management

CONTENTS

Competitive Strategies in the Conditions of Digital Economy

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The work deals with the complexity of creating and implementation of a competitive strategy in the conditions of digital economy. It analyses the characteristics of digital economy and the changes it brings about from the point of view of the strategic management. Special attention is paid to the analysis of the specific features of the business environment, network infrastructure and the nature of competition. The focus of our attention are te knowledge, information and ideas as resources. The study presents some current approaches to facors of competition, creation, and achievement of competitive advantages and also some concrete examples of a successful Internet business, with the prospects of its further develoment.

1. Introduction

The development of digital economy brings about the challenges related both to exploring and anticipating the opportunities in the external environment and to novel approaches to business doing. The implications of the changes in strategic thinking deal with the re-defining of the industrial structure, that is, the boundaries of certain activities, primarily from the input point of view. The exchange of information via the Internet, extranet and intranet can be viewed as a source of value creation.

The modern, largely Web-based environment characterised by a growth orientation of the firm, its customers, suppliers and competitors towards electronic business means changes in both the strategic and operational management, and especially in the method the firms compete. The Internet use has broken through the space and time barriers, making the importance of physical location negligible. The predominant resources in the digital economy are knowledge, information and ideas.

Important in this context is a novel approach of Webonomics which is concerned with the study of production, distribution and consumption of products, services, and ideas via the Web [1]. The interactive relationship between the firm and its external stakeholders is very important here. It means an increasingly intensive networking. The managers make business decisions in an environment characterised by a network infrastructure, both the hardware and the software used in the communication. Cellular communication means new opportunities offered by media convergence.

A growing portion of economic value in the digital economy is the result of electronic devices. New "rules of the game" demand speed, flexibility and innovative-ness. Traditional firms have to change their strategic orientation and business operations in order that they should remain competitive in the changed conditions and with new electronic infrastructure.

The origins and development of the digital economy are based on the expansion of the knowledge industries and the implementation of information and communication technologies (ICT). The information-based firms known as "soft" companies increase their share in value creation in a large number of economies. This predominantly applies to the firms engaged in the production of software, telecommunications, financial services, advertising, and media.

2. Dynamic approach to competitive strategy creation and implementation

From the point of view of increasing competitiveness, the concept of strategy refers to the guidance of the firm in the conditions of competition in order that the firm should achieve competitive advantages, not only as regards the customers or users of services, but also as regards anything that can ensure advantages on the home or export markets. In case of the entrance on the electronic market, the firm's prospects are better if managers develop a competitive strategy bearing in mind the complexity of change brought about by the digital economy.

The leading companies in the world today implement different strategies. Generally, however, the companies achieve competitive advantages vie innovations in a broad sense, ones that can be manifested as a new product / service, new technology or a new marketing approach, where innovation is mostly derived gradually. In the international market conditions, the innovations that result into competitive advantages are often anticipated by the needs that arise both at home and abroad. Here the role of information in the innovation

and renewal processes is essential, especially the information that is not available to the competition or that competition does not seek. Besides, when the firm achieves a competitive advantage via innovation, it can remain competitive only through permanent improvement, since it is a well known fact that any innovation can be imitated. It is in this way that the firm remains competitive on the foreign market as well. Hence creating permantent advantage often means that the firm has to make all its existing advantages obsolete, otherwise, the competition will do it. Thus innovation and change are connected.

The issue that merits special attention here is that of the production factors whose available quantity in a defined time is less important than the rate and the efficiency with which these factors are created and improved in certain industries. This primarily includes highly significant factors today, such as scientific base or skilled human resources.

Importantly, the absence of advantage in the static competition model may become an advantage in the dynamic one. When, for example, the firm encounters some difficulties, such as high prices or lack of a certain resource, it often has to introduce innovation and to improve its operations in order that it should be competitive again.

Creativity also has an important role in achieving competitive advantage. Three components: expertise, creative thinking skills and motivation "overlap" to result into creativity that generates the key success factors of a certain business [2].

The dynamic approach assumes that formulating and implementation of a competitive strategy is a continually evolving process of prompt adjustment to a changing environment, since the condition in the external environment often change before a selected strategy has been fully implemented. Such a dynamic process involves three independent and simultaneous cycles related to the analysis of competitive environment, development, the analysis of alternative strategic options, and the analysis of the very translation of the strategy into practice. The solution is found in formulating new strategic approaches, continually, throughout the process of the firm's adjustment to a dynamic competitive environment, as well as in changing the strategies in the course of their implementation. Most relevant in this process are an efficient strategic guidance, especially strategic vision, pragmatism and communication networks. These result into a new strategic challenge from the managerial aspect.

The change in the business processes themselves in the concrete conditions of a turbulent environment is complex. It is in this context that the concept of a *learning organization* must be taken into account.

It is important that the competitive environment should continually be studied in order that the signs of demand saturation, technology substitution, changes in the consumption structure and social discontinuities should be timely identified. If there are any signs that a market will cease to be profitable in a future period, the firm will seek an opportunity on another, broader, home or exports markets or in a market niche.

The insight into the dynamic nature of a competitive environment means focusing upon its essential aspects that are changing, as well as analysing whether these changes are strategically relevant. The following step is to survey individual impacts and a structural analysis to identify the key forces in the external competitive environment. Thus we can identify and analyse the competitive position of the firm as related to other organizations that compete for certain resources, or offer their products/services to the same customers. Here the competitive analysis of a strategic group is implemented in terms of similarities or differences between the competitiors, as well as in terms of the market share analysis. The final step is the analysis of whether any opportunities or threats are identified from the aspect of the future business of the firm, namely, whether the strategy and structure are adjusted to the development in the external environment. It is in this way that we get an insight into the environmental impacts which is important in the strategy analysis, as strategic decisions in the digital economy are predominantly made in the conditions of uncertainty.

The aim of the change of strategy is to identify the *strategic gap* that defines the disparity between the current strategic position of the organization and the positions defined by each individual strategic options, as well as to set the timing of implementation of the selected form. Generally, the process of changing the competitive strategy is important because it shows a particular strategic option that may result into a most favourable position for the firm, as well as whether this strategy can be translated into practice within the given period of time. The advantage of a dynamic strategy formulation is in a constant review of varieties/types and identifying the strategic gap, thus eliminating potential threats in taking new opportunities.

All these require that, in case of the dynamic development of a strategy, the mental models reflect the com-

plexity of the real world which results into a continual adjustment process. Here the "soft" data are as important as the "hard" data, since they tell us about the firm's values, principles, identity and challenges. It is important to note that managers also use heuristic methods, due to the type of uncertainty inherent to strategic problems.

In order to be successful, the organization has to create value for its customers/service users and other stakeholders is a distinctive manner, through competitive positioning and integrated service it offers. In this context, the competitive strategy can be defined as a value creation "skill" that ultimately allows for the managers to identify the opportunities to create value for their customers and earn profits. Various factors work within the business networks frame and jointly create value in new forms, which implies an entirely new value logic in the digital economy conditions. Here the importance lies with the firm's competencies, primarily the technology, the implementation of information and comunication technology, specific expert knowledge and new business processes accumulated over time and incorporated into the offer "package" of the firm. In the conditions of fierce competition, it is important that the customer is willing to buy the firm's products, but also to pay for them, which includes the possiblity of electronic payment. Hence an important advantage of any firm is its established customer database.

An increasing number of firms involve their customers into the product design process in order to view their needs from the real world. This often means an integration of marketing and research and development funstions [3]. To measure the competitive strategy efficiency the indicator related to profitybility per customer is also used.

3. Relevance of knowledge as resource

Knowledge management is of utmost importance when it comes to achieving competitive advantage. Knowledge exchange and implementation have in the last years been identified as key sources of sustainable competitive advantage. Improvement and strategic choice mean learning something new, especially in teh conditions of a fast changing business environment characterised by a modern, knowledge-based economy.

In this paper we especially focus on the *Balanced Scorecard (BSC)* as an important new method to measure the firm performance [4]. The implementation of the BSC is especially interesting from the point of view of an increasingly important role of knowledge as an intangible resource that often results into important innovation and here the BSC allows for a comprehensive insight into the business results from the innovation and learning aspects [5].

In order to increase competitiveness in the conditions of permanent changes characterised by the development of digital economy the firms should open their boundaries wide in the learning process, stimulate the exchange of ideas via project teams and meetings with customers and suppliers, which all help the firm identify competitive opportunities better. In the conditions of such supportive, open environment, we find a positive practice of developing learning forums such as strategic study of a changeable competitive environment; the product/service portfolio; technological change and the firm's market position; interfunctional processes and delivery systems analysis; the study of competitive strategies of the most successful companies for the purpose of better understanding of their distinctive competencies, changes in the marketing mix tools, the resulting increase in the market share and capturing of new markets.

From the point of view of creating competitive advantage it is important that the employees should be encouraged to be creative and innovative in mastering new and more successful methods of production or service delivery to customers. Innovation may result in lower costs, differentiation and faster response to oppotrunities and threats from the external environment, which stresses the core organizational competencies and capabilities. The realization of competitive advantage is facilitated by good internal and external communications without which the organization cannot learn the best practical solutions.

The organization learns about the need to change on the basis of observation and interpretation of the events in the environment where the external stakeholders are – the state with its economic policies, the financial institutions, suppliers, customers, competition. It is on this basis that managers make decisions on the activities they should undertake, followed by the execution of necessary changes. These changes in turn affect other organizations (competition, suppliers, customers) in a situation some authors call the environment of "competitive chaos". They interreact in a feedback and the firm learns again of the impact and output of its decisions. Hence it is clear that learning is essentially important in the competitive strategy formulation and implementation. From this point of view, it is necessary that the role of management consulting be awarded due importance [6].

Generally taken, what goes on outside the firm has a larger impact upon the firm's competitiveness than ever before. This external world full of challenge increasingly involves products and other substitutes, changes in economy and good market, the results of the operations indirectly related to the firm and new ways of people's behaviour, including new ways of communication via the Internet. Information and communication technologies evidently affect all the above

mentioned. In the conditions of digital economy the customers enjoy access to a larger number of information, there is a strong feedback, and they become more demanding. These changes surely can inspire opportunities for the achievement of future competitive advantage. As a specific managerial tool, the *competitive intelligence (CI)* is of special importance for in the manager's proactive operations as regards the competition [7]. It provides him with a timely insight into the

changes in the external reality. The competitive intelligence actually means the knowledge of the overall environment and provides activity-oriented answers to the managers who make strategic decisions concerning competitive positioning in the future , where it is necessary that they should be prepared for a variety of aspects of business doing different from what they are used to, and in strategic management this may mean new ways of thinking based on the "look at the outside". This may result in activity, that is, in the firm's business operations that competition either does not expect or does not recognize clearly enough.

4. Competitive advantages in the conditions of digital economy

A fast ICT development resulted in the change in the way the goods are produced and the services are delivered, the nature of products and services themselves as well as in the distribution channels. In the last decade, the digital economy has been an important driver of structural changes and economic development in industrial countries and in certain regions [8]. Numerous sectors of economy are being transformed through a fast development, adoption and implementation of innovation from the information and communication technology sphere. Especially striking are the changes in the field of the expanding service provision. From the point of view of the firm and the economy in general, the impact of ICT is primarily felt in reducing transaction costs. In case the ICT clusters are formed, the firm's location is also becoming important.

In creating an appropriate competitive strategy in the conditions of the digital economy the managers should analyse the firm's position as regards the competition in the sphere of electronic business. Also important is the decision on what should be an adequate role of electronic business in traditional companies. The firm's competencies in the field of information and communication technologies, as well as the needs for financial resources have to be analysed thoroughly. The developments in the field of cellular telephony are expected to be spectacular in the future.

From the competitive strategies perspectives, the classification of business in the new economy, based on the "physical/digital" characteristics is also important [9]. The product may be physical or digital, the process, too, may be physical or digital, and so may be the case with the mediator. This results into nine different types of business, from those purely "physical", to fully digital business types where the product itself, the process, the delivery and the payment are digital.

The use of the Internet in the digital economy has led to a change in the configuration of certain jobs, as well as to a balance between producers, mediators, and customers. Characteristically, the customer becomes the "king" of new economy [10]. Thanks to the Internet, he is very well informed on the offers of a variety of manufacturers, or service providers, at relatively low costs of searching, which enables him to make fast comparisons and choose the most appropriate product of a quality, design, and price that he finds appropriate, even in global conditions.

Doing business on the Internet includes not only buying and selling, but also delivering services to customers and cooperation with business partners. It is differentiated in comparison with the traditional way of business doing also in that it eliminates the problem of time difference and geographical distance between the business partners in terms of goods ordering and payments; in case of certain products it applies to the delivery as well. It is in this way that the boundaries of business are expanded to electronic products. From the economic aspect, however, it is important that the return on investments in electronic commerce be higher. The customers should be offered higher quality products adjusted to their needs, at lower prices and with higher qualty services. Here we need an appropriate software that helps maximise the effectiveness via a new method of business doing. Its advantages are in the improvement of quality, activity, the additional services, on one hand, and in the reduction of costs and sales prices, shortening the time cycle, or transaction, on the other, which is especially important in the conditions of the global economic crisis and recovery. Also important is the managerial decision making in the domain of pricing [11].

Characteristically, many companies have lately achieved a considerable business success implementing, alongside the traditional business, a new model of electronic commerce. A typical example is a well-known American retail company, *Wal-Mart Stores* [12].

The networking equipment market is characterised by a fierce competition globally. The example of *Alcatel-Lucent* is illustrative: among the sources of competitive advantages the company gives priority to technological improvements, product and service quality, a reliable and timely delivery, competitive production costs, flexible production capacities, local attendance and long-term relations with customers [13]. An important factor of differentiation as regards the competition in the conditions of recession may be a desire and competence to offer certain forms of financing.

Within its strategic orientation the *Samsung* company advocates a *Smarter Life Concept*, especially in Europe. The concept is based on *smart design* that improves the functionality of the products for the customers, on *smart experiences* and *smart connections* that will ensure that the Samsung products can interconnect automatically, share the contents and improve customer experience [14].

It is important to note that, contrary to the previous failures of a large number of *dot.com* firms following the initial "boom", the pure *dot.com* strategy proved successful in many cases nowadays. This is also characteristic of many an *on-line* auction.

New business strategies on the Internet focus on the importance of information. Economic information is fundamentally different from the economic "thing". When a physical product is sold, it is not owned any longer, whereas information retains ownership after the sale and can be sold again. A physical thing can be replicated, however, this costs as much as manufacturing the "original". On the other hand, the costs of multiplying information are really low, even taking into account the initial costs of research, development, experimenting, and testing. While things wear off or are spent in time, information may become obsolete, however it may gain in value through use. It is evident that tangible products exist in time and space, and that they can be counted or kept in stocks, while information can be found "anywhere and at any time" [15].

The synergy effects in the cooperation between firms were recognized at the first European B2B Internet market for commodity industries in 2000. It was initiated by the *Nestlé* and *Danone group* companies as leaders in the food industry, and was further established by *Henkel* and *SAP Markets* on mySAP.com e-busness platform [16].

A growing portion of economic value in the digital economy is the product of electronic devices. In the new economy which is dynamic, global and networked, the most important competitiveness factors are innovations, product and service quality, time and low costs. From the economic aspect, it is important that marginal production and distribution costs for digital products are very low. This refers to software, music, electronic books and magazines, films.

The importance of connectivity enabling innovation and technologies increases, since communications are the basis of *on-line* business. Certain authors use the term *click-here economy*, linking it to a broader choice

of customers due to the Internet use. The same logic can be applied to the business related to the transactions between two organizations – B2B (business-to-business), where electronic catalogues and direct electronic connections change the supply practices of the firm. All the above analysed show that understanding that the Internet customer is an entirely new entity for whom *on-line* behaviour is typical makes the crucial first step in creating a competitive strategy.

In the case of "new" customers the subject of their purchase (tangible and electronic products), the reason and the manner in which they make their purchases change. In an interactive communication with the company on the Internet they express different expectations. Here the expression "Market is conversation" gets its full meaning. The customers expect a product or a service especially adapted to them in the customation process. Besides, they can buy comfortably seated in their rooms or offices, 24 hours a day, 7 days in a week, which is in the "digital world" known as "24x7".

In case of alternative competitive electronic business strategies, practice has shown that managers often create strategies that, starting from the model of generic competitive strategies proposed by M. Porter, simultaneously follow the orientation towards low costs, differentiation, and focusing [17].

In their relevant and quite unique approach, A. Hax and D. Wilde propose a new framework for generic strategies in the conditions of modern, knowledge-based, global economy – the Delta model in the form of triangle whose three tenets represent three types of new strategies: the best product, solutions for customers, and connections [18]. The strategic option of developing the best product is related to the traditional sources of competitive advantages on the basis of lower costs in comparison to competition and differentiation. The second strategic alternative is developed in case of a broader concept of offer of a product or a service that meets the majority of or even all customers' needs. The focus here is upon the customer, rather than a product. This is largely viable due to the possibility of direct communication with customers via the internet. From the aspect of a successful design and implementation of this strategy the relationship marketing is very important. The firm tends to provide a related group of products and services aiming to increase the customers' ability to create their own econimic value. The innovation process is oriented towards a joint approach (with customers) in the development of distinctive products and building and maintenance of a long-term relationship with them. The

broadest range is the one belonging to the third strategic option which starts from the systems approach to business, taking into account all those who contribute to the economic value creation.

The resource-based strategic concept primarily deals with with the problem of how the firm can provide the factors necessary in creating core competencies that make the basis for establishing sustainable competitive advantages in the complex process of strategy implementation. Strategy is also understood as a function of quality and quantity of the firm's competencies without which it is basically "powerless". The newly established relationship between firms of various sizes, their cooperation and networking resulted into the generation of a new mental space as well as into the implementation of genuine business models on a global basis. The development of business connections leads to innovation outsourcing practice too. Besides, innovative processes require flexible and customized responses and answers, a continual experimenting and testing. In the conditions of digitalization the products are increasingly made to order, and information is highly personalized [19]. One of the key words of the new strategic approach is the strategic framework whose typical features are non-linearity, changeable boundaries of the firm, holistic understanding of the business, involvement into industrial clusters, open-ended innovation and a continual review of business models. The analogy with biology via understanding the business ecosystem, as well as the analogy with physics via energy related categories are inspiring.

Also relevant is a recent *poised strategy* approach and the adequate method of performance measuring [20]. The poised strategy is connected to the firm's dynamic competence the basis of which is a specific way of thinking, the managerial skills of balancing, as well as the organizational competence to energize, revitalize and change itself. Such an organization is characterised by a creative energy and dynamics through "movement" in different or newly created conditions. In practice, the poised strategy means a larger number of business models in order to realize the innovation of values for the product buyers or service users that the firm offers. The incremental and penetrating innovation competencies in business networks understood as eco-systems are also important.

The capacity space, as a specific type of mental space, includes the attitude towards resources, competences and dynamics of innovation, and is especially important when a manger focuses upon improving competitiveness. The intangivle intellectual assets have be-

come crucially important as a competitiveness factor at the beginning of the 21st century. The committment to study, to knowledge acquisition and sharing is immanent to innovative firms. The networking of knowledge is a process running both inside and outside the company, with open-ended innovation processes. The poised strategy focuses upon a specific rejuvenation of the firm, via a challenging dynamic re-energizing based on manifold business models in varied business eco-systems connected to a large number of business competencies, suitable for multidisciplinary and multidimensional knowledge, with adopting appropriate impacts, which basically is a vitalistic approach to business and its organic connections.

Especially challenging for the companies oriented towards innovation-based competitive advantages creation are issues related to human resources – recruiting and development of innovators who will create an important invention as a turnpoint in the developmental sense, since talent is a rare resource. The estimates are that only 5-10% managers with high potentials in modern corporations command the skills and capabilities to become innovators in any given period of time [21]. In a large number of manufacturing and service industries, the creation of a powerful base of talents in the company and the building of intellectual capital are considered to be crucial for a satisfactory implementation of a competitive strategy and achieving planned goals. Many successful companies conduct intensive processes of talent management. These initietives may result into the creation of a specific innovation node from whose perspective the innovators will have a better insight into how the existing products, services, ideas, human resources or the entire business may be recombined in new, value adding ways.

The analysis of the Bloomberg Businessweek list of the most innovative companies in the world in 2010 has shown that the "top 12" were the following: *Apple, Google, Microsoft, IBM, Toyota Motor, Amazon.com, LG Electronics, BYD, General Electric, Sony, Samsung Electronics, Intel* [22]. Importantly enough, the list contains a large number of Asian companies, innovative in global aspects. The majority of the companies listed rank among the most competitive companies in terms of their offer on the global market and as concerns the demands of digital economy. It is important to stress that the sixth best *dot.com* company is the *Amazon.com* company which has successfully implemented both the diversification strategy and the competitiveness improvement strategy on the basis of certain categories of cost reduction. The highest income growth rates among the "top 12" in the 2006 –

2009 period were achieved by *BYD* (42%), *Google* (31%), *Apple* (30%), and *Amazon.com* (29%).

The strategic orientation of the Apple company includes its committment to the best consumer experience of their customers through innovative hardware, software, computer peripherals, services and the internet offer. The focus is upon the company's competence to design and develop its own operating systems, hardware, application software and services in order to deliver new products and solutions with a superior user-friendliness, compatibility of the new software versions and an innovative industrial design [23]. It is in this way that from the competitive point of view new concepts are implemented, ones that have been presented in this paper and are relevant in the conditions of the digital economy. Especially important is the fact that the Apple company is successfully positioned in comparison with the competition, that it offers superior and well integrated solutions related to what in the recent period is understood as a digital lifestyle, and, which is especially important, to efficiency improvement. Building competitiveness largely depends on the ability to ensure a continual process of introducing innovative products and technologies on the market. The Apple company is known for its design and development of almost complete solutions for their products, including hardware, operating system, numerous software applications and integrated services. Such a strategic orientation implies substantial investments into research and development, amounting to $ 1.1 billion in 2008; $ 1.3 billion in 2009; reaching $1.8 billion in 2010 [23]. Besides, the company is oriented towards achieving competitive advantages in the area of cellular communication and media devices, including iPhone and iPad. This is a highly competitive industry where a number of large, experienced and recognized companies work and the competition is expected to grow fiercer still. Achieving competitiveness largely depends on the ability to place new products with high profit margins and in a longer term.

5. Conclusion

The digital economy with developed knowledge networks bears manifold implications on managerial strategic thinking that results into new approaches and manners of formulating a competitive strategy, as well as into the strategy implementation processes. Especially important is that this should provide results in the firm's business practice, as well as help respond to the challenges and take opportunities of further development using the advantages of new electronic infrastructure.

Markets are in many cases characterised by a frequent introduction of new products and services, as well as by fast technology improvements. Low costs and sales prices, especially in the conditions of the economic crisis and recovery remain important competitive factors, however, the product characteristics such as quality and reliability, innovations related to design, marketing competencies, service and post-sales support, the brand name and the company reputation are important too.

Fierce competition is characteristic of a large number of business domains in the conditions of digital economy. Highly competitive markets are marked by a fast technology improvement, changing approaches to designing, new solutions in the industrial design area, short life cycles of both physical and electronic products, but also by the individual and business customers and service users' sensitivity to the price levels.

More fierce competition is anticipated in the development of cloud computing which is important from the point of view of an evolving digital economy. Innovation will remain one of strategic priorities of many companies, especially in the IT sector, in the future period.

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Ecological Footprint as Indicator of Students Environmental Awareness Level at Faculties of Organizational Sciences, University of Belgrade and University of Maribor

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The Ecological Footprint is a complex sustainability indicator that answers a simple question: How much of the Earth's resources is demanded to support humankind lifestyle and activities? Ecological Footprint translates consumption and waste flow data into a measurement of the biologically productive area required to sustain that flow. We used Ecological Footprint as input feature that provides an effective heuristic and pedagogic tool for capturing current human resource use. The key aspect of this paper will be focused on the measuring of environmental awareness level among the students of the Faculty of Organizational Science, University of Belgrade and University of Maribor. For the determining student's environmental awareness level and their Ecological Footprint, we used a closed form questionnaire with 15 questions. Statistical analysis has been performed in SPSS software package.

1. Introduction

Human economy depends on the planet's natural capital that provides all ecological services and natural resources. As a result of population increase and economic development, humans have exerted a considerable impact on the earth and are facing a series of incompatibilities among the natural resources, environment, and economy, such as the dichotomy of population growth and depression of resources and environment deterioration. It is required a new concept of development – one which is sustainable and which takes into account the satisfaction of the needs and wants of every citizen of the earth, of the pluralism of societies and of the balance and harmony between humanity and the environment. The implication of this ecological situation is obvious: to be sustainable, human beings must live within nature's carrying capacity; and they must measure where they are now and how much further they can go, [32].

Significant changes must occur in the entire world to assure the kind of rational development – changes which will be directed towards an equitable distribution of the world's resources and more fairly satisfy the needs of all peoples. This kind of development will also require the maximum reduction in harmful effects on the environment, the utilization of waste materials for productive purposes, and the design of technologies which will enable such objectives to be achieved, [25].

The reform of educational processes and systems is central to the building of this new development ethic and world economic order. Recommendation 96 of the Stockholm conference on the Human Environment called for the development of environmental education as one of the most critical elements of an all-out attack on the world's environmental crisis, [33].

The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones. Environmental education means a brand-new style of life, new ethical and cultural values and responsible persons. Environmental education can be defined as "learning to protect and improve environment in a systematic, planned and knowledge-based way during the whole human lifecycle in order to spread awareness about basic characteristics of environment, its structures and relationships that tends to make a human protect and improve environment in a way that will ensure humans' existences now as well as in the future", [16, 17. 18, 24].

The one of key characteristic of environmental education is action because environmental education has to promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental problems and issues as a basis for environmental problem solving and action. Because of these, occurs a need for an adequate measurement of these environmentally sounded actions, and as a good tool for this measurement it can be taken environmental indicator – Ecological Footprint.

Ecological Footprint (EF) is used to translate consumption and waste flow data into a measurement of the bio-

logically productive area required to sustain that flow. In this research Ecological Footprint was used as input feature that provides an effective heuristic and pedagogic tool, at courses of Environmental Management and Technological Systems and Principles of Ecology, for capturing current resource use of students of the Faculties of Organizational Science, University of Belgrade and University of Maribor.

2. Importance of environmental education

The Belgrade Charter was adopted by a United Nations conference in 1976 and provides a widely accepted goal statement for environmental education: "The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward the solutions of current problems and the prevention of new ones."[25]. A few years later, the world's first intergovernmental conference on environmental education adopted the Tbilisi Declaration. This declaration is built on the Belgrade Charter and established three broad objectives for environmental education. These objectives provide the foundation for much of what has been done in the field since 1978:

- To foster clear awareness of and concern about economic, social, political, and ecological interdependence in urban and rural areas;
- To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
- To create new patterns of behavior of individuals, groups, and society as a whole towards the environment, [26].

Environmental education's essence is in its role in the education for a sustainable future. That's the reason why environmental education uses content from the environment, economy and society to organize learning processes that help understanding the evolution of human interaction with the environment through development, to analyze present realities, and to plan and participate in coherent processes of change toward a more sustainable future. This set of knowledge, skills and values, endorsed by representatives of all sectors of every society, is the framework for education for sustainability and the basis for much of the new curriculum planning taking place across the world. This kind of education (for sustainable development) is learner-centered, providing learners with opportunities to construct their own understandings through hands-on, minds on investigations. Learners are engaged in direct experiences and are challenged to use higher-order thinking skills. Education for sustainable development supports the development of an active learning community where learners share ideas and expertise, and prompt continued inquiry. Also, this education provides real-world contexts and issues from which concepts and skills can be learned. It recognizes the importance of viewing the environment within the context of human influences, incorporating an examination of economics, culture, political structure, and social equity as well as natural processes and systems.

Through comprehensive, cohesive programs, learners explore how feelings, experiences, attitudes, and perceptions influence environmental issues. They become knowledgeable about natural processes and systems and gain an understanding of human processes and systems. They develop a sense of their rights and responsibilities as citizens, are able to understand the ideals, principles, and practices of citizenship in democratic societies, and they gain the skills necessary for citizenship, [17]. The awareness, knowledge, and skills needed for these local connections, and understandings provide a basis for moving out into larger systems, broader issues, and a more sophisticated comprehension of causes, connections, and consequences. Education for sustainable development fosters skills and habits that people can use throughout their lives to understand and act on environmental issues. It emphasizes critical and creative thinking skills along with other higher level thinking processes that are key to identifying, investigating, and analyzing issues, and formulating and evaluating alternative solutions. The aim of good higher environmental education is to enable students to work in or lead interdisciplinary teams to find solutions, using environmental sciences and management methods, so that they'll be skilled to devise integrative environmental knowledge and management solutions for complex environmental issues on a regional, national and international level, for the private as well as for the public sector. What has to be offered in the program of good higher environmental education is interconnected with the wide range of requirements in professional life; therefore the program of higher environmental education is designed to meet these new sustainability challenges, by integrating inputs from the social and human sciences into the study of environmental planning and engineering, [17, 18]. The focus is on how firms, governments, and other organisations can support sustainable development in an economically efficient and socially acceptable manner. Logical, the mode of teaching modes varies throughout the higher environmental education program and includes formal lectures as well as project-based individual and team studies, during witch students are asked to

get actively involved in organisational and contents related aspects of the teaching program, giving feedback for a continuous advanced evolution of higher education for sustainable development and future, [15].

3. Ecological footprint

From this point of view, struggle for ecological services and goods will play a most important function in the 21st century. All human activities require the use same property of earth - primarily biologically productive land, but also includes land used for buildings and roads, food production, the production of energy and material resources and land required for waste-disposal and the absorption of emissions. In the early 1990's the Ecological Footprint concept was created by Mathis Wackernagel and William Rees at the University of British Columbia [20, 28, 29], and nowadays Ecological Footprint become established as important environmental indicator.

The Ecological Footprint tracks the area of biologically productive land and water required to provide the renewable resources people use, and includes the space needed for infrastructure and vegetation to absorb waste carbon dioxide (CO_2). The Ecological Footprint is an accounting framework that tracks humanity's competing demands on the biosphere by comparing human demand against the regenerative capacity of the planet. In order to determine whether human demand for renewable resources and CO_2 uptake can be maintained, the Ecological Footprint is compared to the regenerative capacity (or 'biocapacity') of the planet. Biocapacity is the total regenerative capacity available to serve the demand represented by the Footprint. Both the Ecological Footprint (which represents demand for resources) and biocapacity (which represents the availability of resources) are expressed in units called global hectares (gha), with 1gha representing the productive capacity of 1ha of land at world average productivity. The collective impact of this land consumption determines the limits for our local functions. The following [9]:

- Biodiversity land,
- Bioproductive land (Arable land, Pasture land and Forested land),
- Bioproductive sea space,
- Built land,
- Energy land.

Relying on *Oslo Methodology*, Ecological Footprint can be defined as, [1]:

- a *method* for calculating and evaluating the environmental impact of the consumption of goods and services;

- an *indicator* that provides a simplified demonstration of significant environmental impacts from various types of consumption;
- a *tool* for environmental impact assessment when considering different alternatives in a political/administrative decision-making process, or for reporting on the state of the environment in a regions.

The Ecological Footprint is a resource accounting tool that measures how much biologically productive land and sea is available on Earth, and how much of this area is appropriated for human use. The Ecological Footprint clarifies the relationship of resource use to equity by explicitly tying individuals' and groups' activities to ecological demands, [30]. The Ecological Footprint analysis attempts to measure human demand on nature. It compares human consumption of natural resources with planet Earth's ecological capacity to regenerate them.

Calculating Ecological Footprint we make effort to measure how much biologically productive area is required to produce the yearly resource flows consumed by the residents of a region (a city, a country, or the world), to absorb wastes or emissions (especially CO_2), and to host the built infrastructure in that region, [4].

In future, the Ecological Footprint can be used in process of identifying and planning strategies, which can help us to succeed in a world of limited resources, and ensure their rational use. The world average of Ecological Footprint last year was 2.7 global hectares per person, while the Ecological Footprint of Europe was 4.7 hectares. The situation in Balkan is a little bit better, the lowest footprint is in Serbia (2.4 ghp), than it comes Bosnia and Herzegovina (2.7 ghp) and Croatia (3.7 ghp), and with highest Ecological Footprint in region has Slovenia with 5.3 global hectares per person, [9].

4. Results of statistical analysis

4.1. Results of statistical analysis for students of Faculty of Organizational Sciences, University of Belgrade

Environmental Management course is taught at the third year of undergraduate studies at the Faculty of Organizational Sciences, University of Belgrade. Survey was conducted on 44 students (more than 40% of total number of students which is by all means a characteristic of a representative sample). Students answered on 15 closed-type questions and according to their responses, the EF value was calculated for each of them. Creation and evaluation of survey was based on the Global Footprint Network standard. After attending course of Environmental Management, students filled the survey

papers once again. Our aim in this research was to determine whether there are or not significant improvements of achievement levels in action-oriented higher environmental education occurred. These improvements include the creation of new patterns of student behavior in their relationship with environment.

In order to evaluate results of survey, we used statistical software package SPSS 17. In the sample of 44 students, 24 of them were female students and 20 were male students. We first wanted to examine if female students are more ecologically aware then male students. Thus, we focused on the variable EcoFootPrintBefore. Using Kolmogorov-Smirnov test, we determined that variable is normally distributed ($Z = 0.790$, p>0.05). In respect to these results, we used parametric t-test for independent samples. Mean value for female students was 1.216 ± 0.128, while mean value for male students was 1.21 ± 0.148. Results showed no significant difference between genders, $t_{(42)} = -0.160$, p>0.05.

Very important issue that we wanted to raise is possible difference between genders in answering on each of the 15 questions. Chi-square test of categorized data was performed and results showed that there is no statistically significant difference between male students and female students. This result is at least unexpected, so we will emphasize couple of interesting observations. We used Chi-square statistics in order to examine whether male students and female students differ in the number of new clothing items they buy. Results showed no statistically significant difference between male students and female students, ($\chi^2=1.381$, df=3, N=44, $p>0.05$). Same conclusion was made comparing variables "What is the percent of food you throw away and what percentage of food you buy is locally grown or seasonal". Results implied no statistically significant difference between genders ($\chi^2=2.151$, df=2, N=44, $p>0.05$; respectively, $\chi^2=2.631$, df=3, N=44, $p>0.05$). Observing, how much meat and meat products students buy, we conclude that there are no significant differences between males and females. Unfortunately, both male and female students are not dedicated to the trend of healthy and organically grown food, which is in Serbia still not widespread, but it is expensive. Their diet is mostly based on meat products, and the result show that 72% of students in their daily diet consume meat products, and that implies low level of ecological perception in food consumption of students and their families.

As a next step, we wanted to examine possible correlation between GPA (Grade Point Average) and the EF value of students. Knowing the fact that both of the variables are normally distributed, Pearson correlation was used. Result indicated that there is no significant correlation between these two variables, r=0.264, *p>0.05*. This result implies that environmental education (with consequential environmental actions) does not depend on formal educational system in Serbia, because (based on educational curriculum and programs), it is evident lack of formal and permanent environmental education at all levels of formal education in Serbia, [21].

Further on, we wanted to explore potential association between number of rooms (space of apartment) and number of rooms that are being heated during winter and cooled during summer months. Knowing that we are examining nominal types of variables, Spearman's rho correlation coefficient was calculated, r_s=0.486, *p<0.05*. Positive direction of correlation indicates that bigger apartments (flat) imply higher number of heated rooms. On the other hand, there is no statistically significant correlation between space of apartments and number of cooled rooms, r_s=-0.031, *p>0.05*.

4.2. Results of statistical analysis for students of Faculty of Organizational Sciences, University of Maribor

Survey was conducted on the sample of 43 freshmen students at Faculty of organizational sciences, University of Maribor. In the sample of 43 students, 28 of them were male students and 15 were female students. We first wanted to examine if female students are more ecologically aware then male students. Using Kolmogorov-Smirnov test, we determined that variable is normally distributed (p > 0.05). In respect to these results, we used parametric t-test for independent samples. Mean value for female students was 1.777 ± 0.257, while mean value for male students was 1.919 ± 0.226. Results showed no significant difference between genders, p>0.05.

The issue that we wanted to search is potential difference between genders in answering on each of the 15 questions. Chi-square test of categorized data was performed and results showed that there is statistically significant difference between male students and female students on couple of questions. For instance, males and females significantly differ on frequency of car using (LI = 6.286, df = 2, p<.05). Same finding applies for question "What is the fuel consumption of the car you travel in most often", statistically significant difference was noted (LI = 12.440, df = 3, p<.01). Our results implied that male students use car far more frequently then female stu-

dents. In addition, they more often use car with high fuel consumption.

Further on, we used chi-square statistics in order to examine whether males and females differ on how much pieces of new clothes are bought by students. Results showed no statistically significant difference between male students and female students, (χ^2 = 5.807, df=3, p>0.05). Same conclusion was made comparing variables "How much percent of food you throw away and how much percent of food that you buy is locally grown or season food". Results implied no statistically significant difference between genders (χ^2=1.273, df=2, p>0.05; respectively, χ^2=2.927, df=4, p>0.05).

Afterwards, we wanted to examine is students environmental awareness influenced by their parents educational level. Nonetheless, results implied that there is no significant difference between students [F (2, 39) = 0.506, p>0.05]. In addition, we wanted to examine if students coming from smaller towns are more ecologically aware than their colleagues from Ljubljana, capital of Slovenia. In our sample, 18 of them were from Ljubljana and 24 were from other cities (one student didn't answer the question). Using Kolmogorov-Smirnov test, we determined that variable is normally distributed (p>0.05). In respect to these results, we used parametric t-test for independent samples. Mean value for Ljubljana students was 1.954 ± 0.249, while mean value for students coming from smaller towns was 1.825 ± 0.215. Results showed no statistically significant difference between students of different hometown, p>0.05. Only difference between students coming from Ljubljana and other cities was in the question "How far do you travel by car each week", (LI = 17.093, df = 4, p<.01).

5. Conclusion

Comparing the Serbia (2.3ghp) and EU (4.7ghp) results, value of students EF is 1.21 ghp, which represents an impressive achievement pointing to a high level of environmental awareness amongst Serbian students at Faculty of Organizational Sciences - University of Belgrade. Although results didn't reach a significant statistical difference between genders, it is obvious that male students are more dedicated to environmental issues and protection. High level of environmental awareness amongst students does not depended on formal educational system in Serbia (it lays in adequate good higher environmental education, and knowledge absorbed from Environmental Management course), because it is evident lack of formal and permanent environmental education at all levels of formal education in Serbia. We can conclude that environmental subjects must be in-

cluded as a basic one at all level of Serbian formal education. Further on, must be emphasized that both male students and female students are not dedicated to the trend of healthy and organically grown food, which is in Serbia still not widespread, but it is expensive. Their diet is mostly based on meat products, and that implies low level of ecological perception in food consumption of students and their families.

Course of Technological Systems and Principles of Ecology, taught at the first year of undergraduate studies at Faculty of Organizational Sciences - University of Maribor, enrolls a little bit more than 100 students. Our research is based on the sample of 43 students, which is by all means a characteristic of a representative sample. Average value for the EF of students is 1.869 ghp. Comparing to Slovenian (5.3ghp) and EU (4.7ghp) results, this represents remarkable achievement which proves high level of environmental awareness amongst Slovenian students. In the core of these impressive results, lays adequate and permanent environmental education, and knowledge absorbed from above mentioned course. In recent papers, it is often cited that level of parental education is significantly correlated with children's environmental awareness. However, in our research no significant difference between students with different parental education background was noted. This finding clearly shows that Slovenia has excellent educational system concerning environmental issues, especially in elementary and high school. Also, results showed that female students are ecologically more aware than male students. Although, results didn't reached statistically significance, trend that female students are far more dedicated to environmental protection is obvious. In particular we have to mention results concerning issues of car using. As the matter of fact, results implied that male students use car far more frequently then female student. Further on, they more often use car with high fuel consumption. In addition, our analysis points out that both male students and female students are dedicated to the trend of healthy and organically grown food. Also, their diet is mostly based on locally grown food, which implies high level of ecological perception and healthy life trend in Slovenia.

The results of both studies and analysis emphasize the importance of environmental education. In order to this, we can conclude that higher education institutions have to contribute to further development of environmental awareness and formal environmental education, by achieving following goals:
- Acquire skills, assess and apply complex management concepts in order to solve today's and tomorrows environmental challenges.

- Gain knowledge in environmental sciences and their practical application.
- Train soft skills by working in international and interdisciplinary teams.
- Combine a theoretical orientation with practical project work.
- Give a range of practical techniques in such areas as environmental planning, environmental policy, environmental management systems (EMS), modeling, geographic information systems (GIS) and data management.
- Corporate social responsibility, logical framework analysis, life cycle assessment (LCA), and energy analysis and planning.
- Use different tools for project design, environmental monitoring, quality control and evaluation as well as planning.
- Train in using cost-benefit and cost-effectiveness methods.

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Decision Making Criteria for Outsourcing or Onsourcing of IT Service Provision in Public Sector

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The study focuses on the uncharted area of the Slovenian public sector. It uses an in-depth analysis of the contemporary pro et contra arguments and presents the research findings concerning IT outsourcing and insourcing in the Slovenian public sector. Regardless of the fact that state governments have always been purchasing some goods and services on the external market, the last two decades have shown an exponential growth of competitive tendering and outsourcing as a powerful tool of public management. In Slovenia, the use of competitive tendering and outsourcing of IT services has been growing rapidly, many will say unfoundedly and irrationally; the reported expenditures on contracting out in the public sector in the last years have doubled reaching in the time of global economic and financial crises, roughly estimated, tens of millions of euros. The research outlines some methodological, contextual, procedural and other aspects and considerations and eventually presents Saaty's multiple criteria decision model for planning IT outsourcing and provides guidelines on critical assessing IT outsourcing projects in the future development of the public sector and its services in Slovenia.

1. Introduction

The global social changes in the last three decades have initiated the need for reforms in both the private and the public sectors. The social, economic and technological development pressured the public finances and raised numerous issues on an efficient, transparent and earmarked spending of assets. The public sector is facing difficulties especially in three fields of its operation: global developmental trends and their growing pressure upon accounting expenditures, growing expectations of citizens as regards the offer of public services, despite fiscal restrictions, and an alarming demographic situation in which an already numerous population of retired persons grows by far faster in comparison with the creation of new jobs for the unemployed and the active population entering the labour market. All these result in a large financial burden when it comes to payments of pensions, offer of health care services and other public services. The above-mentioned events initiated some speculations on the type and scope of rights and services that should be offered by the public sector in a situation characterised by so restrained resources of public finances.

It is but for these financial problems in 1980s that a convergent development of technology and administrative and economic sciences led to the forming and implementation of new business strategies in the public sector. The public sector started using certain managerial instruments to reduce operations costs and improve efficiency in the first place, although the use of these instruments in the past was exclusively the characteristic of the private sector. The situation described above resulted in performing some jobs from outside, i.e., outsourcing[1] (English: outside source using) which means: by concluding a contract by which a specialized contractor outside the organization is assigned to perform some services and business processes which were primarily the liability of the public sector. It is in this way that outsourcing has become a major feature of the strategic development of the public sector. As well as the private sector, the public sector too started to transfer jobs to outside providers who provided public services in most diverse areas of social life based on the contract concluded with the public sector organizations: municipal utility works, social and health care, education, infrastructure maintenance, to even prisons and military issues. It did not take long,

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[1] **Here it is necessary to mention that, when talking about outsourcing in a strict sense, we primarily have in mind an outside provision of certain business processes or services, however, still within the boundaries of the country in which the organization that transferred some processes to outside providers, works; when talking about outsourcing in a broad sense, we think of the transfer of business processes and services to entities in some other country. In such cases, the terms "offshoring" or "dislocalisation" are often used although they have no direct connections with outsourcing in the public sector. In this paper, outsourcing will be primarily studied in its stricter sense, namely, withing the country's boundaries. For either outside or inside performance we use the English terms outsourcing and insourcingwhich are equal in meaning; namely, both terms are part of very rich Anglophone economic terminology.**

however, for the enthusiasm for these so-called revolutionary invention to expire. Already in the 1990s, according to the research of numerous experts, more than 75% organizations were dissatisfied with the inefficiency of outsourcing and poor results, and more than 50% organizations that practiced outsourcing tried to recover the provision of services and business processess, once outsourced, to their own organization [1]. Organizations were unanimous in compalining about an unpredictable rise in costs and an ever poorer quality of services provided by outsourcing.

The lack of an adequately critical and analytical approach in identifying the real needs for outsourcing has often left organizations in rather difficult positions, sometimes even to the brim of survival and worse. Trying to achieve short-term benefits, organizations endangered their long-term survival and made further development, as well as accomplishment of their visions and strategies, impossible. The negative experiences that accumulated for thirty years in the outsourcing area have in the last years reached a critical point and caused a turn back, or a return to insourcing certain business processes and services.

In addition to the analysis of outsourcing and insourcing strategies, the paper focuses primarily on the study of outsourcing and insourcing of information-technological services (hereinafter: IT services) in the public sector and the criteria such decisions are based on. The prevailing scientific paradigms in this field by no means approve of the outsourcing of key business processes, especially in the public sector and argue that focusing upon the fundamental activities of the organization and upon key tasks is becoming a strategic feature of the modern organizational development.

Finally, in the context of the abovementioned, it is necessary to take into consideration the insourcing of certain business processes and IT services that have so far been left to outside providers and that proved to be an instability and dysfunction factor in the long-term, since outsourcing of certain business processes led to the so-called "hollowing out effect"[2] on the organizations which means that transferred jobs had a decisive

impact upon losing some crucial competences and potentials of the organization and hence upon an inefficient performance of the key organizational tasks.

Our topic of interest in this study is the interdisciplinary area of IT services outsourcing and insourcing in the public sector, that is, its cross-section between economic, administrative and other scientific paradigms. The very breadth of the topic of study clearly shows that partial approaches based exclusively upon analytical economic theories and normative articles, do not offer a conceptual and multple criteria satisfactory model for a selection and development of an adequate strategy of the public sector operations. What we need is an in-depth and systems analysis of the IT outsourcing and insourcing strategies impact upon the operations of the public sector and their implications upon the entire social environment. From this aspect, the study is based on a combination of the scientific theory (methodological level), economic science theory (institutional level) and on the theories on economic entities behaviour (antropological level).

Our aim in this study is to shape and structure a conceptually balanced approach to forming an integrated IT services outsourcing or insourcing in the public sector, on the basis of varied theoretical platforms. Making use of the results and conclusions of empirical studies of various autors, we attempted to present an analytical hierarchy multiple criteria decision-making model for appropriate decision making in selecting a certain strategy for provision of IT services and other business processes in the public sector.

In addition to basic economic methods that primarily throw light upon the financial background of the problem and offer exclusively quantitative estimates on the adequacy and legitimacy of the selection of one of the mentioned strategies, in the analysis and in making important strategic decisions, such as deciding in favour of IT services outsourcing or insourcing, it is necessary that a method should be employed that will include a multiple criteria structured and multidisciplinary approach to an insight into the entire problem matter. According to the experts, the in-depth scientific research should use analyses, the primarily socio-eco-

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[2] **The "hollowing out effect" is a common term for a set of negative results usually incurred by a loss of autonomy of one or more organizations. This effect may be caused by the acquisition of the organization or by joining by another organization. The term also so applies to outsourcing since the transfer of services ans/or business processes, sometimes even key ones, to outside providers may result in losing control and management, losing financial means, competences, organizational vision, trust, knowledge, creative potential and culture capital in the organization.**
In some cases, we can talk of a "hollowing-out effect" in an example of a broader social phenomenon, environment or even the whole state, which in the globalization area sets a rather serious problem (excessive moving of production and other operations to other states – offshoring, etc.) [6].

nomic criteria and the Cost-benefit analysis, as well as the Balanced Scorecard to offer above all more conceptual and longer-term solutions to the problems posed [2], [3]. The Cost-benefit analysis and the Balanced Scorecard will, in addition to the economic criteria, employ their method of quantification of key strategic organizational factors to help select the most efficient business strategy, and strengthen this decision from the financial, organizational, personnel as well as the social aspects. In the final section of this paper the Analytical hierarchy process method (AHP method) will be presented, one of the best-known and most popular methods of multiparametre decision-making that could help find more rational and more efficient manner of spending of assets, where the quality of decisions really depends on a host of factors.

2. Outsourcing

2.1 Definition of outsourcing

The concept of outsourcing is burdened by numerous connotations and prejudices. This is seen in a broad range of definitions of this concept, from most concise to superficial and partial definitions of the phenomenon in consideration.

Greaver defines outsourcing as a transfer of certain repetitive activities and decision-making authority to outside providers, under the conditions previously defined in the contract on cooperation [4]. As these are repetitive activities, defined in the contract, outsourcing can be said to go beyond the use of external consultants. In a majority of outsourcing examples, actually, it is not only the activities and business processes that are transferred, but also the instruments of labour and the decision-making authority. Ellram and Maltz define outsourcing as a contracted transfer of liabilities to perform some operations within an organization to a third party [5]. The head office of the provider and the site where the operations are performed may be geographically the same or distant from each other. This primarily depends on the type of operation transferred to the outside provider and its logical needs.

The concept of outsourcing is therefore possible to interpret as a business strategy by which an organization, due to certain reasons (most times these reasons are of the cost type), transfers the performance of certain business processes or services to entities outside the organization, with the intention to focus on its key tasks and core activities.

The abovementioned definitions of outsourcing highlight some disagreements among the definitions of the concept, ranging from minor semantic differences to fun-

damental differences in the conception, understanding and defining outsourcing. Partial approaches, inconsistency and disagreement in defining the outsourcing concept itself set additional difficulties in its evaluation as well as in the analysis of its appropriteness, efficiency and performance. The accuracy in defining the strategic concepts of organizational business activities is much more important than it apperas at first sight, the more in the public sector because each error is paid by public money. Namely, it is only with clearly defined future business strategies that we will be able to conduct a sound analysis of the current situation in the organization and evaluate the effects and results of the selected strategy. In case we fail to define the strategy correctly and we do not know its economic, normative, contractual, developmental and organizational frames and traps, our decision making is reduced to the level of intuition.

3. Reasons for introducing outsourcing

3.1 Advantages and benefits of outsourcing

Due to the scope of the problem that goes far beyond the boundaries and ambitions of this study, the organizational reasons that result into the project of IT services outsourcing, or its terminantion, will be only shortly described. The reasons, according to various authors, differ, however, they all meet in the following Greaver's classification [7]:

1. Organizational reasons
   - Organizational transformation,
   - Improvement of efficiency with a focus on core competencies.

2. Business improvement
   - Improvement of business results,
   - Improvement of managerial skills and increase of control.

3. Financial reasons
   - Reducing investments into ownership and setting the capital free to be invested further,
   - Acquisition of new capital with the transfer of material resources to outside provider.

4. Incomes
   - New market opportunities via the outside provider's network,
   - Acceleration of organizational growth using the outside provider's potential.

5. Costs

> Cost reductions due to higher cost efficiency of the outside provider,

> Fixed costs transformation into variable costs.

6. Personnel reasons

> Employees are given chances for career development,

> Increase in employees' commitment and efforts in the non-core organizational competencies.

Obviously, within each of the listed categories there are still more concretely and accurately stated reasons for outsourcing, however, for the needs of this paper, the above classification is quite satisfactory, since it describes the general trends in decision making in favour of outsourcing rather well.

Numerous research, conducted primarily in the USA, corroborate the above classification of the most important reasons in favour of IT services outsourcing [8]. The most important reason in favour of outsourcing is undoubtedly the cost reduction; as many as 48% organizations included in the research listed costs as the most important factor; then follows that the organizations reported a 40% higher focus upon the core competences; the third position is the lack of internal resources in the organization (35%). The reasons that follow refer mainly to the quality of the services and products and are more focused upon the customer satisfaction. Below are listed the access to the outside providers' ultimate technical competencies and knowledge, risk reduction, better opportunities for investments into strategic projects, etc.

3.2 Weaknesses and risks of outsourcing

As well as the above mentioned advantages and benefits of outsourcing, it must be noted that outsourcing projects bear numerous potential weaknesses and risks that have to be assessed and analysed before the decision on implementing an outsourcing project is made. The biggest problem in the outsourcing projects is the fact that problems emerge later in time, when the organization is already deeply involved in the outsourcing project. Causes of such a situation are many, in both business entities involved. Numerous experts argue that the private sector companies are most endangered due to the selection of the wrong outside provider, whereas the public sector organization are most seriously exposed because of outsourcing inadequate operations, unpredicted costs and the "hollowing-out effect".

Bongard classed the potential weaknesses and risks in outsourcing projects into six categories [9]:

1. Costs

> Rise of unpredicted costs,

> Fixed price of services contracted with the outside provider that really falls over a longer time span, especially in the IT services area.

2. Labour force

> Employees feel threatened, fear from losing jobs, lack of motivation to work,

> Fall in productivity, weaker organizational climate and culture.

3. Technology, technological knowledge

> Loss of core knowledge in organization, fall in the intellectual capital of the organization, "hollowing-out effect",

> Wrong estimate and transfer of organizational core competences to outside providers.

4. Information

> Discretion is threatened, possible loss of confidential information,

> The ouside provider conceals information on potential problems until it is too late.

5. Dependance on outside providers

> Loss of control over the outside provider and consequently over business processes,

> The outside provider has too much power, especially in very complex outsourcing projects.

6. In-house resistance

> The outsourcer's distrust in outside provider may pose a serious threat to the relationship,

> Passive attitude and lack of interest among individuals within the outsourcer's organization in the outsourcing project.

The description of potential weaknesses and risks of outsourcing also includes the fact that each listed category includes a host of additional and concrete impact factors, which may affect the project as instability factors or even discontinue the outsourcing project; however, for the purposes of this study the above presented description of factors is illustrative enough.

4. Outsourcing and IT

Due to its applicability, IT is a rather specific field of study within all the subsystems and on all organizational levels, as well as in the relations with entities outside the organization. The abstract nature of the raw materials that enter the information system or information process makes IT outsourcing difficult to plan and construct as it is often hard to define the evaluation of the selected business strategy itself and its effects and long-term benefits it brings to the organization.

Economic analyses and classic methods of assessing IT services outsourcing projects are often inappropriate for an objective evaluation of similar projects, because of the dispersion of both vertical and horizontal effects these projects bring to all the organizational segments and entities in its environment. It is for this reason that assessing IT services outsourcing projects in the public sector, their achievement and efficiency and the very use of IT and the related services, calls for ultimate caution, as citizens are at the same time the majority owners and consumers of their services.

Our aim in theis paper, as we have already stated in the Introduction, is to introduce a qualitatively structured multiple criteria decision-making model for making decisions connected to IT services outsourcing or insourcing in the public sector organizations. The nature of the outsorcing strategy itself requires that a dual approach should be used in forming such models founded on several criteria. A good decision making for the IT services outsourcing projects, based on objective criteria, has to include two aspects, the material and the formal ones, i.e., the content and the process aspects.

The material aspect focuses upon the contents of IT services that a public sector organization plans to transfer to outside partners to perform, as well as to the expected benefits that the organization should achieve through a selection of such a business strategy. There is almost no business activity that has not been outsourced, either partially or fully. This previous sentence raises some questions as to whether all services and operations are really adequate to be transferred to the outside provider, having in mind that public services are by a rule financed according to plans and that they are meant for a broader public benefit that should be provided by the public sector; and also, why do we need such a transfer of services and operations at all, if we take into account the number of highly trained experts that work within the public sector system itself. An important issue, too, is whether the public sector organizations have formed the criteria (financial and other),

namely, the strategic frameworks in which they decide which segment of operations of the organization or information system (IT services) is appropriate to be outsourced over a long-term period and why.

The formal aspect focuses upon the entire process of IT services transfer to the outside provider and all the side effects. This aspect deals with the entire process, from the outsourcing idea, to a public tender and the selection of the outside provider, to concluding the contract with the outside provider and the evaluation of the business relations following each completed business cycle. It often happens that organizations do not follow the planned phases of the process, but rather make short-cuts towards the goal, which in a long term may prove to be a critical error. Such a thing is highly dangerous in the public sector, since the costs of wrong decisions made by the organization are paid by the entire social community, not only by the owners or liable individuals, as is the case in the private sector. All the phases in the process of the IT services transfer to the outside provider are of paramount importance and succeed each other in a regular order. A proper implementation of the outsourcing project requires a consistent and accurate implementation of all the phases of the process.

A rational and multiple criteria founded outsourcing decision requires that both aspects, material and formal, should be joined together and that a structured, multiple criteria decision-making model should be created. Only on the basis of such a decision-making model can we decide about the steps we will take and of the beginning of the outsourcing project procedure, as this model actually clearly and directly shows whether the IT services operations or the overall operations in general are appropriate to be outsourced.

5. Approaches to the development of a multiple criteria decision-making model

The development of a multiple criteria model for making decisions as regards the IT services outsourcing in the public sector inevitably requires, especially in the nowadays social and economic circumstances, that a balance be established among numerous different factors, such as: economic, social, political, normative, and technological. All these require that numerous stakeholders be involved, each with their own priorities and goals, into all the phases of the development process and consequently the decision-making process. Taking into account the abovementioned assumptions, the stiudy continues to focus upon forming and development of a multiple criteria decision-making model (MCDM) which will help managers set priorities and

make adequate decisions in the field of IT services outsourcing in the public sector.

The multiple criteria decision making (MCDM) is one of the best known trends in the decision-making theory. MCDM includes a number of different methods, each of which has such qualities due to which its implementation is confined to defined, usually narrow, fields of complex decision-making. Following the analysis of these qualities and an estimate of their adequacy, the most appropriate method will be selected for the design of a multiple criteria decision making model in the area of IT outsourcing in the public sector. Thus, according to experts, the methods are classed according to the types of data used in the decision-making process; hence we know [10]: deterministic, stohastic, and fuzzy models. The methods are further classed in accordance with the number of individuals involved in the decision-making process; here we talk of the methods involving only one individual making decisions, or of the methods involving a number of individuals, namely, a group. In designing a multiple criterion decision making model for IT services outsourcing, due to the nature of the research area, we will implement a deterministic method with one individual making decisions, which will improve the reliability and accuracy of the model. It will also facilitate the implementation of the designed model. In addition to the above mentioned, it must be noted that the classification used is only one among many, since these methods, however different, have a lot in common (alternatives, attributes, objectives, decision criteria, ...), therefore two or more complementary methods can sometimes be used, in accordance with the nature of the decision-making process itself.

If the characteristics of IT services outsourcing are taken into account on the basis of the above said, then planning, development and designing a multiple criteria model has to satisfy three important criteria:
1. The decisions in complex problem solving have to be made on the basis of a larger number of relevant qualitative and quantitative criteria;
2. The subjectivity aspect of the decision-making person has to include potential ambiguities; that is, the lack of information in judging has to be valued and calculated into the overall decision-making process;
3. The model must be shaped in such a way that in its inplementation phase, in making concrete decisions, it has to allow for the use and comparison between different alternatives, having in mind the definition of the goal, as well as the selection of key criteria and subcriteria.

The review of the methodological framework used in the development of the multiple criteria decision making model is shown in Figure 1. In the first step, the methodology focuses upon defining priorities and then upon the analysis of the complex structure of the problem and the inclusion of all the tangible and intangible factors, i.e., all the measurable qualitative and quantitative factors within the complex problem structure. In the second step, the methodology goes one level higher, including into the decision-making process some more complex interactions among factors, such as the interrelation among the factors and their hierarchal structure. This is the phase in which the final choice and assessment of the relevant criteria and subcriteria are made. In the third step, the entire range of chosen criteria is further weighted in a more adequate manner, taking into account their importance, time limit and other organizational preferences; namely, each decision-making process is burdened with some objective restraints that cannot be avoided and that are necessary to include if we want to achieve long-term strategic goals. It is also necessary that the subjectivity of the decision-making person be also assessed and, if needed, the criteria weighting should be assigned to other individuals, and only then a compromise should be reached, a solution that would enhance the objectivity of the model itself as well as facilitate its implementation and use in the future.
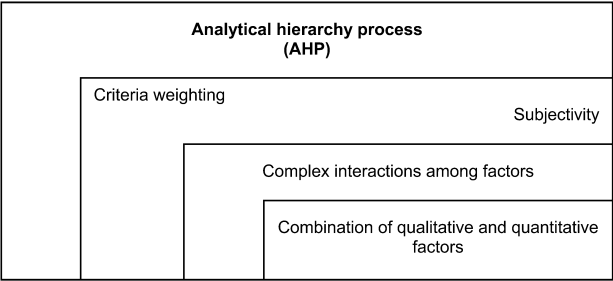
Figure 1: Methodological framework of the multiple criteria decision making model development

Given all the necessary conditions that have to be met as well as the above mentioned model characteristics, the **Analytical Hierarchy Process** model (hereinafter: AHP model) is selected for the needs of IT services outsourcing in the public sector. The analysis of all its characteristics and the assessment of its adequacy has proved that this model meets all the previously defined requirements (numerous similar models are used in similarly structured problems in the field of multiple criteria decision making, such as: ANP – Analytic Network Process, ELEKTRE, PROMETHEE, etc, which are usually the extention of the AHP model and serve as a corrective to calculate more precise and more reliable results). The AHP model will be further elaborated in the following chapters.

6. Analytical hierchy process

The author of the Analytical Hierarchy Process meant as a support to decision making in various areas is Thomas L. Saaty [11]. The multiple criteria decision making model in the IT services outsourcing or insourcing used in this study is called the Saaty application (Saaty©). The original Saaty© programme was established by Andrej Mrvar[3]. The application was devised on the platform of the analytical hierarchy process. Hence the application's name. The AHP model is one segment of a well known decision-making model and the Expert Choice, the expert programme system. Regardless of the fact that the model is more than ten years old, it is still used as one of the best decision-making support systems, and its use has even highly increased lately.

The entire AHP model is based on the structured or hierarchical order of the elements of an entity or a process. Generally, hierarchy means the structural order of the parts of an entity according to their importance or characteristics; organizationally, hierarcy is a system of control established in an environment for the purpose of an effective conduct and efficient achievement of goals. As regards the achievement of goals, each business entity has to, in accordance with its specific features, choose among a variety of decision-making processes and select the most optimal one when it comes to making decisions on important strategic and even tactical issues. Decision making in the given framework of rational and efficient business in the public sector always has the same objectives, namely, to find the best solution out of the group of offered solutions, on the basis of given criteria [12].

6.1 Saaty model in multiple criteria decision making

The Saaty© application is based on the AHP model that has lately become increasingly popular. Nevertheless, this model of outsourcing and insourcing is rather difficult to find in literature, especially in the IT services area, although the AHP has numerous advantages over similar models, as it allows for the study of both rational and intuitional factors, which considerably facilitates the selection of the best solution. This assumption is, naturally, possible if we take into account certain adequate and appropriately weighted criteria, which will be dealt with further below. The entire decision-making process is based on conducting a sim-

ple process of making comparisons between different valuations, which is further used in ranking the solutions achieved in the course of the decision-making process. In this decision-making phase, the Saaty© application serves to make the comparison via the comparison matrix of all the pairs of criteria. On the basis of all the pairs of criteria the most optimal solutions are selected. The identical procedure is repeated among potential subcriteria, too, if during the procedure we come to a conclusion that a further decomposition of criteria into subcriteria could ensure a more objective and a more argumented decision making.

Together with its instruments the AHP includes and allows for the involvement of a large number of relevant factors which guarantees an appropriate and objective, i.e., consistent approach to making final decisions. The implementation of the AHP may help set realistic goals and priorities. Here it is important to take into account both qualitative and quantitative aspects of decision making. The essence of the AHP model is "breaking" the decision into a number of smaller decisions. In the first place, we mean breaking into "one-to-one" comparisons, which consequently allows for a more realistic assessment of the given problem [14].

The simplest way, used in problem structuring, is hierarchally constructed from three segments (Figure 2):

- Goals are set to the highest level;

- Criteria are set to the medium level;

- Solutions are set on the third, lowest level.
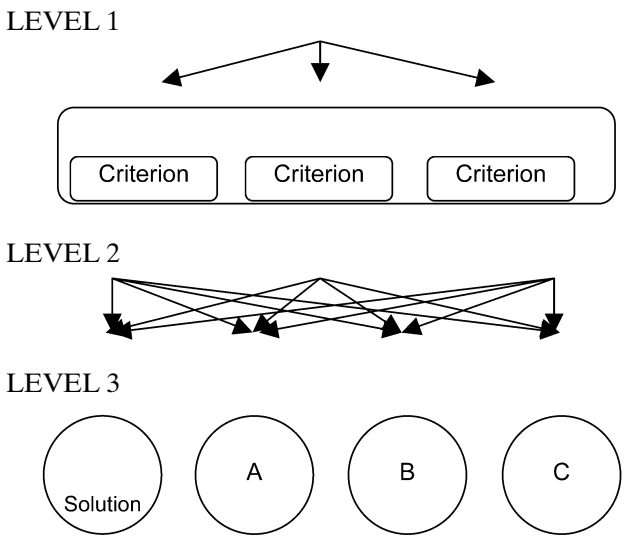
Figure 2: Decision-making hierarchy in outsourcing

Reja, 2002, p. 14

[3] **The version of the Saaty© application used in this paper was designed by Dimitrij Rejja, Andrej Mrvar and Dean Lamper. The application is based on the previous programme platform, devised for the DOS operational system. A new version of the Saaty© application allows for both student and professional use [13].**

The above structure allows for the classification of elements in terms of their importance and ranks them into their appropriate levels that would meet the selected criteria and bring the organization to the set goals. In structuring the overall decision-making process we should keep only to the relevant factors that show implications as to the decision-making subject and be careful not to stray into an excessive dissection of the problem, which may disguise major aspects and result into low-quality decisions. Model design requires a good knowledge of the problems and a balanced application of data for an objective assessment of criteria. Too large a number of criteria may devaluate the hierarchy relations and the relations among the criteria themselves, whereas too small a number of criteria does not allow for calculating all the important aspects of the problem and offers an unbalanced and partial solution to the problem in the decision-making process, as it does not include all the relations among the elements and their correlations. Hence accuracy, consistence, and good knowledge of the nature of the problem is of great importance in setting the criteria.

The leading experts in the study of outsourcing and its broad socio-economic implications stress a multi layer nature of this phenomenon [15], mirrored in an extremely complex and aggravated evaluation of all the effects of outsourcing, that are often well hidden due to the long time cycle of the project and emerge only after a long time period.

On the basis of the studies of the leading experts, and the complexity of the overall outsourcing area, we have chosen the following criteria for the design and practical illustration of the effects and use of the Saaty model in a multiple criteria decision making:

1. Costs

2. Competences

3. Quality

4. Customer satisfaction

5. Risk

6. Organization

7. Development

8. Innovation

For the purposes of this work a simulation of a hypothetical problem situation was made using the Saaty model, where the public sector organization selects one out of two offered solutions, or IT services outsourcing

and insourcing. The final decision must be based on the above quoted criteria, the hypothetical starting points of the project are € 500,000 for the outsourcing project and € 350,000 for the insourcing project. The absolute and relative estimate of the criteria and their decomposition into subcriteria was performed on the basis of subjective preferences and serves to better illustrate the overall procedure of the multiple criteria decision making.

We will proceede to present and more accurately analyse the entire Saaty procedure as well as its application and the selection of the most appropriate solution (alternative) in the concrete problem situation, which will be based on the above quoted data.

1. Mathematical computing using Saaty procedure (IT services outsourcing)

6.3.1 Comparison of criteria

The first step in the Saaty procedure is the comparison between the prepared and afore-selected criteria. The comparison of pairs in the analytical hierarchy model means comparing between homogenous elements. Weighting and comparison of the pairs of criteria in our example, the so-called reciprocal matrix for devising the decision-making model for IT service outsourcing is presented in Figure 3 and shows only one of numerous possibilities of weighting nad assessment of the criteria within a given framework of the Saaty procedure. Naturally, each individual has his/her own point of view and goal, so they decide upon and weight criteria according to their individual preferences. The general comparison scale is shown below:

- 1 – criteria i and j are equally important

- 2 – criterium i is slightly more important than criterion j

- 3 – criterium i is substantially more important than criterion j

- 4 – criterion i is significantly more important than criterion j

- 5 – criterion i is absolutely more important than criterion j

The comparisons can be assigned with values 2,4,6,8 if we cannot make a decision on the basis of the values from the above quoted scale. The reverse value means that the criterion j is superior to criterion i, e.g. $a_{ij} = 1/7$ means that j is significantly more important than i.

In applying the multiple criteria models we often come across the situations where we deal with two very similar, however, not identical criteria. In such cases it is difficult to provide an objective rating of the characteristics of both criteria. When such a situation emerges in the process of structuring the decision-making model, the best solution is to make the comparison on the basis of the comparison between smaller segments of sub-criteria instead on the basis of larger entities [16]. It is necessary that the values of certain elements should be analysed accurately and compared between each other by segments, for which a 9-grade scale suffices. For the purpose of a more accurate analysis, therefore, segments of a certain element should be compared between each other.

In the decision making process on a complex problem we usually have to deal with a large number of criteria, which make them difficult to control and rate consistently. The AHP allows for joining the criteria into joint criteria which are further linked to other joint criteria into a tree structure. The hierarchy principle of arranging elements allows us here to control complex systems. It offers us a global insight into the major higher level factors as well as a detailed insight into the structure and functions on the lower levels. The hierarchy also helps reduce the number of comparisons of the criteria we have to enter into the decision-making procesure. It is for this reason that matrices are more reconciled [17]. The AHP within the Saaty procedure allows for a transition from lower ranked (on lower levels) to joint (on higher levels) value criteria.

Criteria	Costs	Competencies	Quality	Customer satisfaction	Risk	Organization	Development	Innovation
Costs	1	2:1	1:3	2:1	3:1	3:1	1	1:2
Competencies	1:2	1	1:2	1	3:1	3:1	2:1	3:1
Quality	3:1	2:1	1	1:3	3:1	3:1	2:1	2:1
Customer satisfaction	1:2	1	3:1	1	2:1	3:1	2:1	2:1
Risk	1:3	1:3	1:3	1:2	1	1:2	1:3	1:3
Organiztion	1:3	1:3	1:3	1:3	2:1	1	1:2	1:2
Development	1	1:2	1:2	1:2	3:1	2:1	1	2:1
Innovation	2:1	1:3	1:2	1:2	3:1	2:1	1:2	1

Figure 3: Positive reciprocal matrix

6.3.2 Relative and absolute comparison of criteria

In Saaty procedure, criteria can be compared in a number of ways (Figure 4).

Type of criteria	
	Relative ratio
X	Absolute values – less is better
	Absolute values – more is better

Figure 4: Possible methods of comparison between criteria

The relative method serves to compare pairs of values and, on the basis of the comparison, to rate the differences among them [18]. The analytical hierarchy process uses both relative and absolute comparisons.

Relative comparison (Figure 5): In this measurement we compare all the criteria by pairs. In the example of the n criterion, this means n(n-1)/2 comparisons. In Saaty model, the relative comparison of criteria uses a 9 – grade scale, as shown in Figure 5.

Ratio between criteria	
Costs	Competencies
2:1	
	X
9:1 1:9	

Figure 5: Relative comparison of "costs" and "competencies" criteria

As shown in Figure 6, the Saaty model allows for a relative comparison of individual criteria among each other, too, taking into account the possible solutions (alternatives).

Criteria	Competencies	Outsourcing	Insourcing
	Outsourcing	1	2:1
	Insourcing	1:2	1

Figure 6: Reciprocal matrix for relative comparison of "competencies" criterion and the highest individual value in two potential solutions (alternatives)

The absolute comparison (Figure 7): absolute comparison refers to a certain rating of the criteria. The rating may be absolutely arbitrary, e.g., 1-excellent, 3-medium, 5-poor. In this phase, it is necessary to define which grade is better (lower or higher). The subcriteria grades therefore affect the value of the joint criterion. In our concrete example, the financial rating of a certain solution (alternative), i.e., the cost of an IT service outsourcing project was set, which, according to our approximation amounts to € 500,000, while the cost of an IT service insourcing project, was estimated to be cca. €350,000. The Saaty procedure requires that an absolute criterion should be additionally defined and that the decision on which grade is better should be entered; in the case described it is obviously the grade " less is better" (Figure 7).

Criteria	Costs	Less is better
	Outsourcing	500,000
	Insourcing	350,000

Figure 7: Absolute comparison between criteria

6.3.3 Preferential relations and utility functions

The selection, the rating and the weighting of criteria is followed in the Saaty procedure by a calculation of the utility function. In the multiple criteria decision making we deal with two highly important notions [19]:

- Preferential relation S (preferable to ...): xSy

- Utility function ω (x) which measures the preference level for the solution x

which in the concrete case means that we know which solution we prefer (we know the preferential relation), but we cannot assign or determine any deffinite value to the solution (we do not know the utility functions).

The square matrix A = a_{ij} (i = ...m; j = 1...m)[4] represents all the pair comparisons of the m criterion.

6.3.4 Comparison matrix A and utility ω

This matrix gives us the utility vector with the solution of the problem of single values of the matrix A. The calculation of the individual value of the matrix [20]:

$$A\omega = \lambda\omega$$

where λ is the highest single value of the matrix **A**, ω is the adherent single vector[5]. The single value that belongs to the obtained single vector is calculated using the formula:

$$\lambda = \frac{1}{m}\sum_{i=1}^{m}\frac{(A\omega)_i}{\omega_i}$$

The A matrix is characterised by the following features (Figure 3):

- values one are distributed along the diagonal,

- symetrical values are inverse.

Such a matrix is called a positive reciprocal matrix. Using a positive reciprocal matrix, a single vector that belongs to a single value can be calculated in a number of ways:

- An accurate method – raising method – matrix is raised to a certain big enough power and then we sum the power and normalize it by rows, so that the sum is 1.

- Approximate method[6] - matrix is normalized, so that the sum by columns is 1, and then we calculate the average value of an element in a row. Thus we obtain the vector , i = 1..m.

The ratings in the matrix are interconnected, hence at least an approximate transitivity is present:

$$a_{ik} * a_{kj} = a_{ij}$$

The extent to which the comparisons of criteria are mutually reconciled can be calculated for each reciprocal positive matrix. Here, in the example of total reconciliation, the highest single value is equal to the A matrix dimension $\lambda = m \Leftrightarrow$ absolute reconciliation. The highest single value is actually higher than m ($\lambda > m$). On the basis of this deviation the consistency index I is worked out:

$$I = \frac{\lambda - m}{m-1} \qquad \lambda = m \Leftrightarrow I = 0$$

Using this index, the AHP computes the consistency ratio CR:

$$CR = \frac{I}{I_R}$$

Where I_R is a random index obtained from randomly generated positive reciprocal matrices. If $\frac{I}{I_R} < 0,1,$ then the matrix is consistent enough, if not, then the matrix should be adjusted because it is otherwise useless. The results will be incorrect due to inconsistent comparison. In our example $CR < 0.1$ which means that the matrix is consistent enough.

Throughout the calcultion process in the Saaty application the most important coefficients are visible; so it is in our concrete example of decision making on the IT services outsourcing or insourcing in the public sector. On the left we observe: the name of the model, the size of the model (8x8 matrix), the highest single value of lambda (λ), CI, CR, MaxD (maximum deviation from consistency) and the position of the largest deviation in the matrix. In the example that $CR < 0.1$, the entire text in the status row is written in the Bold or Italic form,s which means that the matrix is not consistent enough, i.e., that the whole procedure should be repeated.

This index has still to be compared to the index we obtain from randomly generated positive reciprocal matrices of equal dimensions on the 1 – 9 scale. The random index I_R (random index – Table 1).

m	2	3	4	5	6	7	8	9
I_R	0.50	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Table 1: Random index

---

[4] **Such a matrix is called a positive reciprocal matrix – symetrical values on either side of the main diagonal are reciprocal numbers.**

[5] **The explanation of the vectors and functions can be found in the following paragraphs in chapter 6.3.5.**

[6] **Saaty© application allows for the use of either approximate or accurate method**

The above presented phases of the AHP or the Saaty multiple criteria decision making procedure follow each other sequentionally, which the application performs by itself. The user then has only to define and select the criteria and determine their relative and absolute values in the comparisons. In addition, in weighting the criteria it is necessary that the consistency ratio should be controlled, and this must be *CR<0.1*. Otherwise the matrix is, as we have already stated, inapplicable due to the inconsistency of ratios.

6.3.5 Formal sequence of the Saaty procedure in the IT services outsourcing example

1. R_j – criterion (j = 1..m)

   X_j – solution (i = i..n)

   ω_i – criterion j advantages (j = i..m)

   q_{ij} – advantage of solution i per criterion j

   P_j – joint advantage of solution i per all criteria

2. The result of the Saaty procedure are the matrix Q and the vector .

Matrix Q

ω	ω1	ω2	ω3	…	ωj	…	ωm	
Q	R_1	R_2	R_3	…	R_j	…	R_m	
X_1	…	….	….	…	…	P_1		
X_2							P_2	
…								
X_i					q_{ij}		P_i	
…								
X_n							P_n	

3. We achieve the vector   as a single vector of the matrix of pair comparisons of all m criteria.

4. For each criterion R_j (j = 1..m) we compare by pairs all the solutions between each other. R: X/X q_{ij}, vector q_j presents the advantages of all the solutions in relation to the criterion R_j, and we put it as a column by the criterion R_j into the matrix Q.

5. We calculate the joint advantages as related to all the criteria. The advantage of the solution i is:

$$P_i = \sum_{j=1}^{m} \omega_j q_{ij}$$

We choose the solution i because it has the highest value P_i.

P_i for the solution Insourcing reached the value 0.5131. The value reached by the solution Outsourcing, in our example, is slightly lower and amounts to 0.4869.

As regards our choice of criteria, their weighting and their both absolute and relative comparisons, the solution Insourcing was rated higher, which is clearly shown in our above calculations.

As we can see, we have chosen 8 criteria in our example, those that are deemed to be most relevant by the majority of literature dealing with this problem. A large number of criteria supports the multilayer nature and the complexity of outsourcing and its implications upon numerous spheres of organizational operations. Due to all the listed reasons, a serious scientific study of this problem requires a broader and deeper insight into the background and contents of the overall phenomenon of outsourcing.

7. Conclusion

Regardless of various attempts to reform, reengineer or reconceptualize it, the public sector has in the last thirty or so years remained in an unfavourable position. The dilemma of the public sector between the wishes and needs of the citizens, on one hand, and planned restrictions and savings on the other, is best illustrated by the legend on Buridan's ass which, as we know, ends sadly.

It is necessary that steps should be taken towards understanding and study of strategic factors of operations in organizations that are, due to the nature of the public sector, engaged mainly in service provision, where the importance of choice between outsourcing and insourcing is even greater. A thorough analysis of the above mentioned issues may significantly help experts in their future research of this problem, either as a whole or as only one segment. Large investments into IT and the modernization of business processes are often ineffective if organizations neglect a planned and systematic design of the respective business strategies which due to their importance rank among the most important factors of an efficient and successful public sector.

The selection of a suitable business strategy (outsourcing or insourcing) is a factor that may act as a catalyser in creating a more efficient and a more rational public sector. It is clear from the study of the public sector and its specific features that a deeper insight is needed into the existing concepts of its work as well as an identification of both the elements, i.e., the business processes

and services that need to be sustained and developed further, and the elements that should be changed or re-designed. Such activities could significantly contribute to setting the foundations for a potential study of deeper and hidden levels of the IT services outsourcing or insourcing strategies in the entire public sector, which can be a long-term process, spanning over several years. The results of such research that highlight different aspects of outsourcing or insourcing implementation are of great importance for the organizational strategy planning itself, which is especially important for the proper work of the public sector. The business performance of the organization is actually a proof of the consistency of systems and strategies within the organization itself, as well as their reconciliation with a broad systemic organizational environment.

Finally, it is important to note that this paper is only one illustrated example of the possible implementation of a scientific model in planning and designing the organizational business strategy which only proves that in an attempt to manage and do business efficiently in the public sector, it is necessary that, in the phase of the selection of a long-term business strategy, some content and process criteria should be satisfied. The decisions of the public sector organizations on IT services outsourcing have to be based on multiple criteria and must not be founded on short-term cost efficiency exclusively. In addition, the public sector organizations must develop an awareness of long-term strategic implications of their decisions in favour of outsourcing and thus avoid possible negative impacts. And finally, it is necessary that we think about insourcing in certain areas of the public sector activities that can, in adequate circumstances and aided by a quality project management, achieve much better results in the long run, in comparison with outsourcing.

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The Efficacy of Public-Private Partnership Implementation in Infrastructure Improving

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Public-private partnership is a concept that evolves. From the rudimentary partnership which is characterized by a high level of informality, a public-private partnerships have turned into a contractual relationship institutionalized by public and private sectors and now include a wide range of organizational models. Some of them can be said to include significant public and private responsibilities related to planning, financing and implementation. So far a great variety of new models of public-private partnershiphave been developed to address the various challenges, that are set before the public-private partnerships in specific situations and sectors. Consequently, the synergy created within the partnership can be extended to specific niches of infrastructural development. Models of public-private partnerships differ depending upon the participation of private capital in the project realisation and those related to infrastructural projects will be the subject of this paper.

1. Introduction

Applying project financing as a modality of financing has in the past decades become an attractive method of financing, construction and maintenance of the public sector infrastructure, as well as of building industrial facilities. A Long-term business association between the private sector and public institutions aims to make use of the available private sector managerial and financial resources that often are a significant constraint from the point of view of the Government or local autonomies. The organizational structure of such a partnership is a formal system of obligations defining individual positions of entities and their reciprocal liabilities. This results into a distribution of responsibilities related to supplying the necessary resources, risk allocation among entities and, finally, the execution of the project for the purpose of meeting the needs of the public sector.

Synonyms for the notion defined by the contract bond between the public and the private sectors differ from one part of the world to another. They all have their roots in the English language. Thus we often find terms such as: [10]

- ➢ Private Participation in Infrastructure imposed by the World Bank experts, and rarely used outside the financial-developmental sector except in South Corean project financing programmes.

- ➢ Private-Sector Participation, a term most often used in the development and banking sector.

- ➢ Privately Financed Projects, a term most often used by Australian experts, hence it is encountered chiefly in that area.

- ➢ Private Finance Initiative, a term coming from Great Britain and now frequently used in Japan and Malaysia.

- ➢ Public-private Partnership (PPP or P3), a term characteristic of the United States of America region. Originally it was related to mutual public-private funds meant for the development of education, extended to cover the financing of public utilities in the 1950s as well. Since 1960s it has been broadly used and is now also used to denote public-private partnerships in the reconstruction and improving of urban areas.

Public-private partnership can be defined in both broad and strict senses. Strictly speaking, the central idea of partnership is in cooperation, where the partners retain independent identities, but cooperate in achieving mutual business goals and results. [7] The term is so popular that it is often used incorrectly and denotes even those types of relationship that are far from being collaborational. Commercial relationships between public agencies and private contractors, for example, can hardly be termed partnership. [7] Hence the strict definition of partnership means that infrastructure projects of the public-private partnership type need not by nature be partnerships.

The broader definition, at the same time, includes not only mutual, but also complementary goals of interest parties in the project or programme, thus profiling the partnership relations. Thus a concession for the highway construction and management has different goals and meaning for the private sector in comparison with that of the public one. While the Government or a local autonomy are concerned with an acceleration of economic growth, the quality of services delivered and as

low a road toll as possible, the private investors are exclusively interested in financial goals, i.e., the profitability of the project. Not only do these goals fail to be mutual, but they are even adverse to some extent. Nevertheless, if the public sector is not capable of ensuring the capital to finance the highway construction, it is possible, from the aspect of the social community, to find a certain complementarity of interest for such a partnership and denote this relationship as partnership.

All definitions of public-private partnership share some mutual features such as: (1) public-private partnership is always related to the cooperation of two or more entities (of which at least one is a public entity); (2) each entity is a principal; (3) the relationship is of a long-term character, stable and based on mutual or complementary interests; (4) the entities transfer tangible and intangible resources to the partnership; and (5) risk and liability are distributed to all the participants in the partnership. [1]

2. Public-private partnership structure and implementation

The idea that private companies should be included into the realization of traditionally public infrastructure projects resulted in the emergence of public-private partnership. As a model of financing, public-private partnership is most frequently applied in financing capital projects of common concern such as: highways and motorway facilities (bridges, tunnels) where it is possible to charge the toll for exploitation, railways, ports, airports, gaspipes, refineries, electric power plants, social infrastructure (hospitals, schools, prisons, various-purpose social facilities for certain categories of population), communal infrastructure (water supply network, waste water disposal, waste disposal) and facilities used by government institutions and other specialized service sectors. [11]

Since the major motive of private entries to participate in the infrastructure projects realization is an adequate financial return rate, proportional to what can be earned by investing into alternative projects of similar risk, the structure of the partnership between the public and the private capitals is formed in such a manner that it ensures and adequate return rate. Consequently, the partnerships between the state and the private capital can be described as joint ventures in which entrepreneurs and the state cooperate, jointly contributing to a faster and more efficient infrastructure project realization. [2] According to Miller and Lesard (2003), the private share in the total investment into infrastructure towards the end of the last millenium varied from 9 and 13 per cent in Germany and France, to 47 and 71 per cent in the USA and Great Britain, respectively. [9]

The partnership between the public and private sectors is an agreement between a state and a private subject(s) where the private partner is entitled to perform certain operations in the project realization (design and planning, construction works, financing, managing and maintenance, collecting receivables). Such a type of contract is meant to earn the benefits such as the opportunity for the private sector to ensure more favourable options of long-term financing and the insurance of such financing in a much faster and more flexible manner. The public-private partnership contracts are concluded on a long-term basis, for a space of time of 25 to 30 years.

According to Finerty (2007), a typical financial contract concluded on the public-private financing concept has the following characteristics: [5]

➢ The contract defines the obligation of the financially liable party to complete the project and, for that purpose, to provide all the funds necessary to complete the project successfully;

➢ On completion of the project, i.e., since the moment its exploitation begins, the financially liable party is obliged to ensure that the built facility works. Thus it will generate sufficient cash to cover the operational costs of the project as well as service the debts it incurred during the construction. The expected cash equivalents should siffice to meet the due expenses even in case the project fails due to force majeure, or any other similar reasons;

➢ The guarantees that in case the works are stopped and additional capital necessary to put the project into operation needs to be raised, the financially liable parties shall provide the capital through insurance premia, advance payments for future delivery or in any other way.

Defining an adequate structure of public-private finance is a complex task, since it is necessary to bring into accord and adjust the goals of a large number of participants simultaneously. Among the private sector ones these are usually investors, lenders, companies involved in the construction of the facility or provision of a certain operation service. On the part of the public sector there are usually the government institutions that create and implement various policies of public-private partnership. Finally, there is the public, that is, the future consumers of the facilities built through the public-private partnership.

The public sector is assumed in many countries to be in charge of delivering the basic types of services. The manner of creating and delivering services, however, changes. The needs and desires of the public sector to cooperate and make use of the advantages of the pri-

vate sector are increasingly evident, hence an ever greater number of contracts on joint operations of the public and private entities for the purpose of mobilzation of the capacities and the financial means of the private sector. The forms of these partnerships differ, however, new structures emerge continually to meet the conditions of the environment in which the project is being developed in the best possible manner. This means that partnership is a dynamic form which does not recognize the "best model", nor can the approach of the most adequate structure selection be standardized.

The general postulates that allow for the understanding and facilitate prioritizing in the selection of an adequate structure of public-private finance start from the notion that: [4]

> Each public-private partnership structure has its strengths and weaknesses that must be identified and integrated;

> Public-private partnership does not ensure that the problems will be solved promptly and is implemented in cases of apparent and clear benefits, in relation to the traditional direct financing;

> The public-private partnership structures must be adapted as regards the sector and the context of implementation;

> The desired impact and the expected benefit of the public-private partnership concept implementation has a decisive role in the selection of the structure and plan of financing.

The following Table [4] presents the basic characteristics of the implementation of the public-private partnership model, with the implementation proposed for a specific sector. The selection of the appropriate structure is a complex task and is based on individual project characteristics and needs.

Public--private partnership model	Major characteristics of the public-private partnership model	Public-private partnership model implementation	Strengths of the public-private partnership model	Weaknesses of the public-private partnership model
Contracting provision of services	Concluding contract with a private entity for the design and construction of a public facility; Facility is funded and is the ownership of the public sector ; The key motive for such contracting is the transfer of design and construction risks	Suitable for large projects with small operational requirements; Suitable for large projects in which the public sector tends to retain operational liability	Transfer of project design and construction risks; The model has a potential to accelerate construction programme;	Possible conflict between the planned and the ecological requirements; Operational risk can be higher; The start-up phase is highly critical; Not atrractive for financing by the private sector
BOT	Concluding contract with a private sector entity for the design, construction, and managing of a public facility during a defined period of time, upon which the facility is transferred to the public sector; Facility is funded by the public sector and is public ownership during the contract period; The key motive for such contracting is the risk transfer with the risk of project design and construction.	Suitable for projects with considerable operational contents ; Especially suitable for the water supply and waste treatment projects;	Transfer of project design, construction and realization risks; The model has a potential to accelerate construction programme; Transfer of risk affects the adoption of cost approach to project cycle; The model promotes the innovation of the private sector and higher value of invested capital; The model fosters the improvement of the quality of business operations and maintenance ;	Possible conflict between the planned and the ecological requirements; Contracts are more complex and tender process is longer; Requires a system of monitoring the management and operations; The cost of new entrance into business if the entity fails to satisfy ; Not attractive for private financing, imposes the need of long-term financing to the public sector;

DBFO	Concluding contract with a private entity for the design, the construction, business operations and financing of the facility for a defined period upon which the facility is returned to the public sector; The facility is the ownership of the private sector during the contracted period by which it covers the expences through public subsidies; The key motive is using private financing and transfer of the risks of project design, construction and work; Different varieties of liabilities are included.	The model is suitable for projects with considerable operational contents; The model is especially suitable for road building, water supply networks and waste treatment projects;	Same as for the BOT model; The model attracts finances from the private sector; It especially attracts debtor finance; It provides a predictable and consistent cost profile; Increases the potential of the accelerated construction programme; Risk transfer is larger, which encourages the private entity to adopt the cost principle during the project design phase;	Possible conflict between the planned and the ecological requirements; Contract can be more complex and the tender procedure can be londer; Requires a system of monitoring the management and operations; Cost of new entrance into business if the entity fails to satisfy; Guarantees for financing may be required; Requires a system of management replacement/change;
Concession	Same as for DBFO, except when the private sector covers the expences via charging the service to the consumers; The key motive is the "polluter pays" principle, followed by private financing, and transfer of operational, design and construction, risks.	The model is suitable for the projects allowing for charging the consumers for use; Especially suitable for road building, water supply networks and waste treatment projects;	Same as for DBFO model; Facilitates the "polluter pays" principle implementation; Raises the demand risk level and helps generate the income of the third party;	Same as for DBFO model; Model can be politically unacceptable; Requires a more effective use of alternatives/replacements, for example, alternative routes, alternative options of waste disposal;
Contracting certain risk-bearing works	Concluding contract with a private entity for the design and construction of a public facility; The facility is funded and is the ownership of the public sector; The key motive for such contracting is the transfer of design and construction risks.	Suitable for large projects with small operational requirements; Suitable for large projects in which the public sector tends to retain operational liability.	Transfer of design and construction risk; The model has a potential to accelerate construction programme;	Possible conflict between the planned and the ecological requirements; Operational risk may increase; The start-up phase is critical; Not attractive for private finance

Public-private partnership creates a platform for exploring, forming, financing, and construction of new infrastructure projects that would otherwise be for decades delayed or would never be built. Numerous public-private partnership modalities have been developed so far to respond to different challenges set before the public-private partnership in specific situations and sectors. [3] Hence this model of financing is especially applicable to the developing countries with a clear need for building or improving their infrastructure, [8] which encouraged a vigorous involvement of the private sector capital into the infrastructure projects renewal, development, and realization. [6]

3. Implementation of public-private partnership models in traffic projects

Some of the most important issues that have a major role the selection of the preferred organizational form public-private partnership in the traffic projects realization result from the size and the scope of the project, possibility of charging the consumers for the service of using the traffic network and the expected level of project risk. The traffic systems meant for mass usage are adequate to the traditional project development and financing scheme, to a larger or smaller extents. Operational costs of one such scheme are relatively low in comparison with the costs of the capital required for the construction of such a traffic system. The traditional contracts on construction are the extention of the now ruling conventional approach and an attempt to transfer the planning and construction risks to the private sector by the fixed-price contracts. Even in such cases the liability for the infrastructure maintenance rests with the public sector. In some cases the construction of especially large road networks can be partly or entirely funded by user charges. The chance to choose the road communication using bridges and tunnels is a visible benefit for the user which is related to the possibility to charge the use of the route selected. In such circumstances the public sector has to make a decision as regards the transfer of project financing liabilities, but also the road toll charges, to the private sector partner.

Varied types of contracts are already in use in Europe. The concession contracts for toll highways are appropriate where the private sector will finance a large road network system, collect the toll and bear the risk of the possible charge of such a service. The BOT (Build-Operate-Transfer) contracts are most appropriate where the public sector charges for the services provided, which serves as basis for paying the private-sector investor. The DBFO (Design-Build-Finance-Operate) contracts, or organizational models, are such models where the Government provides incentives for the private entities to build traffic infrastructure, in order to pay the entity off later, by imposing additional obligations to drivers through higher price of fuel or the car registration. The private sector partner takes over part of the risk of collecting the receivables. The users of the road are not charged to pay for the use of the road. This type of model was implemented to build a certain number of major routes in England, Finland, Scotland, Spain and Portugal. This model, however, has a number of weaknesses. They stem from the fact that the public sector still bears a higher risk in charging the dues, as well as that the drivers do not pay the economic price of the built infrastructure. It is in this sense that

the implementation of this model may result into a non-rational investment allocation in the infrastructure project realization.

4. Implementation of public-private partnership model in water-power supply projects realization

Public-private partnership has been a model of financing the water-power supply sector for decades. Thus the first concession for the development and water-power and waste water treatment plants management was granted to the private sector entity in France 40 years ago. This led to the rise of large and diversified private utility companies. The EU Drinking water directive and the Urban areas waste water directive had a significant impact upon the changes in terms of the public sector liability concerning these issues. Meeting the requirements of the Directives means investing considerable capital into new facilities of the water-supply network and the waste water treatment capacities, in a large number of countries. Hence the countries that have not so far included the private sector into the water supply and waste water treatment operations now analyse the private sector potentials and its financing capacity in order to meet the requirements of the Directives.

Considerations on the selection of a preferred form of public-private partnership in the water supply project sector are similar to those characteristic of the traffic sector, hence they also take into consideration the size and the scope of the project (including operational contents), possibilities of collecting the dues from the consumers and the expected level of risk transfer. The construction of a water-supply network or a waste water treatment plant using the public-private partnership model is usually related to the level of availability of information on the structure and operation of the existing networks. If the available information is not sufficient, then the traditional agreements on financing and construction of such facilities may prove to be more adequate. On the other hand, contracts on water supply and building the waste water treatment plants are most often adequate for the BOT (Build-Operate-Transfer) and DBFO (Design-Build-Finance-Operate) models. Besides, concession contracts too are characterised by a specific form of execution, that is, where it is possible to introduce the user charge. The water supply network facilities and the waste water treatment plants are not suitable for the traditional ways of project realization. The risk of the increase in the complaxity of the treatment process rests with the public sector and is not included into the design flow of these processes.

5. Implementation of public-private partnership model in landfil projects realization

The implementation of public-private partnership is stimulated in those sectors in which the burden on the public sector has increased significantly. This is especially evident in the urban waste disposal projects. Due to economic and ecological reasons, public agencies tend to abandon solving this problem by building landfils, which used to be a traditional way od waste disposal problem solving. New methods of waste treatment, such as conversion of waste into useful energy or recycling, require substantial investments and specialzed technical skills, i.e., know-how.

Considerations on the selection of the preferred public-private partnership form in the landfil building projects sector are similar to those in the traffic and water-suply sectors. They include the size and the scope of the project (including operational contents), the possibility of user charge and the required level of risk transfer. The projects in the waste treatment sector are more adequate for higher-developed forms of public-private partnership in which it is possible to transfer a significant level of operational risk. The implementation of a concession allows for the financing of the project on the "polluter pays" principle; hence the process of risk assignment related to the scope of waste materials. This type of project financing is predominant in Great Britain.

6. Conclusion

A successfully selected public-private partnership model is one in which the liability, obligations and risk distribution are assigned to the entity that can manage them best. Hence it is important that the contract should be carefully planned and defined and an adequate monitoring and regulation of liabilities agreed to in the contract be ensured. The Government sector that analyses the opportunities to start a public-private partnership should first take into consideration the technical, the financial, the economic, and the legal feasibility of the project and adjust the goals of the Government to the interests of the private investor. The best public-private partnership option can be selected only via a comprehensive feasibility analysis, and this analysis will in turn start the remainder of the process. Well concieved and defined project structures of public-private financing allow for the creating of an appropraite monitoring and performance measuring mechanism via the set key performance benchmarks.

By meeting these preconditions the ultimate goal of partnership is achieved – the improved project efficiency employing the resources in private sector ownership. Here we primarily mean capital and a specific know-how based on the experience in one business field. The private sector is considered to be more successful in doing business and copes better with the burden of risk management (such as construction risk or standard quality maintenance risk), whereas a regulatory risk is better managed by the public sector. A correct estimate of the strenghts of each of the involved parties and their managerial skills directly impacts the selection of the public-private partnership model as well as the success of of the entire project.

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Measuring Effectivness of KM Projects

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In today's ever changing global economy organizations are finding it difficult to stay competitive. Under these circumstances it is no wonder that organizations are considering Knowledge Management (KM) as one of the possible solutions. The success stories and benefits reaped by some organizations through effective Knowledge management luring others to impalement one or the other KM systems. It is difficult to determine if a particular KM project is successful or not, as many of the benefits are cumbersome to quantify and subjective in its nature. Also, some organizations leave the projects midway as they fail to see financial benefits of the implementation.

In this paper we discuss various methods and metrics to monitor KM project implementation and to develop a methodology to determine impact of KM project on financial results. We categorized these metrics into Three groups; first group of metrics focuses on measuring Knowledge acquisition (the amount of information), second group on measuring effectiveness of KM systems (easy to access, system response time) and third group of metrics focuses on measuring success of overall project. In the process of developing methodology to identify impact of KM on financial results, we proposed a methodology similar to Event Study methodology used to measure abnormal stock returns caused by firm specific as well as economy wide events.

1. Introduction

At the very beginning of this article we give basic definitions of terms which will be used: **measure** is "*A reference standard or sample used for the quantitative comparison of properties, e.g., the standard kilogram is maintained as a measure of mass*", while **metric** is "*A system of related measures that facilitates the quantification of some particular characteristic*". It is obvious that measure with no comparison gives very little or no information at all, thus this paper will deal with metrics for Knowledge Management (KM) initiatives.

Before tackling questions on KM we must give definition on **Intellectual Capital (IC)**. In recent years many scientist are challenged to give standardized definition of IC as it became necessity of modern business. According to the definition given by Steven M.H. Wallman, SEC commissioner, IC are "*assets currently valued at zero on the balance sheet*" and represents not only human brain power, brand name or trademarks but also assets bought long ago, booked at historic price but during time transformed into prime real estate. Another definition of intellectual capital is given by Brooking (1996). "*Intellectual capital is the term given to the combined intangible assets which enable the company to function.*"

In today's ever changing global economy many companies rely on intellectual assets in order to generate revenue, like software companies where products are developed and delivered electronically. Therefore, now days it became obvious that company's balance sheet shows only part of company's value. Having said this, it is clear that tangible assets are loosing their dominance in front of intangible assets and importance of proper measurement of their value is raising many accounting questions, especially in the field of brand names, production process, distribution channels, trade secrets etc.

Business writer William Davidov (The Virtual Corporation) says: "*There's a need to move to a new level in accounting, one that measures company's momentum in terms of market position, customer loyalty, quality,etc. By not valuing these dynamic perspectives, we are misstating the value of a company as badly as we were making mistakes in addition.*"

2. KM metrics

Process of measuring intangible assets (IC) is connected with KM initiatives, as it is assumed the outcome of KM initiative has impact on IC.

Impact of KM initiative can be decribed by different approaches, such as:

1. House of Quality, (Hauser & Clausing 1988)
2. Benchmarking approach (American Productivity Center (APQC))
3. Balance Scorecard, (Kaplan and Norton 1996)
4. Intangible Asset Monitor (IAM), (Karl-Erik Sveiby 1986-87)
5. Scandia Navigator, (Edvinsson&Malone 1997)
6. IC Index (Roos, Dragonetti&Edvinsson 1998)
7. Technology Broker (brooking 1996)
8. Citation-weighted Patents (Hall, Jaffe&Trajtenberg 2000)

Some of these methods will be disscuses here, while others are beyod the scope of this paper.

House of Quality is presented in a form of matrix with a shape of a house, where roof of house represent relationships while walls characterize processes.

Left wall of the house, which are outcomes of KM initiative, represents goals and objectives whereas right walls of house stand for weights of the outcomes. Center of the house stands for correlations between the metrics and the performance outcomes. By analyzing those correlations management can decide on which areas of KM to focus in order to achieve highest results and influence overall performance of the company.

This matrix actually measure how customer's desires are linked to company's capabilities. Example of House of Quality is available at http://www.qfdonline.com/templates/qfd-and-house-of-quality-templates/. This method is also recognized as Quality Function Deployment (QFD) since it is using matrix to correlate customer needs with capabilities of company to satisfy those needs. More details are available at http://www.qfdi.org/ .

This tool concentrates on maximizing customer satisfaction by translating customer's needs into business processes throughout company. Furthermore, it compares with competition and optimizes features which are delivering biggest competitive advantage to the company.

Benchmarking originates from Xerox Business Systems in the late 1970s when Japanese companies where able to produce similar products with lower price and better quality, then those produced in USA. Therefore, Xerox wanted to explore if it is possible to imitate work done by competition. Two general types of benchmarking exists, one is internal and the other external. An internal benchmarking deal with comparison of departments within same organisation while external compares different companies. Essentially, benchmarking is comparison tool identifying best practices within comparable sectors and emulates them in order to achieve the highest results.

American Productivity and Quality Center (APQC) benchmarking methodology was developed in 1993 and it is known as one of leading methods for successful benchmarking. The KMAT was developed by APQC and Arthur Andersen in 1995 as a tool for self-assessment. Main idea behind this method is to classify companies to be compared with, identify strategic

objectives and define which best practices can be successfully implemented.

The Balance scorecard method (BSC) was developed by Kaplan and Norton in 1996 with an aim to help organisations in achieving equilibrium between their vision and real life targets, presented by performance indicators. These indicators are spread between following dimensions: Customer, Financial, Internal Business Processes and Learning and Growth. Within each dimension, further development in the area of the goals, metrics, targets and initiatives is possible. For example, if we observe financial dimension, goal can be profitability growth as a major goal to be achieved; metrics can be monitored in some specific area like change in net margin; target is particular result to be achieved e.g. growth in profit margin in amount of 3%; initiatives are projects or actions which helps achieving desired goals.

Even though this method was imagined as performance improvement metrics, it can also serve as strategic management system, since each organisation can adapt it to its own needs. Therefore, each BSC method should be "custom made" for each and every organisation. Now days some tools and templates are available to help organisations implement BSC initiative.

It is interesting to mention similar method called **Intangible Asset Monitor (IAM)** developed by Karl-Erik Sveiby in 1986-87 in Sweden, since both concepts are developed independently of each other. Similarities and differences are explained by author of IAM himself, prof. Sveiby at his website http://www.sveiby.com/articles/BSCandIAM.html. In this article we will just mention that both methods categorize intangible dimensions into four, both agree on idea that strategy must be the driver of the metrics designed, change should be measured and both approaches should improve learning and growth. On the other hand Svieby says: "*the origins and the foundations of the concepts beneath the surface are very different. I would like to think of the IAM as more of a "Knowledge Era" measuring instrument, whereas I regard the BSC as more "Industrial Era". Therefore BSC users will probably develop non-financial indicators that are different from those using the Intangible Assets Monitor.*"

Swedish insurance company **Scandia** published in 1994, together with annual report, additional report called "Visualizing Intellectual Capital in Skandia" (Skandia, 1995) which opened new area in the field of measuring intellectual capital. This broadened form of accounting resulted Scandia's ability to transform in-

tellectual capital into financial capital. At Skandia the intellectual capital ratios are grouped into major focus areas: the Customer focus, the Process focus, the Human focus and the Renewal & Development focus, presented in the Picture 1. Reason for giving the name

"Navigator" is twofold: firstly, it should guide an organization how to manage intellectual assets and secondly, it should guide people through set of measures that represent the true resources, capabilities, and future potential of an organization.
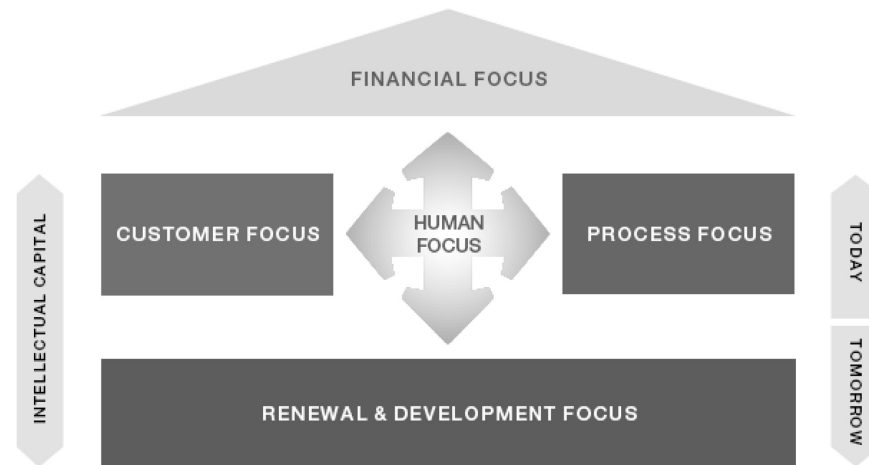
Picture 1: *Scandia Navigator*
(Source: *"Visualizing Intellectual Capital in Skandia"*, Supplement to Scandia's 1994 Annual Report)

3. Quantifying KM benefits

Wen-der Yu et.al (Quantifying benefits of knowledge management system - A case study of an engineering consulting firm, published in ISARC 2006) developed quantitative benefit models for KM systems. These models quantify 3 types of benefits. Where in data was collected through questionnaires answered by KM system users.

(1) Time benefit – Saving of time (TB) required to solve a problem with KMS (ND_S) compared to with the time required in the traditional process (ND_T)

$$TB\% = (ND_T - ND_S) \times 100 / ND_T$$

(2) Man Hour benefit – Saving of man-hours required (MHB) to solve a problem with KMS (STT) compared with the man hours required in the traditional process (TTT). Traditionally the problem is solved via meeting. Where as in KMS, the problem is posted in a Community Of Practice (COP) and all members of COP participate in discussion to solve problem. Thus man hour benefit is derived from avoidance of meetings.

$$MHB\% = (TTT - STT) * 100 / TTT$$
$$TTT = ND_T * (MP_T * OT * \Delta\%) + (MN_T * MT_T * MPN_T)$$
$$STT = \Sigma ORT_S + HRT_S + FAT_S$$

Where,

TTT is total man hours required to solve problem traditionally

ND_T is working days required for traditional problem solving process

MP_T is number of participants in traditional process

OT average daily working hours of meeting participants

$\Delta\%$ is the average percentage of daily working hours spent by meeting participants in solving problem

MN_T is the total number of meting required to solve problem

MT_T is total number of meeting required to solve problem

(3) Cost benefit – The cost benefit measures difference of cost between traditional approach (TTC) and KMS (STC) approach.

$$CB\% = (TTC - STC) * 100 / TTT$$

$$TTC = [ND_T * (MP_T * OT * ?\%) + (MN_T * MT_T * MP_T)] * EAP$$
$$STC = [\Sigma ORT_S + FAT_S] * EAP$$

Where,

EAP is the average hourly salary of the participants ($/hr)

TTC is the total cost of problem solving in traditional approach ($)

STC is total cost of problem solving in KMS approach

4. Estimation of ROI of KM projects

In 2003, BEI consulting developed Cost / Benefit model to evaluate Return On Investment of (ROI) of KM initiatives. Cost / benefit method divides benefits into two main categories, those are:

1. Tangible benefits like increased quantity of work, cost savings, faster product cycle time etc.
2. Intangible benefits like increased customer satisfaction, quality of decisions, employee satisfaction etc.

Tangible Costs are categorized into: Purchase cost, Implementation cost (including change manage-ment), Maintenance cost. Further these costs are subdivided into:

1. Sunk Costs (Costs expended to date on the status quo alternative that are not recoverable) the paper suggests that Sunk costs should not be included in the actual ROI calculation
2. Recurring and non recurring costs
3. Cost avoidance (cost avoidance is term used to describe those costs that are avoided by selecting a particular alternative

To summarize the model following table is prepared:

		Year	1	2	3	4	5	Total
Cash In Flows	Cost Savings	Purchase						
		Development						
		Transition						
		Maintenance						
	Cost Avoidance	Purchase						
		Development						
		Transition						
		Maintenance						
		Sub Total (1)						**A**
Cash Outflows	Costs	Purchase						
		Development						
		Transition						
		Maintenance						
		Sub Total (2)						**B**
		Return Per Year (1-2)						**(A-B)**

ROI = (A-B)/B

5. Methodology to determine impact of KM projects on financial results

The earlier methods that are used to determine ROI and benefit quantification used qualitative data as input. Also these methods consider Knowledge Management projects as stand alone. As research suggest KM projects are more effective when KM project implementation objectives are aligned with overall business objectives of the firm. Keeping this concept in mind we propose a methodology to confirm impact of KM projects on financial results. Some of the terms used in the methodology are

Return on Capital Employed (ROCE): It is a ratio that indicates the efficiency and profitability of a company's capital investments. ROCE should always be higher than the rate at which the company borrows, otherwise any increase in borrowing will reduce shareholders' earnings. ROCE is Calculated as,

$$\text{ROCE} = \frac{EBIT}{Total\ Assets - Current\ Liabilities}$$

Market "Beta" (β)

Beta is a statistical measure which indicates risk of a stock. It measures volatility of individual stock with respect to the market. Beta is calculated from historical stock prices through regression analysis. By definition, the market has a beta of 1.0. A stock that swings more than the market over time has a beta above 1.0. If a stock moves less than the market, the stock's beta is less than 1.0

Assumptions

1. Knowledge management has impact on many areas of firm operation thus effects over all profitability of companies
2. Only firm wide implementation is considered as starting point for study
3. Benefits of Knowledge management can not be realized in shorter duration, thus a period of approximately 2 years to be studied
4. As Knowledge management is mostly internal affair of a company, Return on Capital Employed (ROCE) is considered as a measure instead of market price (used in Event study methodology)

Methodology

"Step - 1: Event Window"

Event window is the period during which firm's ROCE is observed. Each event widow consists of financial quarters. We selected quarter as measurement because most of the firms publish quarterly financial results. By using this legal data we can calculate ROCE. The quarter in which firm wide KM project implementation started is considered as quarter "Zero". Quarterly ROCEs before implementation is estimation window and Quarterly ROCEs after implementation is started as post event window

Event window 1 [-1, 0, +1]
Event window 2 [-2, 0, +2]
Event window 3 [-4, 0, +4]
Event window 4 [-8, 0, +8]

"Step – 2: Estimation of normal return"

Normal return is expected ROCE if the KM project is not implemented. In order to calculate normal ROCE we can use industrial average ROCE.

$$ROCE_E = \beta_f * ROCE_I$$

Where,

$ROCE_E$ = Expected / Normal ROCE of firm that is studied

β_f = Market Beta of firm

$ROCE_I$ = Industrial average of ROCE

"Step – 3: Calculation of abnormal return"

Abnormal returns are the returns from the capital employed because of KM implementation. This is difference in estimated / normal ROCE and actual ROCE.

$$ROCE_A = ROCE_O - ROCE_E$$

Where,

$ROCE_A$ = Abnormal ROCE of firm that is studied

$ROCE_O$ = Observed ROCE

$ROCE_E$ = Estimated / normal ROCE

"Step – 4: Calculation of cumulative abnormal return (CAR)

Cumulative Abnormal return on Capital employed is calculated as

$$ROCE_{CAR} = {}^{T2}\pi_{i=T1} (1+ROCE_{Ai}) * (1+ROCE_{A(i-1)})-1]$$

Where,

$ROCE_{Ai}$ is abnormal ROCE of ith quarter

$ROCE_{A(i-1)}$ is cumulative product of abnormal returns of all quarters prior to i^{th} quarter

6. Conclusion

A positive CAR indicates successful KM project implementation while negative CAR shows unsuccessful KM project implementation. It is crucial to note that negative CAR does not mean that Knowledge management is leading to losses. Instead companies should focus on other means and ways to stay competitive.

This paper gives an overview of some methods known so far in theory and practice, at the same time proposing method which needs to be tested and validated by studying results of companies that implemented KM projects. Furthermore, the use of market "Beta" to calculate normal return (ROCE) also needs to be validated.

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Management of Receivables in Function of Support to Business Success

UDC: 658.14/.17 ; 657.21

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The aim of this study is to identify the fundamental segments for the proper receivables management. Adequate collection of receivables is generally, after profitability, the second most important measure of success of business. Therefore, companies are obliged to carefully take account of their balance of trade and to manage them properly, so that the company's liquidity would not be called into question.

1. Introduction

The subject of this paper includes the key aspects of the management of receivables collecting from the customers, since thay are one of the most important liquid assets of a company. An adequate collecting of receivables from customers requires a high quality accounting system. The receivables from customers are a very important component of investments into circulating assets which needs to be converted into another form – cash assets through receivables collecting, and in as short a time as possible.

At any moment of the company's operations the profits earned may be „trapped" in stock supplies or in debtors, thus becoming unavailable to the company.

As a balance component, the receivables (from the aspect of the company as a supplier) represent the inflows that will in future come as a compensation for the products, goods and services sold, however, with the risks emerging as possible non-negotiable receivables. An adequate collection of receivables is a significant precondition for an efficient business doing of any company. Planning cash flows, a timely adjusting of cash inflows and outflows, is impossible without an adequate planning of collecting receivables from customers, on a daily basis. The above mentioned is even more important in the conditions of the economic crisis and the problems with the company solvency. Cash is indispensable when business is to expand or short-term financial problems are to be overcome.

The sold products, goods or services mean income for the company, and will mean an inflow when the sales are cashed. (the most important issue in an accounting dealing with income is to define the moment in which the incomes are recognized. The recognition of the income from the transactions of the sales of goods, service delivery and the usage of the entity assets by the others are treated by the International Accounting Standard (IAS) 18 – Incomes. Under this standard, income is recognized when the inflow of the future economic benefits into the entity is probable, and when these benefits can be realiably/positively measured. See more in [1]). Making it possible for the customers to make deferred payment has an important role in income generation, however, the consequence may be the rise of costs and a delay in receiving money. Contrary to this, that is, in the circumstances when the company takes the money from the customers before it delivers the goods or a service to them, it is liable to deliver these goods or services in a defined period of time.

Every company will tend to collect their receivables as soon as possible and without losing their customers. Customers are becoming an ever more important factor in the growth of the business in the conditions of globalization. [2]

A relative importance of receivables from customers as a percentage of their total assets depends on a number of factors, such as: company business (competence), season, whether the company supports long-term financing, the defined credit policy, etc.

The practice of deferred payment is considered to be one aspect of crediting.

The receivables from customers, dependant and associated legal persons and other buyers in the country and abroad and on the basis of the sales of products, goods and services belong to the short-term receivables category.

2. Identifying key segments of receivables management

Circulating assets are made up of three parts, namely: 1) stock supplies, 2) receivables from customers and other receivables, and 3) cash and cash equivalents. Each of the assets is characterised by a different level of

solvency. The liquidity of assets is defined by:

1) the time span in which the assets will be transformed into money (cash);

2) the number of phases one type of assets has to pass in order that it should be transformend into cash;

3) the risk level that these assets will ever be transformed into liquid assets.

Receivables from customers should be viewed through several segments (Figure 1).

In order that the important differences between the types of receivables from customers, they are classed into three groups: 1) unrecovered debts (usual date of maturity); 2) bills of exchange received; and 3) other receivables from customers.

Unrecovered debts are a result of the sales of products, goods or services, and the companies usually expect to collect these receivables within 30 to 60 days. Naturally, the time of payment can, under the contract signed or according to the usual business practice between the customer and the seller, be shorter or longer.

The bill of exchange as an instrument and a security of payment has a twofold function: (1) instrument of payment and (2) instrument of security of collecting receivables. The bill is issued as an evidence of liability. It is issued for a period of 60 to 90 days or longer.
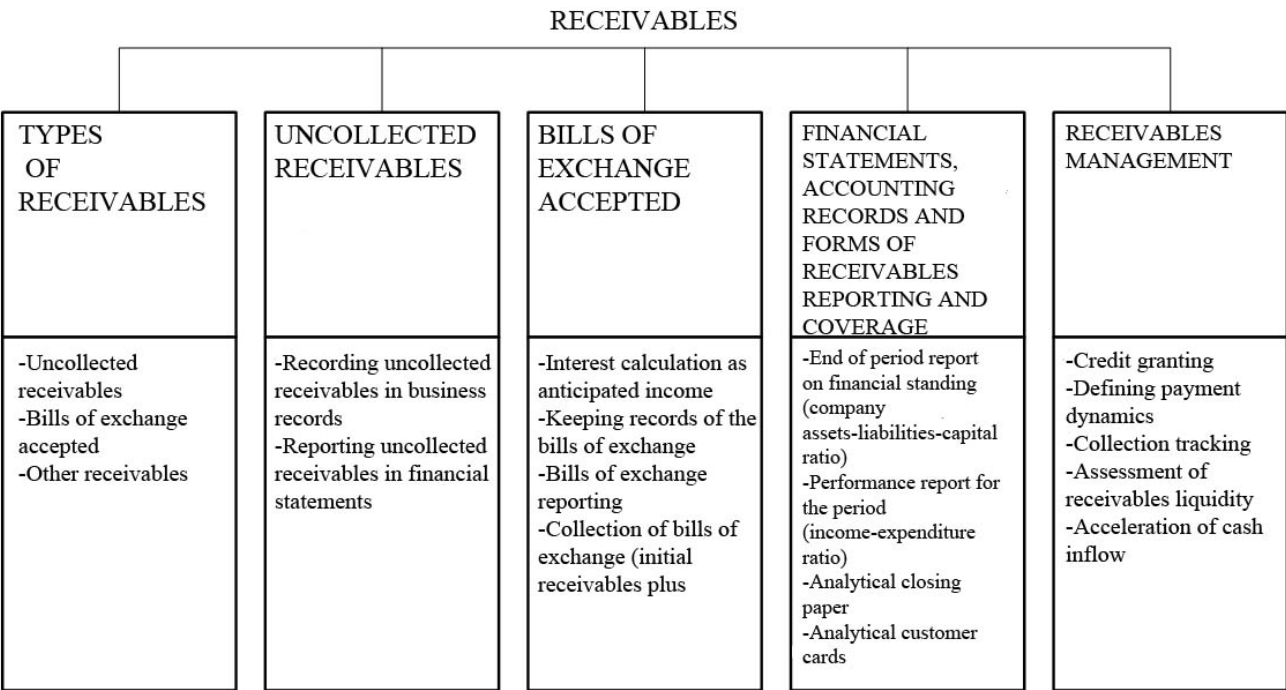
RECEIVABLES

TYPES OF RECEIVABLES	UNCOLLECTED RECEIVABLES	BILLS OF EXCHANGE ACCEPTED	FINANCIAL STATEMENTS, ACCOUNTING RECORDS AND FORMS OF RECEIVABLES REPORTING AND COVERAGE	RECEIVABLES MANAGEMENT
-Uncollected receivables -Bills of exchange accepted -Other receivables	-Recording uncollected receivables in business records -Reporting uncollected receivables in financial statements	-Interest calculation as anticipated income -Keeping records of the bills of exchange -Bills of exchange reporting -Collection of bills of exchange (initial receivables plus	-End of period report on financial standing (company assets-liabilities-capital ratio) -Performance report for the period (income-expenditure ratio) -Analytical closing paper -Analytical customer cards	-Credit granting -Defining payment dynamics -Collection tracking -Assessment of receivables liquidity -Acceleration of cash inflow

Figure 1. *Receivables from customers per segments of observation*

Other receivables from customers refer to the activities that are not the result of business operations, e.g., debiting the customers for overdraft interest.
Two accounting problems related to unrecovered receivables (debts) are:

1. The moment of recording the unrecovered receivables from customers; and

2. Valuating of unrecovered receivables from customers.

The initial recording of unrecovered receivables is the moment when the realization is invoiced. The sales discounts reduce receivables from customers. The seller may offer conditions, such as discounts, to motivate the buyer to make earlier payments.

For example, the 2/10 conditions mean that the customer qualifies for a 2% discount if he pays in a period not later than 10 days. The recovery of goods from the customer also reduces the unrecovered receivables.

Relevant for the valuation of receivables is the net re8alized value, that is, in practice (1) invoice value, or (2) invoice value reduced for the amount of estimated sum that is considered unrecoverable. (Pointed out by Marko Fabris, consultant.)

An important issue that has to be answered is: in which way should a company report the receivables from cus-

tomers in its financial statements. This is sometimes rather difficult since part of these will remain uncollected. The issue seems to be even more complax if we have in mind that financial statements present a financial standing and financial results of the entity (IAS-1), which are the issue of interest of a number of stakeholders (internal and external) – for the purpose of economic decision making.

Although each buyer is obliged to fulfill the credit conditions set by the seller, it inevitably happens that he may not be in a position to do so, as the buyer has experienced a fall in sales due to the aggravation of economic conditions on the market.

The accounting practice uses two methods to define uncollected receivables:

1. Estimate of the management (In estimating uncollected receivables the management needs the information support of the financial-accounting and legal sectors in the company); and

2. The percentage of due receivables, i.e., more than 60 or 180 days, i.e., in accordance with the accounting policy.

Two methods can be implemented to write off the unrecovered debts: (1) the method of direct write-off; and (2) the method of reconciliation/settlement.

In case of the method of direct write-off, if the company finds that an account is not negotiable, it assigns it to expenditures, due to the fact that receivables are valueless, that is, the company deals with the income statement.

The implementation of the reconciliation method in entering various (impaired) receivables means that the level of uncollected receivables is assessed at the end of every accounting period. Unlike the former method, this method allows for a better reconciliation of incomes and expenditures in the income statement.

The analysis of receivables is a basic precondition of an adequate receivables managemnt and for that purpose the company should work out an audit of receivables by currency (maturity), which will serve as a report on the maturity distribution of uncollected receivables. (When auditing the financial documentation of a company for which they are conducting the auditing activity, the auditors pay special attention to the analysis of the age and quality of receivables from customers. It is important to note that in identifying the risks for the *receivables from customers* balance sheet position the audi-

tors especially focus upon the following moments in the testing phase: a) the company (partnership) failed to adequately defer incomes from sales, hence the incomes from sales and receivables from customers are overrated; b) the company failed to apply correctly or did not apply at all the correct exchange rate to exports receivables (receivables from customers in foreign exchange); and c) the company (partnership) failed to test the negotiability of the receivables, that is, failed to calculate the correction of the value in accordance with the ruling accounting policies. It is of special importance that the managers in the company, supported by the financial accounting function, identify their economic liability and the social importance of auditing and submit valid data to the persons conducting external auditing.) When accounts are classified by maturity, anticipated losses for receivables are identified by adding a percentage on the basis of previous experience, as a total for each category. The longer the period of customers' debt, the lesser the probability that the debt will be collected. The result is that the estimated percentage of uncollected receivables rises in accordance with the number of days by the currency.

Generally speaking, the receivables analysis should include the folowing aspects:

a) receivables structure according to maturity;

b) receivables structure by debtors (customers);

c) receivables structure according to the amounts due;

d) receivables structure according to the type of the business transaction they refer to – products and service or for each group of similar products and services;

e) receivables structure according to the territory they were incurred on, that is, according to geographical regions;

f) structure of key debtors (customers).

Under the International Financial Reporting Standards – IFRS 8 – the business segments within the information on the segments to be disclosed include the information on the key customers, since they are the source of a significant risk concentration.

3. Credit policy and receivables liquidity rating

The creation of credit policy is an important segment of an adequate receivables management. A critical point in the process is making a decision as to who qualifies to be granted a credit and who does not. If the credit policy is

too strict, it may result in the fall of sales; however, if it is too "loose", the company may grant a credit to a customer who will pay it off either very late or never.

The basics of the credit policy are the following:

1. Conditions of sale;

2. Credit standards and their analysis; and

3. Receivables collection policy.

The conditions of sale mean that the following ahve to be defined: 1) the credit period, 2) the discount period, 3) discount for cash, and 4) credit instruments.

Usual in the business practice are deferred payments in a defined term whose time span is conditioned by a usual business practice, by the stability of economic conditions, by the business stability of a company, etc.

The length of the credit period is affected by various factors such as: demand, profitability and standardization, credit risk, competition, sales volume, customer type, etc.

The discount period is a period during which the customers qualify for a discount for cash that is a discount on the sales price of the product, goods and services granted to the customer who observes the terms of payment and pays timely.

The credit instruments are the records on indebtedness. The most frequently encountered credit instrument is the invoice with the delivery note sent to the customer together with the products and signed by the customer as the evidence that he has received the goods or products.

The credit policy is linked with the company's marketing strategy. The best way to increase the income is to attract a larger number of customers or increase the volume of sale. For that purpose, it is necessary that the company should implement a consistent marketing strategy that finds an adequate customer profile for the product or a service provided by the company. In creating the sales policy it is necessary that selected marketing strategies for increasing the number of customers should be observed, for example: 1) attracting new customers in order to increase the market share; 2) incraesing the market demand by drawing a larger number of customers to the market, and 3) capturing new markets in order to increase the number of customers.

If companies wish to reduce losses in sales, they may reduce the standard conditions for granting credit. They even may demand from certain customers to provide letters of credit (in this country, letters of credit are generally used in external transactions) or bank guarantees. A letter of credit is such an instrument of payment by which the issuing bank, i.e., the originating bank is bound to effect the payment or authorise another bank (correspondent bank) to pay to the third party – the beneficiary of the letter of credit, upon the advice of the instructing party, on commission – on its own behalf and for the benefit of the client-customer, or for its own benefit (on its own behalf and benefit), on the basis of signed documents and according to contracted conditions (or without documents). Under the Obligation law, the bank guarantee is a written statement by which the bank is obliged to pay the due sum to the guarantee beneficiary in case the third party does not fulfill its obligation on maturity, and on condition the conditions stated in the guarantee are satisfied.

High risk bearing customers may be required to pay a larger portion of the sum in cash prior to the delivery of goods or products or prior to the service delivery. Besides, the companies may demand that banks and suppliers issue references on the basis of which they can rate the customers' financial solvency. In case of new customers, it is important that their references are closely examined, whereas for the existing customers it is important that their financial solvency is checked periodically. [3]

The companies may grant a hire-purchase sale in exchange for the formal credit instruments already mentioned as a form of accounts receivables – known as bills of exchange. A bill of exchange is a written promise that a defined amount of money will be paid on request or in a defined time. Bills of exchange are used in cases where the value of the business transaction exceeds the usual limits as well as in clearing the uncollected receivables. The bill of exchange states a nominal amount that incorporates the sum due and the interest receivable.

Bills of exchange can be stored until their maturity date and then the value of the bill – receivables from the customer with accrued interest is due to be collected. If the drawee fails to answer his obligations, the drawer (person to be paid) has to take appropriate steps. The bill of exchange is paid when the drawee pays the total sum on the date if its maturity.

It is the obligation of companies to state their accounts receivable in their financial statements correctly. It is especially important that quality and risky and contested receivables be stated separately so that the financial statement at the end of the period, or balance sheet, should show a realistic state of the assets.

The credit standards are the minimum conditions the customer has to fulfill in order that he should be granted to buy on credit. Here it is important to analyse the customer's character on the basis of how he answered his financial obligations to the suppliers in the previous period, as well as whether suppliers have any disputes in court with him and if so, how they were resolved.

The credit analysis is about collecting credit information on the customer, followed by an analysis.

The credit granting companies should define the payment period and present it to their customers, with special attention paid to the terms of payment offered by the competition. For example, they may grant the same terms as the competition and simultaneously offer a substantial discount to the customers who effected their payments in a period shorter than the credit period granted.

The commercial credit is an important instrument of financing a company and has so far been thoroughly studied in the relevant literature; however, the focus was upon financial subtleties. For an adequate receivables management, it is of special importance that a model should be created to identify the response to obligations to suppliers as well as receivables from the customers in case of the changes in the costs of stock, profitability, risk and solvency, respecting all the specific features of the concrete company along the way.

When problem customers are identified, the company takes steps to notify them by phone, in writing, and finally by taking them to court.

In order to improve the sales conditions the company offers a broad range of commercial and financial discounts. The company will, for example, decide on offering a trade discount after it has defined the opportunity cost of using the discounts offered. Namely, if the benefits from using such a discount are larger that the benefits the company would have if it engaged these assets in another alternative, the company will decide in favour of the discount.

One manner in which the companies retain the loyalty of their customers is to provide incentievs for purchasing goods or services in that the seller companies offer coupons – the so-called points the client can exchange for dicounted goods or services.

Two financial ratios are used to estimate the receivables liquidity from customers, i.e., the estimate on collection data: 1) coefficient of accounts receivable

turnover and 2) the average receivables collection period. [4]

The coefficient of accounts receivables turnover serves to test the ability to raise cash from the financially solvent customers. In other words, it shows the average of times per year the receivables are collected. The formula to calculate this coefficient is the following:

$$ART = \frac{NISC}{NARCOB + NARCCB} \qquad (1)$$

where:

- ART = accounts receivables turnover;

- NISC = net income from sales (net incomes from sales make the total sales reduced for the discounts and returns of products and goods) on credit (without changes in stocks of performances);

- NARCOB = net accounts receivable from customers upon the opening balance;

- NARCCB = net accounts receivable from customers upon the closing balance.

A higher coefficient means that cash is collected faster or more efficiently. A too high turnover of negotiable receivables, however, may show that the credit policy is too strict, or that the credit period is too short, which may cause a loss in sales to good customers.

The average collection period serves to track the average time the debtors need to pay their dues. This indicator is calculated using the following formula:

$$APRC = \frac{NDY}{ARTC} \qquad (2)$$

where:

- APRC = average period of receivable collection;

- NDY = number of days per year;

- ARTC = accounts receivable turnover coefficient.

The calculation of an average period of collection is an important part of the company's cash management system. Naturally, we also have to bear in mind that the sales cycle may be shorter than a year, which depends on the type of business.

If the collection period is inordinately long, it may result in the company having to borrow the short-term assets. In order that the collection period be shortened,

customers should be offered different modalities of discounts and those that delay overdue payments should be pressured to pay. It is, however, important to note that the company should be cautious and selective in its attempts to collect receivables, in order that the customers should not turn to other suppliers, due to excessive "pressure".

Receivables collection can be accelerated implementing a broader range of measures such as: 1) setting stricter credit standards, 2) shortening the credit period, 3) lengthening the discount period, 4) raising the percentage of discount for cash, 5) using factoring, and 6) using forfaiting.

Factoring is a financial instrument by which the factor (the factoring institution) finances the company on the basis of the future, undue receivables, incurred from the sales of goods or services on the home or export markets. Factoring is really useful in the circumstances when the collection cycle is long. The commission for the factoring companies usually ranges from 1% to 4%.

Mian and Smith (1992) and Smith and Schnucker (1994) argue that factors can manage risk in a considerably more efficient manner, i.e., reduce the risk.

Forfaiting actually means buying out others' debts. This activities can be performed by banks, insurance companies, and certain other specialized companies.

Companies can sell their receivables at a discount to specialized institutions engaged in these operations, which is characteristic of the developed market economies.

Forfaiting is rather similar to factoring, the difference being in that receivables are sold abroad instead of at home. The company – exporter of goods sells its receivables abroad to a financial institution engaged in forfeaiting, most often a certain business bank registered for this type of business.

Factoring usually has a broader range in comparison with forfaiting.

4. Other important issues

In order that the modalities of the customers' liability towards the company management on the national level should be explained in a comprehensive way, it is important that the following instruments be explained: 1) compensation, 2) cession, 3) assignment. In addition, it is important to note that there is a possibility that re-

ceivables become obsolete, that they are collected by debt enforcement or a receivables write-off .

The customer liabilities to the company can cease by compensation. *Compensation* is a way to relieve a client from the obligation by claim offsetting between the debtor and the creditor. For this to be obtained, the following conditions are to be met:

1. both receivables are in currency or other exchangeable assets of the same nature and quality;

2. both receivables are mature;

3. a compensation statement or a written submision for compensation is given in;

4. the receivables are mutual;

5. the receivables are compensatory (without any legal restrictions).

If more than two persons participate in the compensation business, we are talking about a multilateral compensation. In many cases, bilateral compensations are replacing the multilateral ones in the conditions of aggravated collection of receivables. Compensation may be voluntary (contractual) and compulsory. Viewed from another aspect, compensations may be financial (mutual claim offsetting) and commodity ones.

In practice, the creditor may be changed as a result of the receivables being assigned by a contract, and this is called *cession*. This is a legal process in which three persons participate, two of which are related to the creditor, and one is on the side of the debtor. These are:

1. cedent, or assigner – the creditor passing his claim to the other person (old creditor);

2. cessionary, or receiver representing the person to whom receivables are transferred (new creditor);

3. cessus – the debtor.

Cession is characteristic in that it is a two-fold legal and economic business, the contract in which three parties participate – the cedent (assigner), on one side, and the receiver (cessionary), by which the cedent passes the receivables due to him from the debtor (cessus) to the cessionary.

One instrument implemented in clearing the creditor position of the person with an obligation of performance towards the debtor (however he does not perform this obligation personally, but through the third party) is called an *assignment* – transfer.

The assignment is a contract by which the assignor authorises the assignee to act on the assignor's behalf for the purpose of performing a certain act to a receiver of transfer – assignator, and simultaneously authorises the assignator to receive this act, on his own behalf and for the benefit of the assignor. The performance as the subject of assignment refers, by a rule, to monetary transactions, however, it may include other exchangeables too. It is important to note that assignment as a form does not mean the fulfillment of an obligation; it is necessary that the fulfillment – for example, payment of a certain amount of money, really takes place.

The Accounting and Audit Act in this country defines that legal persons and entrepreneurs are obliged to co-operate in order to settle certain financial placements, receivables and liabilities at least once a year. Besides, legal persons are obliged to report unreconciled receivables and liabilities in the additional notes to their financial statements. The creditor has to initiate the reconciliation of his receivables with his debtors, whereas the debtor has to check his liability and inform the creditor about it, in a report named *the statement of open accounts*. If the debtor does not accept his liabilities, he has to make a written statement for each individual amount. If the receivables and liabilities cannot be reconciled, the only solution left to the creditor is to sue the debtor to collect his receivables.

Expiry of debts and liabilities is defined by the Obligation law. The general rules that apply to the expiry are the following:

– with the expiry of debts, the right to claim that a certain liability should be met expires itself;

– expiry is the state of affairs when the legally defined period in which the creditor is in a position to demand that the liability be met is over;

– the court cannot rule on expiry if the debtor does not claim it.

In this country, the receivables the legal persons claim form one another under the goods and services transaction contracts expire upon a three year period, as do the remuneration claims [5]. For all the expences under such contracts the expiry period is three years. Expiry period is estimated for each individual delivery of goods or the deed or service performed.

*Enforcement of claim*s is the obligation and compe-tence of the Central bank to draw the assets from any accounts the debtor may dispose of, without his con-sent, and effect the payment upon the execution orders, according to the priority order, and within the same order of priorities, and observing the time of acceptance. The execution orders are issued by the court, tax, customs or other authorities, and the orders themselves may be in the form of securities, bills of exchange or proxies. Enforcement of claims is regulated by a large number of legal acts, the most notable among which are the following: the Law on business compa-nies, the Payment operations act, the Act on execution procedure, the Liquidation law, the Bill of exchange act, the Tax operation and tax administration act and various sublegal deeds – decrees, resolutions, and in-structions from the National Bank governor. Subject to enforcement of claims are two types of debtors: 1) legal persons with their accounts with the banks, and 2) phys-ical persons that perform a certain business and have their accounts with the banks.

Enforcement of debts is performed by drawing the money from all the debtor's accounts, in domestic as well as in foreign currency.

Enforcement of debts is effected in three phases: 1) re-ceipt and filing the decision and order, 2) the verifica-tion of the validity of decisions and orders, and 3) deci-sion entry.

The problems with the solvency of the companies in this country are rather serious, since the accounts of one out three firms are frozen. (It often happens in do-mestic practice that not even blocking of accounts can produce any effects in case of the financial discipline control, since the debtor can easily continue his busi-ness through a related party.) One of the key reasons is the lack of coordination of the inflows from the sales of goods, products, and services with the payment liabili-ties towards the suppliers. In practice, these problems require that multilateral compensations be performed directly or via a mediator – the agencies that are paid an agency remuneration in the form of commission to con-duct the activities related to the abovementioned com-pensations.

Insolvency is especially a problem with small firms and entrepreneurs who do not have an easy access to finan-cial sources; delay in payments for them may mean their going out of business.

Receivables write-off is effected in cases there is a high probability that the firm will not be in a position to col-lect all dues from its debtors under the contracted con-ditions. In such circumstances, it is necessary that the book value of receivables is brought to an estimated ne-

gotiable level, directly or indirectly – applying the "provision for impairment" account. The definition of the "probablity of receivables collection" is the competence of the management of each firm individually.

A direct write-off of receivables should be a solution only in case it is certain and documented that the debts are not negotiable. (Cases such as expiry of debts, compulsory settlement, final court ruling etc. are those possible cases in which a direct write-off of receivables is performed, by entering them into the liability side and deleting the debtor from the business books.

For the tax purposes, and in accordance with the the ruling legislative in the national environment [7], the write-off of individual receivables is allowed in that they are assigned to expenditures. This does not apply to the receivables due from the persons that are also creditors, under the following conditions:

- these receivables were previously included into the debtor's income;

- these receivables are written-off in the tax payer's books as uncollectable;

- the tax payer submits the evidence that he has not succeeded in collecting these receivables under a court decision.

In order to prevent the receivables write-off and consequently reduce the companies' assets in this country (the customer's account actually shows the assets of the seller company that are in the possession of the buyer; see [6], some steps should be taken in advance. Namely, in case of large transactions with new buyers, it is necessary that a sales contract should be concluded with the buyer, that the contract be secured by a bill of exchange, and that the transactions be done through the current (business) account, and supported by the Serbian Business Register Agency decision on company formation, not older than three months.

5.Conclusion

An effective receivables management improves the cash flow and increases the assets available for the company's growth. Receivables collection is the final stage in the sales process, performed after the distribution and delivery.

Real terms of payment are defined by crediting conditions the company offers to the buyers in case of sales. The changes in the length of the credit period affect the company's profitability.

The task of the financial analysis in sales is to focus the sales function as regards the customer segment to which it offers its products or services in the first place. Good customer relations are important, however, trade is important too. Building customers' loyalty requires that the value of the buyer companies be identified.

The reviews on receivables due and uncollected according to age structure help managers estimate the future cash inflows, which is, of course, important for their timing with the cash outflows. Besides, the reviews of customers receivables by currency allow for the managers to identify doubtful customers and their accounts.

It is necessary that the management should bear in mind that the rise in the risk of credit collecting is a threat of non-payment from the part of one buyer or a group of buyers, which will have a negative impact on the stability of the company itself.

Receivables collecting is a crucial phase in the business process, hence its impact upon the company's cash flows and its solvency is of paramount importance. Receivables can be collected in various ways:

- in contract-defined terms upon maturity;

- by defined activities towards collecting, in case the buyer does not meet his liability in due term;

- by bill of exchange the company negotiates with the bank;

- through the court procedure when the company sues the buyer.

In order to accelerate the cash inflow, the companies may sell their receivables to mediators (most often the banks), to raise cash for a new operations cycle. One reason the companies sell their receivables is that these may be the only acceptable source of cash; when the credits on the financial market are expensive, this seems a more adequate solution. In concluding the mediation contracts the banks charge commission in accordance with the percentage of the receivables sold.

Factoring is also an important form of crediting and maintaining the receivables collecting from their debtors – buyers. Factoring is usually good for the seller, since it improves his solvency in that the seller gets cash before the maturity date, and avoids various financial risks that might emerge in time. Forfaiting improves the cash circulation within the company. Assignment is often used in the conditions of general insolvency, i.e., when the company's current account is frozen.

This country should undertake to develop an adequately organized "security" mechanism for receivables collecting in terms of ensuring that financial discipline. For the time being, the financial discipline is a matter of ethics, or a *fair relationship between the buyer and the seller.*

A good decision making as regards the credit policy requires that we know the company's business, the environmental factors, as well as the economic factors that affect the survival of such business and of accounting concepts on which the company's financial statements are based.

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Hybrid Public Private Partnership Models

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In numerous reports, studies and analysis public-private partnerships are considered to be a key tool for the development of infrastructure and consequently the overall national economy. Therefore, this concept is in the focus of professionals' and scholars' attention. The evolution of public-private partnership is not yet final, and the different institutional arrangements develop in both the geographical as well as the aspect of time. This paper presents a basic generic model of the relationship between public and private partners in the implementation of infrastructure projects, as well as the possibility of the development of hybrid models.

1. Introduction

Public-private partnership is a concept that describes the business relations between the public, the private partners and the third parties in creating public, chiefly infrastructure facilities and services. Its modern history dates back to several decades, however, the concept evolves continually, therefore is the focus of attention of both academics and practitioners in this field. The basis for this interest is in the fact that the demand for infrastructure increases significantly worldwide. In the developed countries IT results from the obsolence of the basic infrastructure and hence the need to replace the depreciated property and equipment in the near future, whereas in the developing countries the needs for new infrastructure are still not saturated, the consequence of a poor historical backgrounds.

The infrastructure projects realization using the public-private partnership model is essentially funded on the shortcomings of purely public and purely private scheme of construction, financing and managing infrastructure objects and provision of infrastructure services. For example, Miller [1] claims that neither fully public nor fully private financing, executing ot managing infrastructure projects are sustainable in the long term.

Milosavljević and Benković [2] structured the potential weaknesses of purely public and purely private investments into infrastructure into two broad groups. One group consists of the weaknesses and potential threats conditioned by the role of the state in creating and managing infrastructure projects. These weaknesses refer to numerous inefficiences such as slow and inefficient decision making, inefficient organizational and institutional frame, as well as lack of competition, and hence market efficiency [3].

On the other hand, the imperfections of private initiative in the execution of infrastructure projects is reflected in the potential assymetry in the service provision and hence the need for stricter control by the state agencies. Furthermore, certain authors advocate the approach of total/large-scale privatization as an ultimate approach to public goods supply. Although fully private schemes are still used, at least in theory, Martimoor and Pouyet [4] maintain that a non-conformity in reliance upon privatization is affected by the weaknesses of the public provision of infrastructure goods, rather than by the real adequacy of the private sector. Although the public-private partnership is to some extent similar to privatization, many authors deem that these terms cannot be equalled, such as Minow, for example, tried [5]. In the privatization process, according to Grimsey and Lewis [6], the state loses control over the subject of privatization entirely, whereas in public-private partnership the control and ownership are shared between the public and the private partners on an equal basis.

In accordance with the above mentioned, to overcome the present problems it is important that a formula for an adequate role and relationship between the public and the private agents be found in infrastructure financing, execution and management. Hodge and Greve [7] claim that almost all definitions start from the assumption that the public-private partnership model is good, as it draws on the benefits of both the private and public sectors. Besides, a successful implementation of public-private partnership requires an effective partnership between the public and the private sectors, which, according to HM Treasury [8] means ensuring a sufficient capacity of the public sector to act as an effective client, an adequate capacity of the private sector to meet the consumers' needs, as well as a mutual trust of both parties to build the partnership on a sustainable basis.

A positive attitude towards public-private partnerships stems from the numerous characteristis of the partnership itself. The primary among them is, doubtlessly, a higher value created in comparison with other methods of infrastructure project realization. This testing is much better known as the "value for money test". This actually means that under the same conditions, the private player would provide infrastructure services or build infrastructure facilities at lower costs compared to the public sector in this job. Another elementary feature refers to the potentials of risk transfer, where the control activities related to expenditures, works dynamics, etc. can be transferred to the private partner. This calls for a lot of caution, since risk transfer should follow the principle that the risk should be allocated to the party best suited to manage it.

In order that these multiple interrelated conditions be fulfilled it is necessary that the relations of all the interest and interested parties in the public-private partnership should be founded. The relationship between public institutions and organizations and the project company is especially important and it is the central theme of this work. Our aim in the paper is to explain the public-private partnership concept itself. We will then proceed to define the general system of relations in the generic model. Finally, possible hybrid models will be presented, however the list, due to their continual development, is not final.

2. Concept and essential features of public-private partnership

Numerous varieties of new public-private partnership models have been developed so far in order that the public-private partnership model should be adapted to specific situations and sectors. Thus the synergy created within the partnership can spread to numerous specific niches of infrastructure development.

In the most highly developed countries the public-private partnerships are used to some extent in the realization of infrastructure projects. In the western European countries, Great Britain has a leading position in the private financing initiative realization (the British equivalent for the public and private sector partnership projects), although other countries too experiment with a wide range of public-private partnerships. In the developing countries, according to Akintoye et al. [9] study, there is a high regional concentration of such contracts, primary in Latin America, followed by such contracts in Southeastern Asia. Types of contracts vary greatly and differ from country to country in accordance with the sensibility of national economies.

Regardless of the range, it is difficult to find a unique definition of the partnership between the public and the private sectors. Broad academic definitions describe public-private partnership as a contract by which the private sector builds infrastructure facilities and provides infrastructure services which has traditionally been the role of the state [10]. More specific definitions include essential features and define public-private partnership as partnership between the public and the private sectors which cooperate for the purpose of achieving mutual or compatible goals (such as provision of infrastructure services) together with the risk and liability distribution and allocation to the public and the private sectors [3].

The lack of a uniform definition of international institutions and organizations makes the problem complex, such as is the one between academics and practitioners in the field of project financing. For example, the World Bank has no uniform definition and treats the public-private partnership concept as rather a broad one. They stress the concept of partnership style in the provision of infrastructure services as an antipode to the "arm's length" style which means the action or behaviour of the parties in the job as independent from each other, both financially and otherwise. Liability is understood in a rather broad sense and ranges from individual responsibility for each assigned job segment to shared responsibility for individual job elements, or the entire job. In addition to these elements, risk taking, rewards for the job done and others are defined [11].

On the other hand, according to the European Commission [12], the public-private partnership can be defined as "the contract between two or more parties that agree to cooperate for the purpose of achieving separate or/and compatible goals, with delegation of authority and liability, joint investment into resources, shared debts and risk taking and ideal mutual benefit."

In addition to the Guidelines for successful public partnerships that follow this definition, the European Commission has previously adopted numerous directives related to the field of collaboration of the public and private sectors which are regarded as the so-called classic guidelines (such as: Supplies Directive 93/36/EEC, Services Directive 92/50/EEC, Utilities Directive 93/38/EEC). The final analysis of the public-private partnership sector was issued in 2004, in the Green book on the public-private partnership and local legislature on public contracts and concessions, thereby clearly classifying this type of partnership. Thus the partnerships are classed into the public-private partnerships which are exclusively contractual in type and the institutional public-private partnerships.

The guidelines provided by the European Union are not binding in character. They are based on a dual goal: the public-private partnership should be unified to such an extent that all the member-countries should be in a position to benefit from this model; on the other hand, no economic entity can be privileged in comparison with the others.

In the domestic legislative and economic environment, public-private partnerships are exclusively under the home country jurisdiction, hence the European Union guidelines are not of critical importance yet. In addition to the general legal norms, public-private partnerships are specially linked to the Concession Law, the Law on Public Acquisitions, as well as other legal and sublegal acts of the Republic of Serbia.

Our aim in this paper, however, is not to highlight the legal aspects of public-private partnership. The relations taken into consideration here are not legal and technical categories in the sense of parties in a business arrangement, although they appear to be such. The focus is rather on the research into the business relations in a managerial sense, and formulating a leeway the players in public-private partnership should have.

3. Business relations and contract relationships in public-private partnership

In public-private partnership, contracts are indispensable in regulating the rights and liabilities of all the contracting parties during all the phases of infrastructure projects realization. In accordance with the specific features of each partnership, the contracts themselves are concluded for each public-private partnership project individually.

Contracts in the public-private partnership model serve to specify all the conditions under which the private party undertakes the liability to build, maintain, provide services of stipulated quantity and quality, transfer the infrastructure facilities upon the expiry of the exploitation period and other important elements. Special clauses are introduced to improve the functionality of the public-private partnership project and consequently manage the project in a more adequate manner.

In drafting a contract attention should be paid to the preconditions, the characteristics of the public-private partnership model itself, as well as to the principles according to which the contracts are granted. The preconditions refer to creating an adequate legal and business environment for the development of the public-private partnership project [13]. This, however, does not mean that it is a sufficient condition for the public-private partnership project implementation. The contract itself has to specify the minimum standards in order that the project should be implemented, but also in order that the risk should be adequately allocated among the business partners. Such contract is quite similar to the contracts on public acquisitions, however, it should be noted that here we deal with different contracts, primarily due to their degree of complexity.

The contracts on public acquisitions are based on the selection of the best offer on the basis of the set of a priori defined criteria and most often the search for the best offer is confined to simply collecting offers. The situation t is different with the contracts on the partnership between the public and the private sectors in that the negotiaations should result into the best long-term offer. This means that the private partner must command the required expertise and the real capacity to manage the project effectively. The private partner has to provide a comprehensive estimate of the investment programme which is in most cases carried out in the time span of several years. Then the transfer of liabilities is effected per contract from the public to the private partner, whereby special attention is paid to the risk allocation in accordance with the characteristics of the infrastructure goods itself.

All the project benefits are directly correlated with the the project performances themselves, therebye avoiding the situation in which the private partner should generate any financial or tangible or legal benefits he does not merit. As a secondary effect, the project exploitation period has to be stipulated, namely the moment the infrastructure facility will be transferred to the public sector. At the moment of transfer, the infrastructure facility has to be in the condition specified at the beginning of the contract, which is by no means easy if we know that the exploitation period may sometimes span to even 30 years.

Upon defining the basic business relations, the project company defines other contractual relations with third parties: contractors, suppliers of various raw materials and power resources, infrastructure services or products purchasers, economic entities engaged in infrastructure facilities maintenance, and various sponsors, investors and creditors. The list of interest and interested parties is not exhausted here, however, in a generic sense, these relations can be represented by the model in Figure 1.
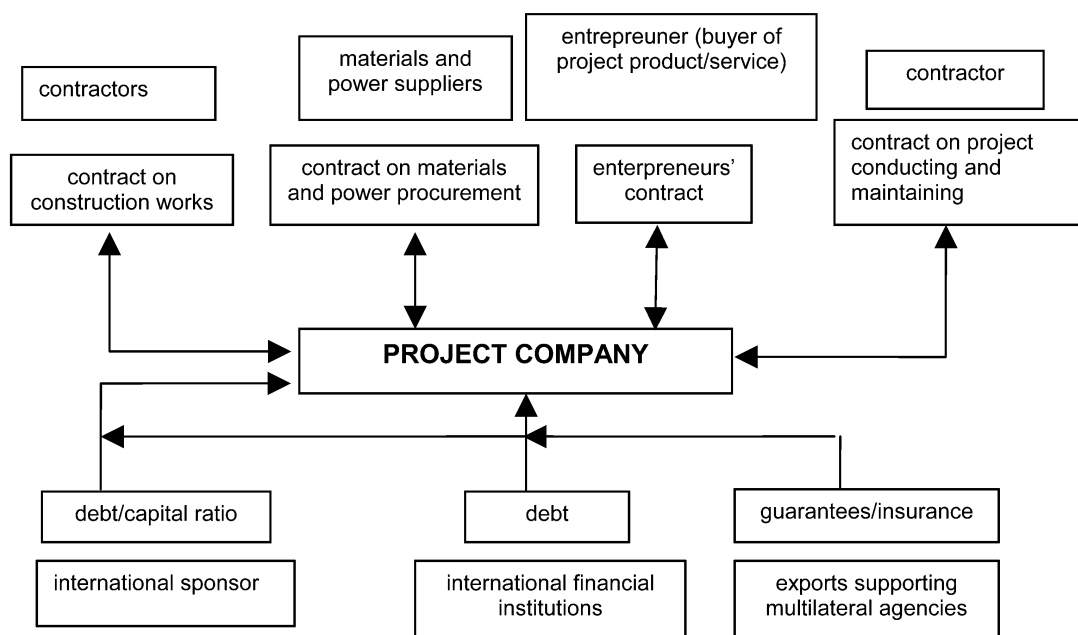
Figure 1. *Generic model of business relations in public-private partnership [14]*

4. Hybrid business relations varieties in public-private partnership

There is no uniform nor universally acceptable decision-making model on which type of public-private partnership model will serve the project best. The abovementioned depends on the features of the project itself, as well as on the perception of the population of the need for partnership. The traditional public-private partnership models are sometimes characterised by rigid assumptions, postponement in negotiations and consequentially increased costs due to the impacts of numerous environmental factors. Any delay in negotiations, the cost progression and the rigidity of the conditions in standardized public-private partnership contracts result into a suboptimal resource allocation.

The hybrid public-private partnership models are developed for the purpose of using numerous opportunities and strengths, as well as overcoming various threats and weaknesses the public-private partnership may be faced with. These models are applicable in specific situations and sectors where a higher quality of product can be achieved.

Specific situational or sector characteristics are the result of risk and uncertainty. They in turn may result from defects (flows in the infrastructure projects execution that could not be predicted in the initial phases), policy changes (adopting changes in required services), demand risk (the result of, e.g., introducing a customers choice), changes in demand for public goods, as well as from rapid changes in technologies.

The models capable of improving the flexibility and shortening the contractual period have the capacity to increase the probability of achieving the goals of the public sector policy in infrastructure development, for the projects that are highly exposed to the above mentioned risks and uncertainties [15].

Hybrid models differ by the level of complexity of the very relations between the public and the private partners. The most complex forms are incorporations and joint ventures. Incorporation means that not all but only certain project operations are transferred to the private partner. Most frequently mentioned elements here are project design, development and financing. This collaboration may be extended to other business operations throughout the project life cycle. Joint venture is a contract binding the public and the private sectors to join their assets, finance and expertise, under shared management, to carry out a programme or a project, sharing both profits and risks. In this type of partnership the private partner retains control. According to Merna and Njiru [16], such a type of projects requires the so-called "value for money" test and has to meet the following criteria: (a) the private partner is selected through competitive bidding, (b) the control over joint investment is the liability of the private agent, (c) state contributions and constraints in the project are clearly defined, and (d) there is a clear agreement on the allocation of risks and the distribution of rewards.

When many projects that are smaller in scope are integrated and entrusted to one partner so that the costs be reduced and the time of the project realization be short-

ened, we talk of integrating or consolidating smaller jobs. Basically, this helps achieve the synergy in the realization of infrastructure projects. Incorporation includes the entrusting of the functions of design, construction, financing, realization and maintenance of facilities to the private partner, most frequently via forming a SPV or a virtual corporation created for a specific project [17]. With such a model of infrastructure building, the public sector retains its minimalistic requirements: it only needs to form a consortium out of the private sector that will be in charge of the design of qualitative infrastructure attributes, construction of these facilities and, finally, of managing them in the best possible manner [4]. The aim of incorporation is to avoid the rivalries and acrymony that sometimes characterise the conventional models of project realization and allow for all the parties to cooperate and collaborate for the good of the project. According to the Deloitte study [15], this model is especially applicable in the defence sector, where projects are large and inseparable from one another and where well defined outputs are often not allowed to be publicised. There are some restraints, though. For example, Iimi [18] states that in case of water supply it is not profitable to create competition for the annual deliveries of less than 400 million m^3.

Public-private partnership can be achieved via the integrator function. The competent public entity appoints the partner from the private sector, the integrator, to manage the project throughout its life cycle. The integrator has a role of a mediator since it regulates the necessary functions and is paid a defined commission for the job. In case of possible delays in constructions, of excessive costs, poor quality, etc., the state does not sanction the contractors, but the integrator. The integrator is most often not allowed to perform certain business operations in the infrastructure project execution directly, in order to prevent a possible conflict of interests, or is allowed to participate only in the initial phases (e.g., construction works); later the integrator is assigned a new mediation role.

The market forces are believed to give value for money through competitive biddings for a concession contract or a contract on public procurements. This is for the reason that bidders are ready to accept the competitive tension and deliver the infrastructure facility or service in a more economical manner than in case there is no competition whatsoever [7]. Competitive partnership can be implemented when the specific nature of the project allows for the ex ante allocation of resources. In such a case the competent regulatory agency may select a number of private partners to compete for new resources. The partner for any subsequent project segment will si-

multaneously be selected, in that the contract will be signed with the party that performed the previous tasks in the best manner. On the other hand, incremental partnership means that certain project business elements can be cancelled or completely stopped if they are estimated as non-productive. The public sector may issue the permits for the project to be continued incrementally and retain the right to form partnerships with other entities if the previously selected alternative proves inadequate. Thus the public partner takes less risk, as it ensures a continual adjustment and the so-called "all-inclusive" liability is eliminated.

Figure 2 presents the prospects of the hybrid public-private partnership models development. It is important to note that they are mutually exclusive, however, in certain specific circumstances, they may be complementary. Then they can be used simultaneously to improve the efficiency and effectiveness of contracting.
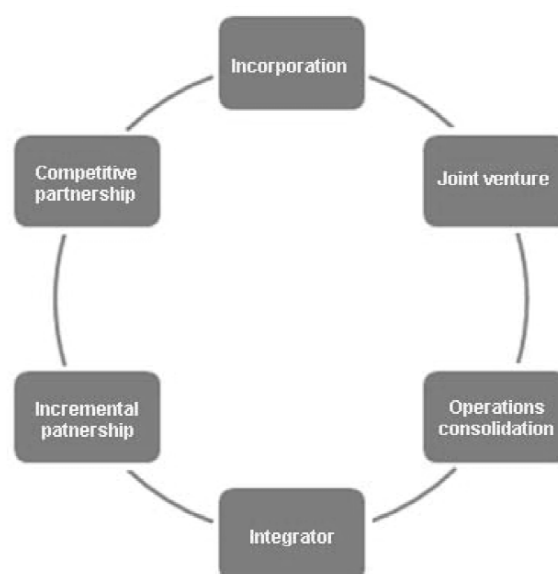
Figure 2. *Hybrid public-private partnership models*

The hybridization options listed in the above-presented model do not close the list. The risks and uncertainties that profile the infrastructure development are numerous. Each infrastructure facility and service is characterised by a new set of risks, therefore, the more detailed the list, the larger number of hybrid models will emerge.

5. Conclusive discussions

The development of infrastructure is one of the key activities of any national economy. The traditional approaches to financing based on direct project financing become inadequate; hence it is necessary that in the provision of infrastructure services a model of public-private partnership be implemented.

The forms of public-private partnership arrangements are numerous. A potentially useful concept of infrastructure development, public-private partnership can be adjusted to individual needs and characteristics of every single project and/or project partner. Here, it is important to note that the basic principles, approaches and techniques implemented in public-private partnership may be enriched by the introduction of specific clauses in contracts. Thus a basic model can take in new contents to grow into an entirely new hybrid public-private partnership model.

The extent to which the concept itself of public-private partnership should be moderated depends on the set of specific circumstances in which a given infrastructure project is executed. It is important to note that the situational approach is the only valid approach in the selection of an adequate public-private partnership model. The situational approach means a selection of an optimal solution on an *ad hoc* basis.

The key criteria characterising the moderation of the concept are numerous. It is especially important to note that a long-term cooperation, a real risk allocation and the liability transfer for certain operations segments should result into a higher quality of infrastructure facilities construction and infrastructure services provision, to the benefit of all the participants.

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Modeling the Fraud-like Investment Founds by Petri Nets

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In this paper we model the fraud-like investment founds using place-transition Petri nets. We will also classify the business using regression line in order to find the possible fraud-like investment founds. In these regression lines we compute analytical the mark of a place in function of some other elements of the Petri net, and next we express this value in function of the same elements using regression. From the identity of the coefficients we find a ratio between two weights of arcs. We make also a $C++$ program where the marks and transitions are implemented as classes for Petri nets, and, using the heritage mechanism we extend the Petri net to Petri net with priorities.

1. Introduction

Definition 1 ([6]). *It is called Petri net the triplet* $N = (S, T, F)$, *where:*
1) S *and* T *are disjoint sets.*
$F \subset S \times T \cup T \times S$ *is a binary relation.*

Definition 2 ([6]). *Let* $N = (S, T, F)$ *be a Petri net.*
1) N *is nonempty if* $S \cup T \neq \Phi$.
2) N *is finite if is finite* $X = S \cup T$.
3) is pure if for any $x \in X = S \cup T$ *we have* $, \quad {}^\cdot x \cap x^\cdot = \Phi$
where ${}^\cdot x = \{y \in X | (y,x) \in F\}$ *and* $x^\cdot = \{y \in X | (x,y) \in F\}$.
4) is simple if for any $x, y \in X$ *such that* ${}^\cdot x = {}^\cdot y$ *and* ${}^\cdot x = {}^\cdot y$
  we have $x = y$.
The element $x \in X$ *is isolated if* ${}^\bullet x \cup x^\bullet = \Phi$.

Definition 3 ([6]). *It is called place-transition Petri net the quintuple* (S,T,F,K,W), *where:*
1) (S,T,F) *is a Petri net.*
2) $K : S \to N^* \cup \{\infty\}$ *is the capacity function of the Petri net.*
3) $W : F \to N^*$ *is the weight function of the Petri net.*
In this case S *is called the places set, and* T *is called the transitions set.*
If the functions K and W *are constant* 1, S *is the conditions set,* T *is the events set, and the obtained Petri net is a condition-event Petri net.*

Let $\Sigma = (S, T, F, K, W)$ a place-transition Petri net and $t \in T$ one of its transitions. We denote by t^-, t^+, and Δt the functions $t^-, t^+ : F \to N^*$ and $\Delta t : F \to Z^*$ such that $t^-(s) = W(s,t), t^+(s) = W(t,s)$ and $\Delta t = t^+(s) - t^-(s)$.

Definition 4 ([6]). *Let* $\Sigma = (S, T, F, K, W)$ *be a place-transition Petri net. It is called mark of the net a function* $M : S \to N^*$ *such that for any* $s \in S$ *we have* $M(s) \le K(s)$.

Graphically the places of a place-transition Petri net are represented by circles, the transitions by rectangles and the arcs (the elements of) by oriented lines. The capacities different of are written between parentheses after the places labels, and the weights different of ∞ are written on the corresponding lines. The marks are represented by points in the places where they are positive. If a mark is large we represent only a point and its value.

Definition 5 ([6]). *Let* (S,T,F,K,W) *be a place-transition Petri net.*
1) A transition $t \in T$ is enabled to fire at the mark M (or it has concession at the mark M) if for any $s \in {}^\bullet t$ we have $M(s) \ge W(s, t)$ (the resources of the precedents are large enough), and for any $s \in {}^\bullet t$ we have $M(s) + W(t, s) \le K(s)$ (if we add the resources produced by t to its successors we do not exceed the capacity).
2) The mark M' is produced by firing of the transition t at the mark M if for any $s \in {}^\bullet t$ we have $M'(s) = M(s) - W(s, t)$ and for any $s \in {}^\bullet t$ we have $M'(s) = M(s) + W(t, s)$, and for the other $s \in S$ we have $M'(s) = M(s)$.

The first part of the above definition is the enabling rule and the second part is the firing rule. We denote by $M[t\rangle_\Sigma$ the fact that the transition t is enabled to fire at the mark M and by $M[t\rangle_\Sigma M'$ he fact that the mark M' is produced by firing of the transition t at the mark M. We denote also by $T(\Sigma, M) = \{t \in T | M[t\rangle_\Sigma\}$. If there is no confusion about the Petri net Σ can be omitted.

Definition 6([6]). *Let* Σ *be a place-transition Petri net and* M *a mark of it.*
1) $w \in T^*$ is a sequence of transitions from M if there exist the marks $M_0 = M, M_1, ..., M_n$ such that

$w = t_0 t_1 ... t_{n-1}$ and $M_i \left[t_i \right\rangle_\Sigma M_{i+1}$. We denote this by $M \left[w \right\rangle_\Sigma$

2) The mark M' is accessible from M if there exists a sequence of transitions w as above such that $M' = M_n$. We denote this by $M \left[w \right\rangle_\Sigma M'$.

In the above definition we accept also the empty sequence λ: we have $M \left[\lambda \right\rangle_\Sigma$ and $M \left[\lambda \right\rangle_\Sigma M$.

Definition 7([6]). *It is called marked place-transition Petri net or place-transition Petri system the pair* $\gamma = \left(\Sigma, M_0 \right)$ *where Σ is a place-transition Petri net and M_0 an initial mark of Σ.*

Definition 8([6]). *A marked place-transition Petri net is without contact if* $\left(\forall M \in \left[M_0 \right] \right) \left(\forall t \in T \right) \left(\forall s \in S \right) \left(M(s) \geq W(s,t) \Rightarrow M(s) + W(t,s) \leq K(s) \right)$.

Therefore if a transition is not enabled to fire at a given mark this happens only because of the lack of resources, not because of overtake a capacity.

If the transitions are produced sequentially we have a sequential evolution of the place-transition Petri net. If some transitions are produced in the same time we have a parallel evolution of the net.

Definition 9([6]). *Let Σ be a place-transition Petri net without contact, M a mark of it and $A \subseteq T$.*
1) A is a set of transitions parallel enabled to fire at the mark M (in Σ) if $\sum_{t \in A} t^- \leq M$.
2) The mark M' is produced by parallel firing of the set of transitions A at the mark M (in Σ) if $M' = M + \sum_{t \in A} \Delta t$.

Remark 1. The above definition is given only for Petri nets without contact, but this definition can be extended by the condition $M + \sum_{t \in A} t^+ \leq K$ (condition to not overtake the capacities).

Definition 10([6]). *Let $\Sigma = \left(S, T, F, K, W \right)$ a place-transition Petri net with $S = \{ s_1, ..., s_m \}$ and. $T = \{ t_1, ..., t_n \}$ The incidence matrix of Σ is the* $m \times n$ *matrix I_Σ such that $I_\Sigma(i, j) = \Delta t_j(s_i)$ for any $i = \overline{1,m}$ and $j = \overline{1,n}$.*

Theorem 1([6]). *Let Σ be a place-transition Petri net and two marks of it, M_1 and M_2 represented as* m – *vectors. The mark M_2 is accessible from M_1 if and only if there exists a* n – *vector f such that $M_2 = M_1 + I_\Sigma \cdot f$.*

From the proof of the above theorem we know (see [6]) that f_i is the number of appearances of t_i in w such that $M_1 \left[w \right\rangle_\Sigma M_2$.

Definition 11([6]). *Let $\Sigma = \left(S, T, F, K, W \right)$ be a place-transition Petri net with the incidence matrix I_Σ.*
1) *The vector with integer components J is an S – invariant if $J^T \cdot I_\Sigma = 0$.*
2) *The support of the S – invariant J is the set $P_J = \{ s_i \in S \mid J_i \neq 0 \}$.*
3) *The S – invariant J is nonnegative if $J \geq 0$.*
4) *The S – invariant $J > 0$ is minimal if there exists not an S – invariant J' such that $0 < J' < J$.*
5) *The place-transition Petri net generated by the S – invariant J is the Petri net $\Sigma' = \left(S', T', F', K', W' \right)$ where*
   a) $S' = P_J$.
   b) $T' = {}^\bullet S' \cup S'^\bullet$.
   c) $F' = F \cap \left(\left(S' \times T' \right) \cup \left(T' \times S' \right) \right)$.
   d) $K' = K \big|_{S'}$.
   e) $W' = W \big|_{F'}$.

From the existence of positive S – invariants we can conclude that we can give weights to the places by a vector g such that for any marks *M* and *M'* accessible from *M* we have $g^T \cdot M = g^T \cdot M'$ (see [6]). Therefore for any initial mark M_0 (which represents the initial resources of the modeled system) the weighted resources of the part of the system represented by P_j remains constant. If the invariant is minimal then the weights are minimal for the involved places.

The set of S – invariants is a $\mathbb{Z}$ – module i.e. it has the properties of a vector space, but instead of a field we have only a ring, namely $\mathbb{Z}$.

D efinition 12([6]). *Let $\Sigma = \left(S, T, F, K, W \right)$ be a place-transition Petri net with the incidence matrix I_Σ.*
1) *The vector with n integer components J is a* T – *invariant if $I_\Sigma \cdot J = 0$.*
2) *The support of the* T – *invariant J is the set $P_J = \{ t_i \in T \mid J_i \neq 0 \}$.*
3) *The* T – *invariant J is nonnegative if $J \geq 0$.*
4) *The* T – *invariant $J > 0$ is minimal if there exists no* T – *invariant J' such that $0 < J' < J$.*
5) *The place-transition Petri net generated by the* T – *invariant J is the Petri net $\Sigma' = \left(S', T', F', K', W' \right)$ where*
   a) $T' = P_J$.
   b) $S' = {}^\bullet T' \cup T'^\bullet$.
   c) $F' = F \cap \left(\left(S' \times T' \right) \cup \left(T' \times S' \right) \right)$.
   d) $K' = K \big|_{S'}$.
   e) $W' = W \big|_{F'}$.

Suppose there exists a positive T – invariant *J* and for a given mark *M* there exists a sequence of transitions from *M* that contains the transitions of P_J with the corresponding multiplicities of *J*, and only these transi-

tions. In this case the mark M can be reproduced after a finite number of transitions (we apply theorem 1). The minimality of a T – invariant means that the mark is reproduced after a minimum number of appearances of the involved transitions. If there exists no sequence of transitions from M as above for a minimal

T – invariant M can not be reproduced after a finite number of transitions.

The set of T – invariants is also a $\mathbb{Z}$ – module.

Example 1([6]). *Consider the following producer-consumer model*:
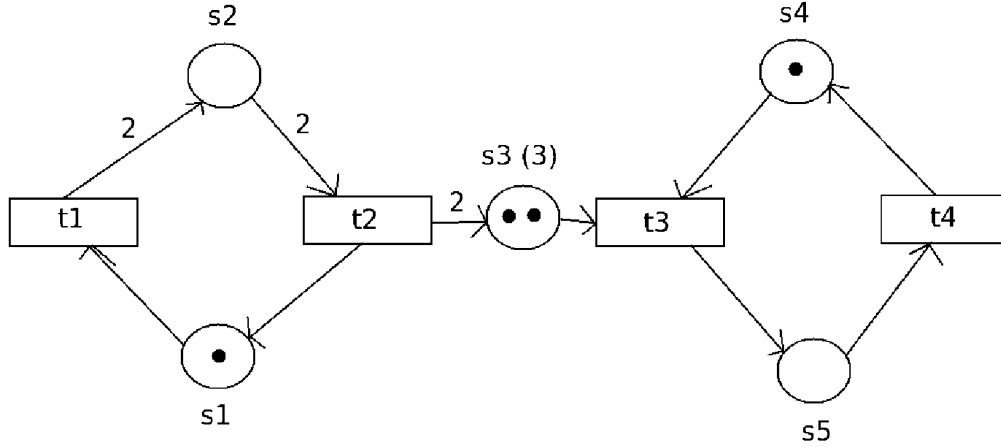
Picture 1: *Petri net for a producer-consumer model*

In the above Petri net the interpretation of the elements is as follows.
- s_1 *is a signal that the producer is ready to produce.*
- s_2 *is a signal that the producer is ready to send the products.*
- s_3 *is a buffer (capacity is).*
- s_4 *is a signal that the consumer is ready to receive the products.*
- s_5 *is a signal that the consumer is ready to consume.*
- t_1 *is the production activity.*
- t_2 *is the sending to buffer activity.*
- t_3 *is the receiving from buffer activity.*
- t_4 *is the consumption activity.*

The transitions t_1 and t_3 are parallel enabled to fire at the initial mark $M_0 = (1,0,2,1,0)^T$. We notice that after the fire of t_1 t_2 is enabled to fire only after we reduce the mark of s_3 (the buffer) by firing t_3 (receiving from buffer). Therefore the producer can not produce as many items he wants while the consumer does not empty the buffer by consumption. After firing t_3 this transition is no more enabled to fire: it must be fired first t_4: effective consumption.

The incidence matrix is $I_\Sigma = \begin{pmatrix} -1 & 1 & 0 & 0 \\ 2 & -2 & 0 & 0 \\ 0 & 0 & -1 & 1 \\ 0 & 0 & 1 & -1 \end{pmatrix}$.

The S – invariants are $J = (2 \cdot x_2, x_2, 0, x_4, x_4)^T$ *with the minimal S – invariants* $(2,1,0,0,0)^T$ *and.* $(0,0,0,1,1)^T$ *We notice that we can take ,* $g = (2,1,0,1,1)^T$

which can be considered as an equilibrium between offer and demand.

The T – invariants are $J = (x_1, x_1, x_1, x_1)^T$ *with the minimal T – invariant* $(1,1,2,2)^T$ *. Therefore if we fire two times the sequence t_3 , t_4 we empty the buffer, and after we fire t_1 and t_2 we reproduce the initial mark.*

We present now some extensions of the Petri nets.

Definition 13([6]). *A Petri net with priorities is a couple* $\gamma = (\Sigma, \rho)$ *where Σ is a Petri net and ρ is a partial order relation on the transitions set T. The signification of the order relation ρ is that if $t_1 \rho t_2$ the transition t_2 has higher priority in firing than t_1.*

A transition t is p – enabled to fire at the mark M (in $\bot$) if $M[t\rangle_\Sigma$ and for any t' such that $M[t'\rangle_\Sigma$ we have not $t\rho t'$. We denote this by $M[t\rangle_{\gamma,p}$.

A mark M' is p – produced by firing of the transition t at the mark M if $M[t\rangle_{\gamma,p}$ and $M[t\rangle_\Sigma M'$. We denote this by $M[t\rangle_{\gamma,p} M'$.

Definition 14([6]). *A Petri net controlled by queues is a couple $\gamma = (\Sigma, Q)$ where Σ is a Petri net and Q is the set of queues with transitions that appear only once in the queue.*

Let $\gamma = (\Sigma, Q)$ a Petri net controlled by queues, M a mark of Σ and $q \in Q$ a queue with above properties.

The transition t *is* Q *– enabled to fire at* (M, q), *and we denote it by* $M[t\rangle_{\Sigma, Q}$, *if* $M[t\rangle_\Sigma$ *and* t *is the first transition enabled to fire in* q.

If M' *is a mark of* Σ *and* $q' \in Q$ *is a queue with above properties we say that* (M', q') *is* Q *– produced by firing of the transition* t *at* (M, q), *and we denote it by* $(M, q)[t\rangle_{\Sigma, Q_i}(M', q')$, *if* $(M, q)[t\rangle_{\Sigma, Q_i}(M', q')$, $M[t\rangle_\Sigma M'$ *and* q' *is obtained from* q *as follows:*

(a) *We remove* t *from* q

(b) *We add to the end of* q *all the transitions enabled to fire at the mark* M' *that are not already in the queue (in an arbitrary order)*

(c) *With the transitions from the obtained queue by* (a) *and* (b) *that are not enabled to fire at the mark* M' *we do the following step depending on* $i = \overline{1,3}$:

(c1) *remain in the queue until a possible removing (when it becomes possible at the step* (a)*)*

(c2) *they are removed from the queue*

(c3) *they are removed from the queue from the beginning to the first transition enabled to fire at the mark* M'.

Definition 15([6]). *Let* Σ *be a Petri net,* M *a mark of it and* $A \subseteq T$. *is a maximal set of transitions parallel enabled to fire at* M *(in* Σ) *if it is a set of transitions parallel enabled to fire at* M *and for any* $t \in T - A$ *the set* $A \cup \{t\}$ *has no more this property.*

Definition 16([6]). *Let* Σ *be a Petri net,* M *a mark of it,* $A \subseteq T$ *and* $t \in T$.

1) t *is max-enabled to fire at* (M, A) *in* Σ, *and we denote it by* $(M, A)[t\rangle_{\Sigma, \max}$, *if:*

a) $M[t\rangle_\Sigma$.

b) $t \in A$.

2) (M', B) *is max-produced by firing of the transition* t *at* (M, A) *in* Σ, *and we denote it by* $(M, A)[t\rangle_{\Sigma, \max}$ (M', A), *if:*

a) $(M, A)[t\rangle_{\Sigma, \max}$.

b) $M[t\rangle_\Sigma M'$.

c) $B = \begin{cases} A - \{t\} \text{ if } A - \{t\} \neq \Phi \\ C \text{ if } A - \{t\} = \Phi \end{cases}$,

where is any arbitrary set of transitions parallel enabled to fire at M'.

Definition 17([6]). *A nondeterministic finite automaton is a quintuple* $A = (Q, \text{Inp}, \text{Out}, \delta, q_0)$, *where,* Q *Inp and Out are nonempty finite sets representing the set of the states, the set of the entries and respectively the set of exits,* $\delta: Q \times \text{Inp} \to P(\text{Out} \times Q)$ *is the transition function and* $q_0 \in Q$ *is the initial state.*

Definition 18([6]). *A Petri net controlled by finite automata, shortened APTN, is a couple* $\gamma = (\Sigma, A)$ *where* Σ *is a place-transition Petri net and* $A = (Q, \text{Inp}, \text{Out}, \delta, q_0)$ *is a nondeterministic finite automaton such that:*

1) $\text{Inp} = P(T)$, $\text{Out} = T$;

2) *For any* $q \in Q$ *and* $U \in P(T) - \{\Phi\}$ *we have* $\delta(q, U) \neq \Phi$ *(unlocking by A);*

3) *For any* $q \in Q$, $U \in P(T) - \{\Phi\}$ *and* $(t, q') \in \delta(q, U)$ *we have* $t \in U$ *(consistency in decision).*

Definition 19([6]). *Let* $\gamma = (\Sigma, A)$ *be an,* APTN *a state of A,* M *a mark and* t *a transition of* Σ.

1) t *is a – enabled to fire at* (M, q) *(in* γ), *and we denote this by* $(M, q)[t\rangle_{\gamma, a}$, *if there exist a state* q' *of A such that* $(t, q') \in \delta(q, T(M))$.

2) (M', q') *is a – produced by firing of the transition* t *at* (M, q) *(in* γ), *and we denote this by* $(M, q)[t\rangle_{\gamma, a}(M', q')$, *if* $(t, q') \in \delta(q, T(M))$ *and* $M' = M + \Delta t$.

2. The model

Consider the following place-transition Petri net system:
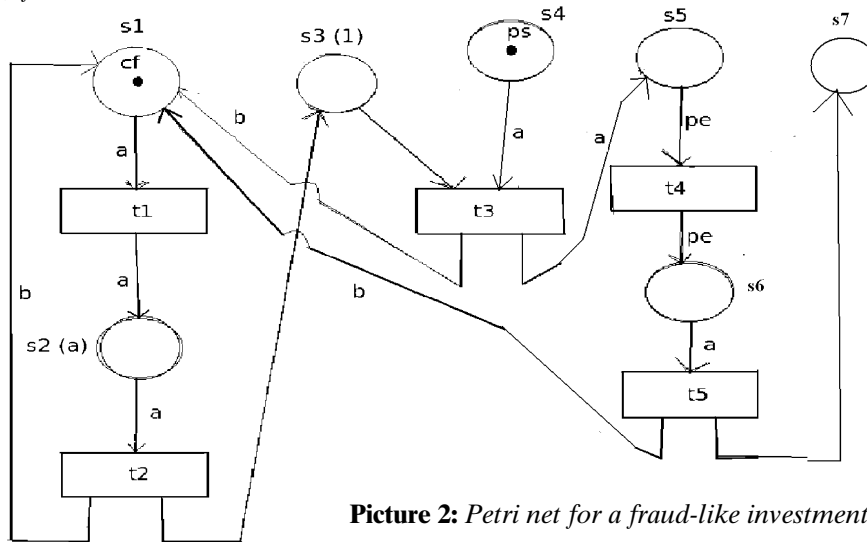
Picture 2: *Petri net for a fraud-like investment found*

In the above Petri net the interpretation of the elements is as follows.

- s_1 is the fictive capital.
- s_2 is the sum that will be invested in a fictive investment (capacity is a).
- s_3 is a signal to possible investors (capacity is 1).
- s_4 is the expected benefit for the organizer.
- s_5 is the first deposit of the organizer (the place where the money from investors are deposited).
- s_6 is the place from where the organizer simulates that the game is not over.
- t_7 is the final account of the organizer.
- t_1 is the extracting operation from the fictive capital.
- t_2 is the fictive investment.
- t_3 is the effective investment.
- t_4 is the copying of the final benefit.
- t_5 is the collapse of the found.

Remark 2. In the above model we have b > a (in fact b >> a), a | pe and $pe \le ps < pe + a \cdot ps$ is the target benefit of the organizer, pe is the real benefit of the organizer, a is the average rate of subscripted money from population and $\frac{b}{a} - 1$ is the false benefit rate of the game.

We can add to the above Petri net the places s_8 and s_9, and the transitions t_6 and t_7 analogous to the places s_6 and s_7, and the transitions t_4 and t_5: the sequence s_7, t_6, s_8, t_7, s_9 is identical to the sequence s_5, t_4, s_6, t_5, s_7. Analogously we can add to the Petri net any number of such sequences containing two places and two transitions.

The above place-transition Petri net is nonempty, finite, pure and simple, and it has no isolated elements. The initial mark is

$$M_0 = (cf, 0, 0, ps, 0, 0, 0)^T. \tag{1}$$

The incidence matrix is

$$I_\Sigma = \begin{pmatrix} -a & b & b & 0 & b \\ a & -a & 0 & 0 & 0 \\ 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & -a & 0 & 0 \\ 0 & 0 & a & -pe & 0 \\ 0 & 0 & 0 & pe & -a \\ 0 & 0 & 0 & 0 & a \end{pmatrix}. \tag{2}$$

The S – invariants obtained by solving the linear system $I_\Sigma^T \cdot J = 0$ (the transposed relation from definition 11) are of the form

$$J = \left(J_1, J_1, (a-b)J_1, \left(2\frac{b}{a}-1\right)J_1 + J_5, J_5, J_5, J_5\right)^T. \tag{3}$$

We notice that the S – invariant J is nonnegative only if $J_1 = 0$, obtaining in this case the minimal S – invariant $J = (0, 0, 0, 1, 1, 1, 1)^T$. An interesting thing is that the Petri net generated by this minimal S – invariant is the chain of places and transitions $s_4 \rightarrow t_3 \rightarrow s_5 \rightarrow t_4 \rightarrow s_6 \rightarrow t_5 \rightarrow s_7$: the investment found consists by tacking money from the investors (place s_4) and deposit to the place s_5, and then moving to the place s_6 and finally to the place s_7.

The only T – invariant is with all the components equal to 0 ($P_J = \Phi$ for any T – invariant J). This means that no mark (including the initial one) can be reproduced after a finite number of steps.

Firstly the only transition enabled to fire is t_1 and it produces the mark $M_1 = (cf - a, a, 0, ps, 0, 0, 0)^T$. Next the only transition enabled to fire is t_2 and it produces the mark $M_2 = (cf - a + b0, 1, ps, 0, 0, 0)^T$. Now there exist two enabled to fire transitions which are also parallel enabled to fire: t_1 and t_3. Even the Petri net evolution is sequential using first the transition t_1 or the transition t_3, even it is parallel the final mark is $M_3 = (cf - 2 \cdot a + b, a, 0, ps - a, a, 0, 0)^T$. This above sequence ($t_2$ and next the subsequence t_1 and t_3) is applied until we obtain the mark $M_4 = \left(cf - pe - a + 2 \cdot \frac{b}{a} \cdot pe, a, 0, ps - pe, pe, 0, 0\right)^T$. In this moment there are two transitions parallel enabled to fire: t_2 and t_4. If we do not apply at the final step t_1 the obtained mark is $M_5 = \left(cf - pe + 2 \cdot \frac{b}{a} \cdot pe, 0, 0, ps - pe, pe, 0, 0\right)^T$, and t_2 is replace by t_1 between the above parallel enabled to fire transitions. The parallelism holds on until we apply the transition t_2 and next the transition t_1, or we apply the transition t_4 and we repeat the transition t_5 until the mark of s_6 is 0. When we apply t_2 the transition t_3 is not enabled to fire because we have $ps - pe < a$. After we apply t_1 the only transition enabled to fire remains t_4 or t_5 (if t_4 was applied). Next we apply t_5 until the mark of s_6 is 0. If the mark of s_6 is 0 the only transition enabled to fire is t_2, and next t_1. In all the above cases we obtain the final mark $M_6 = \left(cf - 2 \cdot a + b + \frac{3 \cdot b - a}{a} \cdot pe, a, 1, ps - pe, 0, 0, pe\right)$ and none of the above transitions is now enabled to fire: the game failed.

Because at any time all the enabled to fire transitions are parallel enabled to fire we can consider the model of Petri net under maximum strategy: when the mark is the initial one $A = \{t_1\}$. For this reason we can consider also the model of Petri net controlled by finite automata: we take

$$Q = \{q_0, q_1\}, \tag{4}$$

$$\delta(q_0, U) = \{(t, q_0) \mid t \in U\} \text{ if } t_4, t_5 \notin U , \tag{5}$$

$$\delta(q_0, U) = \left\{ (t, q_1) \mid t \in U \right\} \, if \, t_4 \in U \, or \, t_5 \in U, \, and \quad (5')$$

$$\delta(q_1, U) = \left\{ (t, q_1) \mid t \in U \right\}. \quad (5'')$$

Of course, we can consider above $Q = \{q_0\}$ and the corresponding δ, but we have used two states for the automaton to point out the stages of the investment found: the collection of money from the investors (transitions t_1, t_2 and t_3) and the simulation of the continuity of the found (transitions t_4 and t_5).

The above marks M_4 and M_6 are obtained by solving the equations

$$M_4 - M_0 = (cf' - cf, a, 0, ps - pe, pe, 0, 0)^T = I_\Sigma \cdot f' \, and \quad (6)$$

$$M_6 - M_0 = (cf'' - cf, a, 1, ps - pe, 0, 0, pe)^T = I_\Sigma \cdot f'' \quad (6')$$

with the variables cf', f'_1, f'_2, f'_3, f'_4 and , respectively cf'', f''_1, f''_2, f''_3, f''_4 and f''_5.

If we denote the final mark of s_1 by Y and the total invested sum by X we obtain

$$Y = c + \left(3 \cdot \frac{b}{a} - 1 \right) \cdot X, \quad (7)$$

where $c = cf - 2 \cdot a + b$ and if we add elements as in remark 2 the coefficient 3 of $\frac{b}{a}$ in (7) increases by 1 for each set of two places and two transitions.

If we classify investment founds using the regression line 7 (see [4]) the fraud-like ones will be classify in classes with large coefficients of the explanatory variable . For only one class these points can be also outliers.

3. Applications

We define in the C++ header "petri.h" two classes: "tranz" and "marc". Class "tranz" has the transitions as objects, and the integer properties "nrloc" (number of places of the Petri net), "indice" (the index of the transition), "pred" (the integer vector of weights from its precedents) and "succ" (the integer vector of weights to its successors). The methods are the constructor of the class and "citire". In the constructor all the weights are initialized with , and "citire" is a void method with two integer arguments (the number of places and the index of the transition) that reads the real weights.

Class "marc" has the marks as objects and the integers properties "nrloc" (the same as for "tranz"), "nrtrp" (number of transitions enabled to fire), "val" (the integer vector representing the current mark of the Petri net), "cap" (the integer vector representing the capaci-

ties of the nodes) and "ltrp" (the integer vector representing the list of transitions enabled to fire). The methods are analogous to class "tranz": in constructor the capacities are initialized with -1 (with the signification of infinite capacity) and the marks with 0. The method "init", having an integer argument (the number of places) is analogous to the method "citire" of class "tranz": we use it to read the capacities and the initial mark. This is the reason that we have called it "init" instead of "citire".

We have defined also two operators with an argument transition and returning the pointer *this. First is the operator "*=" which tests if the transition is enabled to fire at the current mark and, if it is, it increase "nrtrp" by , adds the transition index to "ltrp" and writes that the transition is enabled to fire on screen. The second operator is "+=", it has the argument a transition enabled to fire, replaces the current mark with the produced mark and it writes on the screen the new mark.

Because in the main program we apply the operator "*=" using the transition index from 1 to the number of transitions and then it is fired the transition with the minimum index the Petri net of our model is in fact a Petri net with priorities: the order relation ρ is a total relation decreasing on the transition index. This order relation is not essential because whenever there exist two transitions enabled to fire the final mark does not depend on the order of these transitions. We can extend using this relation the Petri net with priorities by transitions and arcs from s_1, s_2 and s_3 to empty these places. Of course, these transitions have lower priorities then the transitions from t_1 to t_5 and their priorities decrease from the transition of s_1 to the transition of s_3. Because the locations s_2 and s_3 have the marks and respectively 1 we can consider only one transition to empty them with the weights equal to the marks. Tacking into account the final mark of s_1 we can consider two transitions: first with the weight of the arc $cf - 2 \cdot a + b$ and second one with the weight of the arc $3 \cdot b - a$ (we take into account that a | pe).

To define a Petri net with priorities we do not need to consider the above total relation: it is enough to consider only a partial order relation between the transitions that can be parallel enabled to fire at a given moment. Therefore the partial relation is such that t_1 has higher priority than t_3 and t_4, and t_2 has higher priority than t_4. In our C++ program we define the class "priortranz" that is derived from "tranz" and it has in addition the properties "nrsucc", the integer number of the transitions with higher priority and "lsucc" the list of these transitions. We define also the class derived from

"marc", namely "priormarc" using the same heritage mechanism. The constructor of "priortranz" call first the parent constructor, and next initializes the list of successors. the method "citire" is defined in a similar way. The operator "*=" for the derived classes checks first if the transition is enabled to fire using the parent operator, and if it is checks if the given transition has no other transition enabled to fire with higher priority.

Tacking into account the way we have built the list of transitions enabled to fire using the operator "*=" we can also consider that the Petri net is a Petri net controlled by queues in the regime c_2: the first queue consists in s_1 and at any time the queue contains all the transitions enabled to fire and only them.

Example 2. *Consider in the Petri net of the previous section:*
1) $cf = 100$, $ps = 99$, $a = 3$ and $b = 11$.
2) $cf = 400$, $ps = 1500$, $a = 7$ and $b = 30$.

Solution:
1) We have $a \mid ps$, and from here we obtain pe = ps = 99 and the final mark $(1095, 3, 1, 0, \ 0, 0, 99)^{T}$.
2) In this case we have not $a \mid ps$: $1500 = 214 * 7 + 2$. We obtain $pe = 214 * 7 = 1498$ and the final mark is $(18178, 7, 1, 2, 0, 0, 1498)^{T}$.
All the above final marks are in the form M_6 and verify (7).

Example 3. *Consider* 21 *existing investment founds in April* 2000 *(Rapoarte lunare ale Asociatiei Administratorilor de Fonduri în* 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009, [15]). Because we have not the data on the total invested sum, consider as explanatory variable the number of investors (the hypothesis is that the above sum is proportional to this number). As resulting variable we consider the row "VAN" in the Excel table, expressed in millions lei. The results are in the following table.*

Table1: *The 21 investment founds in April 2000*

Found	Active Clasic	Active Dinamic	Active Junior	ALPHA	ARDAF	Armonia
X	521	938	481	453	4532	874
Y	769	2388	839	300191	2796	1193
Found	Capital Plus	FCEx	FDI Galați	FIDE	FIG	FNA
X	8900	2011	229	560	14548	18306
Y	16112	39082	17820	11436	251426	121019
Found	FNI	FON	Fortuna Classic	Fortuna Gold	FVG	Stabilo
X	301331	92	22359	88	2587	651
Y	3412516	59160	37329	7291	3340467	23378
Found	Tezaur	FMT	UNOPC			
X	94	556	379322			
Y	5077	46656	4394222			

We apply the $C++$ program of classification using polynomial regression from Ciuiu, 2007. The degree of the polynomial is 1 (regression lines). If we consider two classes we obtain the first class $Y = 185505.77381 + 10.89722X$ and the second class $Y = 5143278.71429 - 10691.14286X$, containing the investment founds Active Junior and ALPHA. The other investment founds are in the first class.

If we consider three classes we obtain the first class $Y = -8665.80285 + 1324.75936X$ with the investment founds FON, Fortuna Gold and FVG, the second class $Y = 5143278.71429 - 10691.14286X$ with the investment founds Active Junior and ALPHA, and the third class $Y = -19712.58989 + 11.52103X$ with the other investment founds.

We notice that if we increase the number of classes from 3 to 10 it remains one of the classes containing only the investment founds Active Junior and ALPHA. The coefficient of X for the regression line corresponding to the class containing FNI is 11.74369 for 4 classes, 11.7062 for 5 classes, 12.58743 for 6 classes, 11.28776 for 7 or 8 classes, respectively 11.34757 for 9 or 10 classes.

4. Conclusions

In recession time, because of the acute lack of goods, there appear many organizers of such fraud-like investment founds. They promise gains that are not sustainable even in a period of economic boom. A simple Petri net model of this investment founds was presented in this paper. The model can be extended by a transition

that models the payment of the taxes to the state's budget and the place of it, to maintain the appearance of the honesty of the found. Of course, the possible Petri net model of a honest investment found must be stochastic (see [11,14]) to model the risk of the found: we can not have sure gains.

Models using classical place-transition Petri nets and extensions of them are used for the inventory of the products of a factory for selling them to customers by a given number of retailers (see [11]) or raw materials for a printing house (see [3]), for modeling and performance evaluation of hardware/software partitioning (see [8]), or in manufacturing modeling: modeling and evaluation of manufacturing systems (see [14]), modeling and evaluation of its software (see [5]) or deadlock control of flexible manufacturing systems (see [13]). An economic plan for production, supply, quality control and selling in a drugs factory is modeled in [9] by a colored, stochastic, timed and hierarchical Petri net. In this paper was presented also an economic model: the tokens from the places of the Petri net represent sums of money.

Two regressions using the Petri net elements as explanatory and resulting variables (nonlinear ones, not linear as in this paper) were used in [11] to optimize the performances of the modeled system. Using a stochastic Petri net there is defined first a probability distribution for firing three transitions in conflict (which share the same resources): p_1 for the first, p_2 for the second and $1 - p_1 - p_2$ for the last one. Next there are considered p_1 and p_2 as explanatory variables (in fact, because of nonlinearity the real explanatory variables are nonlinear functions of p_1 and p_2), and the resulting variable C – the total inventory cost. Using one of the obtained regressions $C = f(p_1, p_2)$ the optimal cost is obtained in both cases for the minimum point of f.

The operators "*=" and "+=" are defined in the header "petri.h" tacking into account that the multiplication has higher priority than the sum: in any Petri net (common or an extension of it) we must check first if a transition is enabled to fire at a given mark and only if it is indeed enabled to fire we it is fired to obtain a new mark.

All the properties and methods from the classes "tranz" and "marc" are public to have full access to them (including the main program, in which we read some properties as "nrloc" for marks and transitions and we write some other ones as "indice" for the transitions enabled to fire). An open problem is to check which of the properties and methods must remain public and which can become private, or at least protected.

In [3] it is used the software CPN Tools and in [5] there are used the softwares "PED" and "FUNlite Petri net simulator" for the Petri nets. But our header allows us to make classes for extensions of the Petri nets as colored Petri nets (see [3,9,14]), stochastic Petri nets (see [11,9,14]) or timed Petri nets (see [8]) using the heritage mechanism. In the heritage mechanism for the Petri nets with priorities the parent classes are declared in the header "petri.h" virtual for using multiple heritage. In fact, in practice the used Petri nets are not only simple extensions of Petri nets: for instance we can use a temporal Petri net with priorities.

An open problem is to use Petri nets or their extensions for other economic models. For instance we can check if it is a connection between the S – invariants and equilibrium equations. Another open problem connected to this paper is to use some other extensions of Petri nets for modeling the fraud-like investment founds or other frauds, like pyramid games for instance. Firstly we can try to use stochastic Petri nets (with simulation of random elements) to model the random elements of the system and hierarchical Petri nets to model the structure of the system. Using timed Petri nets we can also take into the model the time intervals of the operations in the modeled system.

For the colored Petri nets (see [3,9,14]) the first step is to build the $AS - IS$ model, the next step is to evaluate its performances, to try some changes scenarios (see [9]) to improve the performances of the system and finally to build the $TO - BE$ model. An interesting question is if we can go in reverse order: from the $TO - BE$ model to the $AS - IS$ model. If it is possible we can use colored Petri nets for other models of frauds and even of informal economy (see [2]): the $TO - BE$ model will be the false model and the $TO - BE$ model will be the real model.

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University Leader and Quality in Higher Education

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Apstract. *How the university leaders see the reality in the university; to establish the university leader capability to establish the solution for university development; how the university leader could energize, mobilize people (staff) to fight with the reality, to implement his solution.*
Prior work. *The concepts of leader and leadership are used in other organizations in Romania and in the world; for increasing the competitiveness of the universities from Romania, the concepts of leader and leadership should be transferred and implemented in universities from Romania; the managers of universities from Romania to make performance / quality, to turn into leaders should be another policy of recruitment, selection and training them.*
Approach. *The main methods employed used: questionnaires, structured interview, literature research, own experience.*
Results. *The result of research show us: the ability of management to recognize the problems facing nowadays; the solutions they discern for raising quality in higher education; the possibilities of mobilization / training by the university management staff of universities to implement the proposed solutions.*
Implication. *The paper will help university staff and the politician: to change their attitude related to the leadership in the Romanian university; to offer some principales, methods procedures, technique to be use for a better management in the Romanian University development, to choose the right leaders for Romanian University.*
Value. *The characterization of the leaders in Romanian higher education where does not exist research in the aria.*

1. Introduction

The leader need to be able to see the reality

As a designer see the reality and each leaders see different the reality. Way? Because the reality organizational culture. The reality knowing and understanding the enviroment (E) (Fig.1)

– *The reality of quality imput in the university (XQI)*
  – Students applicants (S)
  – Professors and administration staff (S)
  – Material resources assets (A)
  – Information – resources (I)
  – Finance resources (F)
– *The reality of quality HE process (HEP)*
  – Educational process technology
  – Motivation system in the university
  – The university discipline, procedures
  – Procedures and process assessment
  – Students evaluation and the process
  – Staff evaluation
  – Assets utilization
– *The reality output result of the university*
  – Practical competences of students
– Theoretical competences of students
– Quality of research projects
– Customer satisfaction
– Student satisfaction
– University management integrity
– Decision transparency of university management
– The compare the quality output of the university with: internal standards, external standards, internal objectives – indicative – measurable, competitors, history date etc. (B)
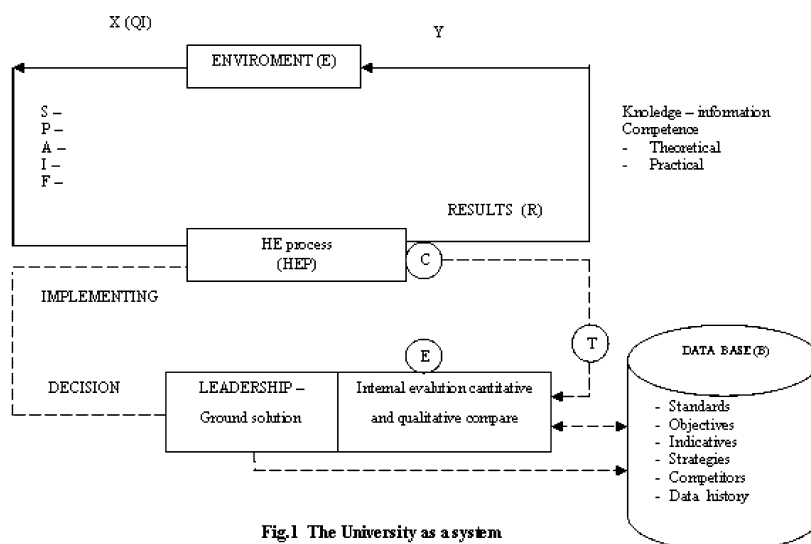

Fig.1 The University as a system

University change cause disintegration wich is manifested in what we call problem because university system is composed of subsystems (faculty, departments subsystem support: library, social services for students etc.) and this subsystem do not change in the same speed. Which is the solution? The solution is INTEGRATION.

The problem is not out of university, it is within us. When university are healty and used to change, change is invigorating. But if university immune system is weak, a change will get university possible into a trouble. Not every university has problems in time of change. It depend on how healty the system is.   The university system is healty when it can deal with change without falling apart.

– Do you have the courage to see what is doing in our (your) school?

– Going mediocraticy

The leader keep seeing for a diagnostic result

The rates lag far behind in socio-economic realities. There are teachers who only attend the changes and teach always the past courses.

– HE diagnosis need to solve: dilemma of grow, dilemma of power, dilemma of profit, selfinteres and community, materials versus quality.

– The leaders needs to be able to do comparative analysis.

External forces for change in the HE are: deregulation, technology, analysis the reality, swot analysis, discover the crisis.

The leader need to be able to ground the solution. Service for university development

The leader need to evaluate: vision, mission and strategies from the university

– Ground the new objectives and startegies for university

– Creating new university programs

– Assuming the risk of the solution promoted

– Assessing, controlling, coordinating quality of educational process

– Search new needs of competence

– Curricula design by customer competence needs

– Search university customer satisfaction

– Making ground the new internal quality standards

– Innovating solution for quality imput unproving in HE

These are not political decision, only sound business decision. The most important DRIVER of performances in the universities is Leadership. We are all the time in a change management business.

The biggest challenge, today, in HE: to develop, mature and spread leadership through un University.

A University leader is a thumb. What does a thumb do? It work with all different to create a leader knows how to help people disagree without being desagreable. A leader is able to build and enrich a culture of mutual trust and respect – a culture in wich people are not afraid to speak their minds.

Without a thumb, you will not have a hand. Without a leader there is not teamwork, and without a teamwork, the cast will be stuck in the mind.

The leader need to mobilize, energize, empower people to fight with reality, to implement his solution (moraly – ethical – social response)

Will be necessary to develop a new generation of higher managers wich have to pay attention to: social responsibility, ethics and moral aspects, individual versus cooperation, business orientention, degree curricula change, balance between tradition and modern new teaching technology, cross disciplinary teaching, risk avertion, communication with the internal and external environment, interpersonal staff cooperation

Passion (respondes) of the staff: developing the competition to all the level, university management as a team, management by performance, green sustenability, cloth relation with HR corporate sector and allumini, value added by training - new competences (knowledge) theoretical and practical, opportunity costs in HE, selectiveness.

2. Research methodology

The main methods used for this research was – the questionary, structured interview, literature research and own experience.

The questionnaire was related to:

- how respondents perceived the reality from universities regarding

- the quality of entries in the system

- the quality of the educational process

- the quality of the results

- solutions for improving the quality of the management solutions from universities

- methods used by university leaders for training / involvement / motivation of staff in universities, for implementation of the solution proposed by the leaders

For reasons of space we refer only to the analysis of some aspects of staff training by the leaders.

The questionnaire was applied to 186 educators from state and private universities from Romania. The structure of the respondents is:

Structure for teaching positions:

Age structure:

Structure by gender:

Structure by leadership position of the leaders:

Structure in term of management practice:

3. Conclusion

To bring about and implement new solution in the university you need leaders and strong leadership

In this period some university managers do not realise that the employees are an asset, not just an expense. The employees can tell to te managers what is going on in the university better that anybody else. There are open-door policies, but how many assistents have you seen walk through the open-door of the university rector, president office to talk to him/her.

Generally speeking, it is a elitist managers in the university system, who are not listen to the people they manage. Energy flow from top to bottom based by reports.

To achive change, wich is essential for a successful university, we need a university that can change easily.

University needs teamwork, cooperation and mutual trust and respect. Managers need to talk more, share more, be open with each other more, and respect each other more.

Teach managers how a leader behaves; teach managers to resolve a conflict.

University are like a fish tank. Unless we supply them with oxygen from top to bottom – management of the university, the fish, organization will die. We have in the university to change what and how we teach. Teach future leadership to listen to university personnel and to each other, to manage more by pride of teamwork and less by workhiping numbers. We have to be "together". Integration is the secret of healty organization, and that is how we will turn a crisis into an opportunity and succeed in the future, and leave behind those that are fighting among themselves to catch the cold.

The limits of the proposed questionnaire analysis are related to:

- the standard of "other prestigious universitie", we believe that it was differed from one respondent to another;

- retaining teachers to talk about "home things". Even one respondent told us that because he was raised and trained in that university he can only grant votes to the maximum limit.

Some respondents considered that some terms are not unambiguously defined, there are situations in which respondents could understand a concept in different ways.

The purpose of the questionnaire was to raise awareness, alert forces within the university that some colleagues have the courage to see reality from within the system, they see reality, but not to recognize it. The questionnaire we wanted to emphasize the questions some of the big problems, important to romanian education that university leaders should tackle. I also received many thanks for the content of this questionnaire.

I am convinced that reforming the higher education system and other systems that can come only from within the system, but from "outside forces". Until now in Romania it have been proposed 6-7 reforms which partially overlapped and who have more disrupt than helped. "Outside forces", in our case, is constituted from the members of the academic community from Romania who have received our questionnaires (over 600) and who are present here, in Tulcea.

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Encyclopedia of Technology and Innovation Management

V.K. Narayanan, G.C.O'Connor, ed., *(Encyclopedia of Technology and Innovation Management),* **John Wiley, 2010**

This voluminous issue that spreads over more than five hundred pages and seven theme areas presents the technology and innovation management as an "autonomous scientific field", which is what editors and authors point out already in the introductory chapter. One consequence of the exceptional multidisciplinarity of the bookis that many results and scientific contributions in this area are omnipresent and related to the contributions to economy and the humanities, then technical, natural, organizational and management sciences and disciplines. The subjects dealing with the technologies and innovation management are taught at a large number of universities and schools worldwide: business and management, organization, engineering and natural sciences, medicine, pharmacy. The encyclopaedia knowledge in this field is a contribution to the concentration and focus of all efforts to present the field of technology and innovation in a coherent manner, with relevant theme units and to clearly apprehend its specific nature and its authenticity. Over eighty authors from the universities from the USA, China, Japan, Great Britain, Spain, France, Denmark, Ireland, Sweden, Australia, India, Singapoore, and other countries participated in writing this paper. As regards the contents and the definition of technology, this is still an open question and a challenge to both academics and practitioners. A multitude of approaches were devised in an effort to un-

derstand the essence of technology as a universal concept, principle, and model. Since this is a dynamic phenomenon, permeating all the spheres of human life and work in both the social and natural environments, derived from the science and present in practice, the efforts to understand its essence and ensure that technologies are managed is a continual challenge.

The evolution of technologies is tracked throughout the human history. The technological creativity on which the sustainable economic growth of the modern era is established stems from two complementary processes the author Joseph Schumpeter termed invention and innovation. The time the innovation is created and the life cycle of the innovation in the periods of growth and development of economy and the society led authors to recognize long cycles in the development that last around 50-60 years each and are characterised by certain unmistakable mechanisms and related to a certain basic technological paradigm.

The emergence of spatial innovative clusters and varied uneven technological growth and development in certain geographical regions have set the grounds for some substantial advantages acquired by the technology transfer from the developed to the less developed countries and regions. Technology intelligence proves to be important on all the levels of society and economy. This is a broad concept that includes collecting and bringing together technical information, the development of technological forecasting, monitoring the scientific achievements and opportunities for further technological growth. The technological intelligence is then observed in the following segments: ratings and validation of technological options, achieving technological competitiveness, using the databases about the patents and other forms of intellectual property, the analysis of technological markets on which the technology transfer between organizations is conducted. Technological forecasting, incremental and radical technological changes, as well as the forms of intellectual property are elaborated in the essays and a specific list of relevant references for these specific theme areas is provided.

On the branch level and on the levels of certain industries technologies are analysed through a model of the life cycle of the branch, the branch competitiveness dynamics, special attention being paid to the branches and industries in the area of high technologies.

A special chapter of the book is devoted to innovation and highlights the demand and the offer as the key sources of innovation. Statistic and dynamic models of innovation are presented through the contributions of a number of authors in creating these models. Thus we find the analyses of the Schumpeter model, the Albernathy-Clark model, the Henderson-Clark model, the Utterback-Albernathy model, the Tushman-Rosenkoff model, and the Foster S-curve. Specially analysed are the Rogers', Moore's and Bass' models of diffusion of information. Open innovation and technological strategy stress the importance of external and internal sources of new technologies, as well as the need to use the technology strategy for the purpose of defining the adequate measure of this relationship as a basis of technological improvement. A special chapter is devoted to the basic concepts of technology and innovation management on the organizational level. The absorptive capacity, learning and establishment of innovative competencies are linked to the organization and stressed as a key factor of innovation success and technology dynamics. Four generations of the research and developement models are presented in the light of the need to manage this phenomenon in order to achieve competitiveness and business success. The development of a new product and the innovations in services, as well as the process innovations are presented via the key specific features and models. National innovation models are theoretically elaborated, and then the national innovation systems of certain countries, namely, China, Taiwan, Singapoore, Japan, Denmark, the USA and others, are described.

One chapter is devoted to emerging technologies, and the prevailing technologies in the 21st century, such as biotechnologies, nanotechnologies and networking technologies are analysed.

Dr Maja Levi Jakšić

TITLE OF PAPER IN ENGLISH
(two lines at the most)

Marko Markovic[1], Ivan Ivanovic[2]
[1]Faculty of Organizational Sciences in Belgrade
[2]Faculty of Economics in Belgrade

Abstract - *These are instructions for preparing papers that will be included in the jou rnal. Your papers should be prepared according to the instructions.*

1. INTRODUCTION

Papers have to be written in English. Original papers should be typed one sided A4 format (210x297mm). Use margin 2,5 upper, 2 cm lower, left and right.

Maximal length of paper is 8 pages including tables, text, pictures, literature and other appendices. Pages are numbered with graphite pencil in upper right corner.

Send two copies of the paper (original + one copy) and diskette in format MS Word 6.0.

If the last page of text is not filled up, the columns on the last page should be even, of the same length.
.

2. SUBTITLE (SIMULATION MODEL) (example: SIMULATION MODEL)

In the middle of the first page, after one empty line, insert English title of the paper. Use font Times Roman Bold 14 pt.

The name of authors and the names of their institutions in font Times Roman 10 pt. should be centered as in the model given at the beginning of this instruction..

Other parts type in two columns 0,5 cm in between. Paper is typed normal space and double space between paragraphs. Font Roman 10 pt is recommended. Beginning of the paragraph is typed at the very beginning of the columns.

The title of the paper and names of authors are followed by short abstract in Italic. All subtitles are typed in Bold, capital letters same sized as in the previous text (not smaller than 10 pt).

3. SUBTITLE (example: COMPARATIVE ANALYSES)

$$\sigma^2(r_p) = E(\sum_{i=1}^{n}[r_{p,i} - E(r_p)]^2) \qquad (12)$$

All equations type in one column, numerated at the right side, as illustrated.

4. CONCLUSION

All figures, tables or graphic presentations are adapted to the width of one column. If necessary, when the figures do not fit in one column, use the width of the page , and then continue as previously, in two columns. See the figure below.
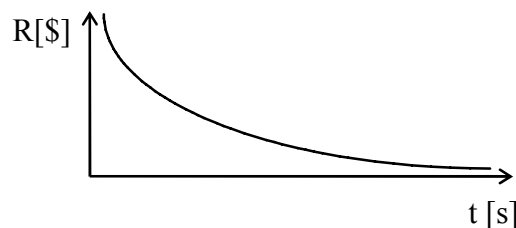

Figure 1. Graphic presentation of results

REFERENCES

Only the literature related to the problems and main ideas presented in paper should be including and ordinal numbers of the references type in angular brackets.

Literature in text has to be quoted in angular brackets to the order of their quotation . For example in [5] it is shown that. The example of literature is shown below.

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