its problems, or ways of serving it. For this reason, fast and wise followers can often benefit more from the market than brilliant and original inventors. Outdated solutions to old problems are being replaced by newer ones [14].

The so-called resource school, which is important for the development of intellectual capital and is also referred to as a school of resources and competences, is also one of the main concepts of strategic management. It emphasizes the need to develop the company through the use of available resources and its own potential. K. Obłój states that the essence of this approach is assumed that the organization is a collection of skills and assets (or resources), and the competitive advantage is built by skillfully reconfiguring these resources into key competencies of the company. On the other hand, the better an organization performs on the market, the better it defends itself against imitation or substitution by competitors, the more valuable the resources, skills and built key competences it possesses are [15].

Although the considerations concerning knowledge are very broad in the literature on the subject, they constitute almost a separate branch of economy, entering also the macroeconomic scale (for example, the "knowledge-based economy"), but for the purposes of this article the emphasis will be placed on the creation and use of knowledge at the level of enterprises and this particular type of organizations, such as universities. Creation and use of knowledge was the basis for the formation of the theory of human capital, and later also intellectual capital. After reviewing the evolution of the theory of intellectual capital through the use of the importance of knowledge, skills, and qualifications, it is worth moving on to the presentation of differences in the very definition of the term "intellectual capital".

3. Intellectual capital vs. profits achieved

The main objective of companies is to generate future profits. Since the entire functioning of the company is subordinated to this goal, it can also be assumed that the organization creates knowledge with the intention of gaining specific profits from it in the future. Such an approach to intellectual capital allows us to state that its two basic functions in an enterprise are creating and acquiring value (Fig.1) [16].

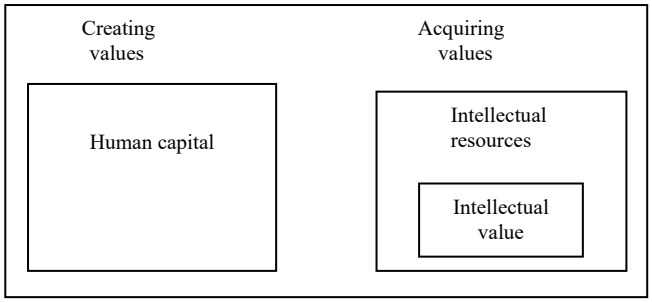

Figure 1. Creating and acquiring values by intellectual capital

As can be seen in Fig. 1. the process of creating values underlies human capital of the company. It is a human being who is a source of knowledge, its creating and sharing [17]. The remaining components of intellectual capital act as tools and take part in the extraction of value.

The role of human capital in its theory is also emphasized by C. Hughes. His theory points out the model "people as technology" (Fig. 2.). According to the theories of many scientists, value is created through technology development or investments in human capital. Hughes combines these two assumptions under the concept of human resources development. This model shows that a company's gaining market advantage consists of a set of specific values [18]:

- position – strength and structure inside the organization,
- use – value created in the workplace,
- maintenance – systems, processes and tools necessary to maintain the technology,
- modification – improvements and smaller or bigger modifications of the technologies,
- time – period necessary for the person or technology to perform particular tasks.

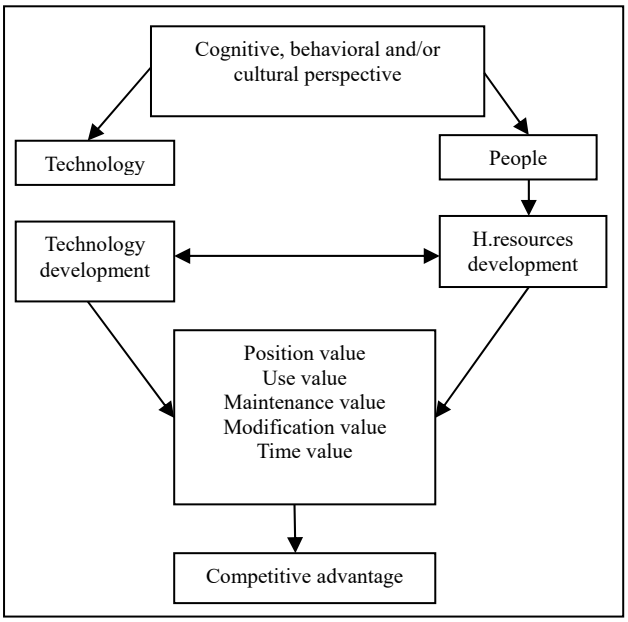

Figure 2. Model „people as technology"

A fundamental problem of traditional business indicators such as revenue, cash flow, profits, market share or tech-

nology leadership is that they do not actually provide information about whether a company generates value for its owners and shareholders or not. Creating value can only be talked about if the company produces more than it has invested in raw materials. For a long time it was commonly believed that the lower the cost, the higher the profit. Modern theories, however, define business activity as added value and prosperity, which is a much more complex approach [19].

As Fig. 3. shows, in order to achieve profits it is necessary to establish close relations with customers. It should also be borne in mind that material forms of value creation (income) depend on non-physical forms. In turn, an increase in nonmaterial assets is possible through efforts to create nonmaterial assets. The key to success lies in creating cause-and-effect relations between these two forms of value creation. In other words, it can be said that the main challenge of an enterprise is to create conditions that will initiate the creation of intangible assets and cause their transformation into physical forms [20].

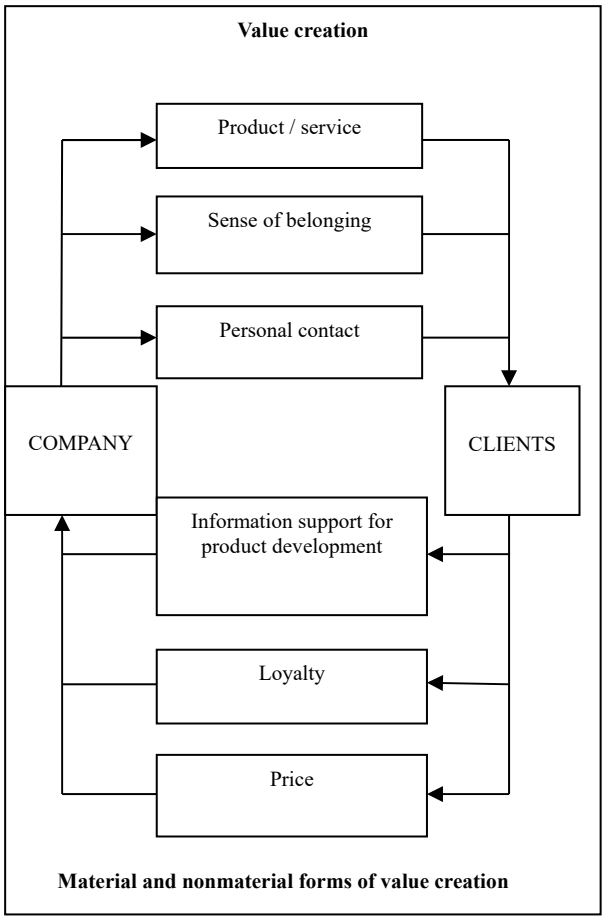

Figure 3. Diagram of value creation in the company

The ability to create value from intellectual resources depends to a large extent on the ways of managing and implementing appropriate business strategies in companies. For example, leading companies have increased the efficiency of their research and development processes by more strongly combining internal research and development with their business strategies and relying on external sources to gain access to full knowledge and complement their technology portfolios [21]. The OECD (Organization for Economic Cooperation and Development) has identified three basic ways in which a company can generate value based on intellectual capital [22]:

1. Increasing consumer surpluses.
2. Increasing producer's surpluses.
3. Increasing a market value of the company.

Particular components of intellectual capital influence creating a value to a different degree. A study carried out by H. Salleh and C. C. Huang among Malesian enterprises allowed for pointing out 10 main elements of the greatest impact (Fig. 4). The results turned out to be in line with similar analyses run by Bukh (2003), or Eccles (2001) [23], among others. The intellectual capital component of the greatest impact on value generating is connected to the human capital which is of key importance for the enterprise [24]. However, another employee-related element (motivation) was only ninth in the ranking. It might be noticed that as many as 6 in 10 factors are connected to client's capital development. This result is consistent with the study by Abdel-Maksoud (2005), who identified timeliness and number of customer complaints as a factor of key importance for the British enterprises [25]. The market shows that it is the knowledge, experience, competence and employees' know-how that is the most important component creating a value for the company. This is an important issue in so far as in the further part of the work the factors influencing the absorption of innovation will be analyzed and perhaps the components creating value for the company will also positively influence its ability to develop and implement new products and services.

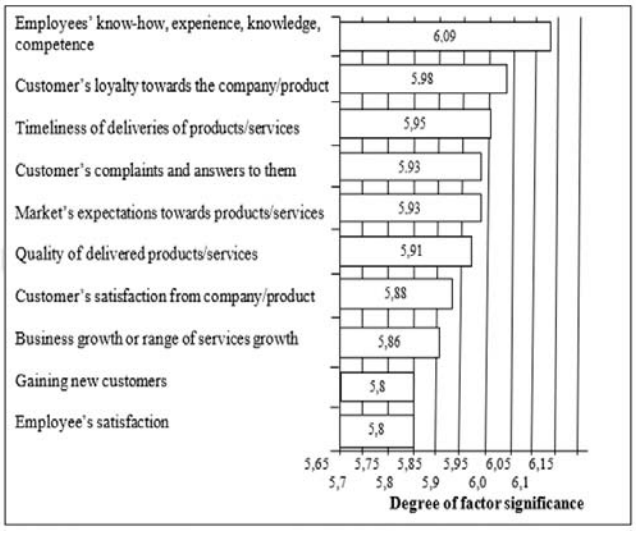

Figure 4. 10 main intellectual capital components creating values for the company.

Following the aforementioned paths of value creation on the basis of intellectual capital, in accordance with the vision

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and strategy of the company, using the available resources and activities, and on the basis of indicators reflecting the current situation of the company, leads to the generation of different values by intellectual capital. (Fig. 5.). A research carried out by S. Harrison and P. H. Sullivan resulted in indicating the most popular values by the entrepreneurs [26]:

1. Profits:
   - Revenue from products and services via:
     - sales,
     - royalty payments,
     - joint venture,
     - strategic alliances;
   - Revenue from the intellectual property itself via:
     - sales,
     - royalty payments,
     - joint venture donations (tax deductions),
     - price premiums,
     - sales increase.
2. Strategic position:
   - Market division,
   - Leadership (innovative, strategic, etc.)
   - Standard setting,
   - Name recognition via:
     - brand,
     - trademarks,
     - reputation.
3. Gaining innovations of others.
4. Customer's loyalty.
5. Costs reductions.
6. Increased productivity.

Companies ascribe certain sets of roles to the intellectual capital in order to acquire certain values from it. While many people imagine profit-generating function as the most conspicuous one, there is a range of other roles that bring different advantages to the enterprises [27].

- Deffensive roles:
  - protection of products and services which are the result of company's intellectual capital innovativeness;
  - freedom of designing;
  - avoiding conflicts.
- Offensive roles:
  - generating of profits:
    - from products and services which are the result of company's innovativeness,
    - from the company's intellectual properties,
    - from the company's intellectual assets,
    - from the company's knowledge and know-how;
  - creating standards on the new markets or for new products and services;
  - gaining access to other technologies;
  - gaining access to new markets;
  - as a basis for business alliances;
  - support for the company's business activities;
  - creating access barriers for new competitors.

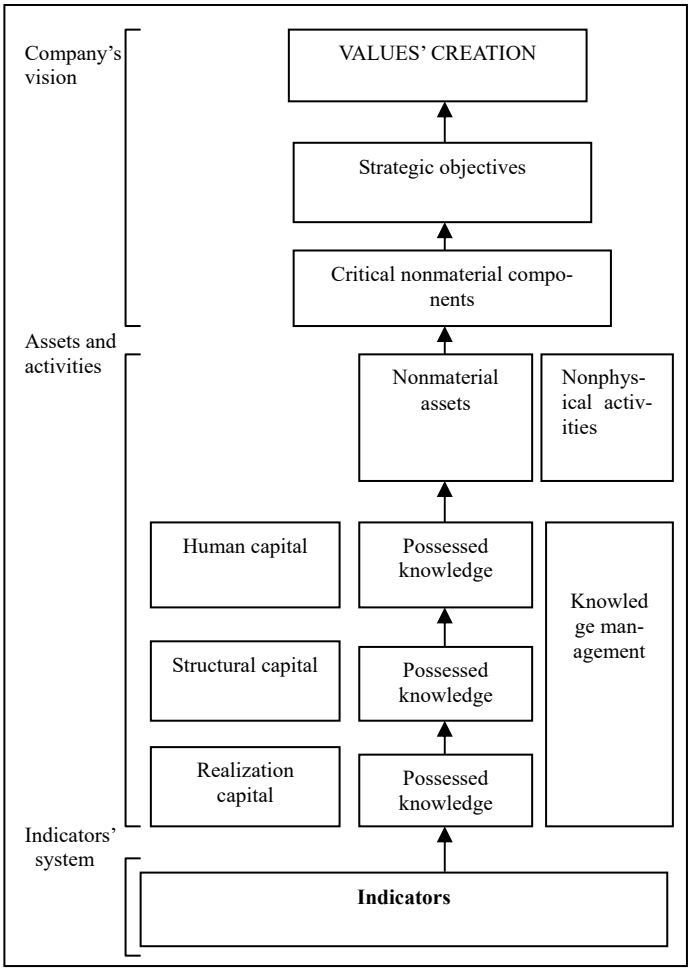

Figure 5. Value creation via intellectual capital

Among the indicated offensive roles is gaining access to other people's technologies, which may translate into the introduction of products and processes that are copies of existing solutions to the company. On the other hand, the above-mentioned creation of standards for new products and services may contribute to the development and implementation of innovative solutions on a national and global scale. Creating and acquiring value through intellectual capital is very much rooted in the philosophy of functioning of every organization. Such orientation of the management concept is a long-term strategy of the organization, whose main goal is to increase the company's ability to generate value in the long term [28]. Intellectual capital has a value that no other asset of the organization can possess. Recognizing the role of intellectual capital as a key factor generating future benefits requires a proper management. Both companies and universities that want to keep their competitive advantage perceive intellectual capital and processes connected to its disposal as a basic components of future value creation [29]. Effective intellectual capital management can also create a value for the organization in form of increasing the ability to absorb innovations [30], it can translate into a higher level of innovativeness of a given organization. Strategies of introducing innovations in the organization influence increasing the value of a given or-

ganization – both commercial company and this specific type of organization which is the university.

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