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Management Accounting in Achieving Competitive Advantage and Bank Controlling

UDC: 657.05 ; 005.521:336.71

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Our aim in this paper is to present a relatively complete theoretical and practical accounting system intended to meet the needs of strategic decision-making in banks, which acts in the form of managerial accounting to address the internal and the external environments in which the bank operates. In the complex economic circumstances, strategically oriented management accounting becomes a very important factor for successful long-term bank operations. Strategic management accounting focuses upon the analysis of the management accounting data of the company and its competition to identify and monitor business strategies.

Introduction

In the current conditions of business doing the critical competence of the bank's strategic management is the ability to generate value for the bank owners and for the users of bank products. In order to survive in today's turbulent market, the bank has to change at a faster pace compared to its competition. A long-term prospect requires that the bank activities should be focused upon external factors, one of the most important among them being achieving competitive advantage. The modern information system of the bank becomes a key factor in enhancing strategic decision making and increasing control for the purpose of improving business efficiency. Competition becomes an increasingly important challenge to the bank.

The managers are expected to make the best and safest decisions for the bank's strategic position. The management of the bank is responsible for the development and policy enforcement, and the procedures oriented towards the managing board goals.

The changes on the market and in the competitive environment require that the existing system be redesigned to a significant extent to suit the needs of strategic management of the bank, special attention being paid to building a flexibly dimensioned management accounting. There is a high level of correlation between accounting reports and an efficient bank management.

Management (or: managerial) accounting has to be continually tested in view of its contribution to a successful performance of managerial functions in banks, that is, successful achievements of strategic goals, especially from the point of view of their contribution to the vision of the future business flows in the bank, as regards provision of adequate information to define various managerial models.

Our aim in this paper is to present the possibilities of strategic management accounting implementation in the bank. Also, we will discuss information potentials of management accounting in view of achieving competitive advantage, the strategic importance of bank controlling, as well as highlight important aspects of organizing profit centres in banks.

1. Management accounting system in planning and measuring financial performance

The concept of strategy means the implementation of a formal system of information management. Achieving goals requires that information be analysed in the decision making processes. If the strategic decision is a structured and planned enterprise, it will draw due attention. It is necessary that the management should proactively identify internal and external strategic strengths and threats, without ruling out the chances for strategic innovations. Managers are assumed to formally analyse competitive advantages and a meaningful assessment of resources allocation and use them as part of the development strategy. Such an analysis will be provided by formal information systems. The strategic management accounting is a useful tool managers can apply in making quality business decisions.

Strategically oriented management accounting is expected to ensure a powerful information support that would allow for implementing prevention measures in order to eliminate ineffective outcomes in the bank's business operations. It is necessary that the bank should be capable of successfully managing unexpected, unplanned changes in the financial sources, which require accounting calculations, which all lead to a conclusion that the bank responds to market changes in an adequate manner.

A major cause of necessary change are the dynamic changes in the external environment, and this demands

that the collaboration between strategic managers and management accountants be close, especially in the sector of cost tracking and analysis, as well as in cost projection. Besides, a strong information support in the field of measuring the profitability of individual bank products and changes in the bank's key clients is of great importance.

Strategically oriented management accounting is a multi-purpose information source oriented towards the management and towards the future, focused upon strategic business units. *Simmonds* defined and described strategic management accounting oriented to the company benchmarking in view of its competition [10]. He promoted collecting information required to define the market share, the competition price, costs and scope. The bank that monitors market share can measure to what extent it may achieve or lose competitive position.

As regards the fact that the strategic development of the bank is directly connected with the bank's develop-

ment plans, it is necessary to stress that strategic planning is directly dependant on the management accounting information. In other words, it is necessary that a high level of coordination should be achieved between the planning and the reporting activities.

Given that the market environment is becoming increasingly dynamic and competitive, banks are forced to continually improve their activities in terms of anticipating their future business operations as accurately as possible, if they want to do business successfully. Namely, banks can no longer afford any incongruence between anticipated incomes and expenses. A growing importance of the budgeting processes in the banks makes the need for a detailed reporting system an increasing necessity.

In order that a proper design of a strategically oriented management accounting should be achieved in banks, we propose the *model* presented in Figure 1.

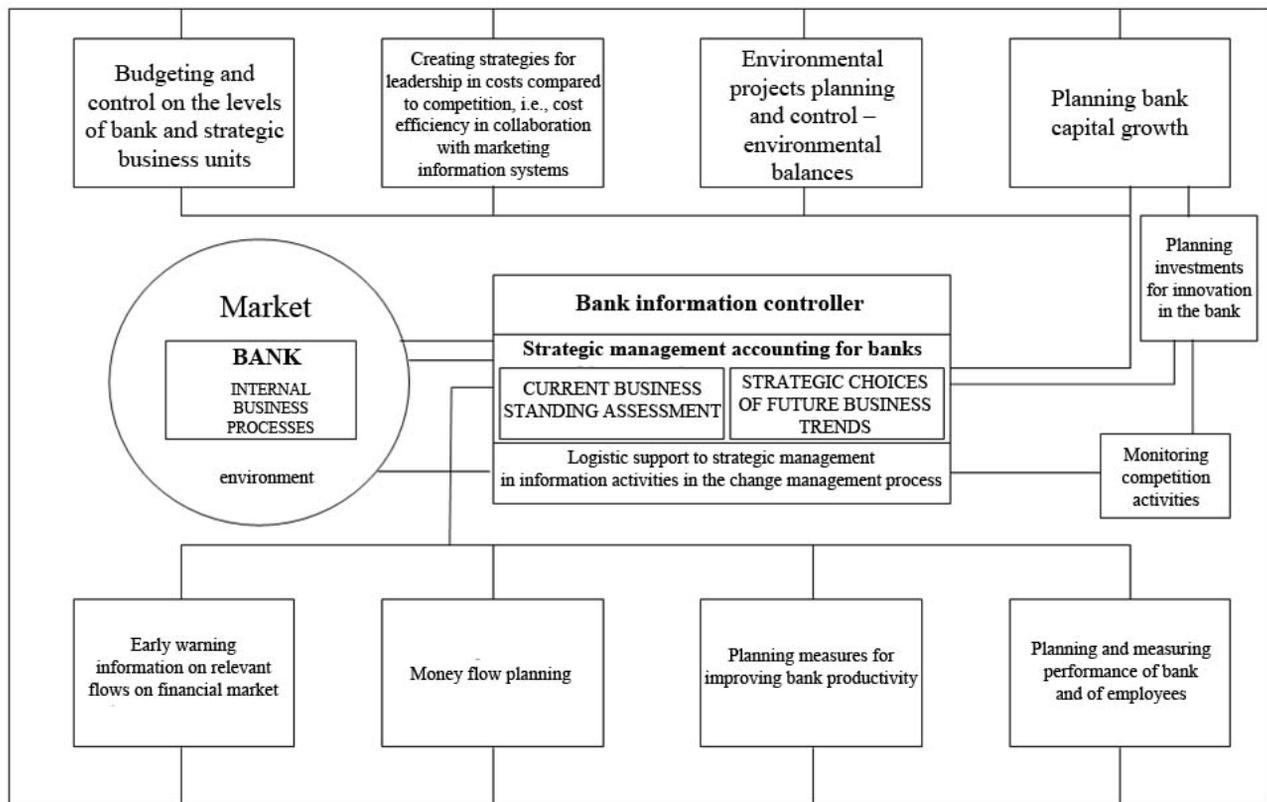


Figure 1. *Strategic management accounting dimensioning model in banks*

The information model of strategically oriented management accounting in banks presented above is meant to support identifying, analysis and interpretation of all relevant information that the management use as the basis to define strategic management goals, which in turn are written in strategic plans, in view of the accounting aspect in the bank's budget. Furthermore, quality and transparent information are meant to allow for the control, as well as for corrective actions in case any deviations occur as regards the planned values. The proposed model should support change in the market environment the bank does business in, especially for the purpose of achieving competitive advantage.

Strategic planning is a process of defining the development strategy of the bank, as well as the process of decision making in order that the adopted strategy should be implemented. It is of crucial importance for any bank to define the direction it should follow. The strategic plan is the basis for designing the operations plan which is generally devised for a period of one year. Organizational activities are undertaken to shape varied interests, including the bank, the specific strengths, as well as institutional pressures.

The strategic plan of the bank consists of two sections: qualitative and quantitative. The qualitative results section includes the analyses of the macroeconomic scenario, the SWOT analysis, the company's mission, the strategic guidelines and the action plan that serves to achieve the plans defined. The quantitative results section comprises the implementation of financial methods and models in the strategic management of the bank's finances. The strategy the bank has selected has to be translated into a succession of goals.

In order that the strategy should be implemented, three issues have to be resolved:

1. Which performance dimensions the banking institution tends to develop?
2. How the goals will be set in an adequate manner?
3. Which rewards and/or penalties should be linked to the achievement of the performance standards?

Strategic bank performance management can be described as an activity of managing the bank solvency in order to define the optimal ratios, on two levels: maximizing the returns and meeting the requirements of regulatory institutions focused upon the preservation of the banking system stability, at minimum risk in business operations. This is, however, far from easy to achieve in

practice, as the goals are basically opposite: larger returns means taking greater risks and vice versa.

Orienting the bank's business operations towards the realization of the strategic performances of the bank is a rather complex process, due to the opposing goals of the bank's shareholders and bank's depositaries. The information horizons of management accounting in the realization function is extended to the following strategic goals of the bank:

- Identifying opportunities and weaknesses from the aspects of cost component (bank product price), relative market share and the amount and structure of the fees and commissions;
- Trends in expanding or narrowing the bank's scope of business on the national or foreign markets, in the domain of financial indicators;
- Comparison of achieved strategic goals and tasks with the planned ones; types and causes of deviations, and taking corrective measures to eliminate negative deviations.

The role of performance measures in the organization is a critical one, both in testing how efficient the banking institution is in achieving short-term goals, and in identifying necessary improvements. For the purpose of the financial performance analysis it is necessary that financial projections are set on the balance sheet and income statement positions with anticipated trends, as well as the projection of the following business performance indicators:

a) Indicators of bank's capability of earning income:

- Returns on Assets (ROA) ratio;
- Return on Equity (ROE) ratio;

b) Indicators of interest margin:

- Interest bearing assets / total assets;
- Average interest rate on interest bearing assets;
- Average interest rate on interest bearing liabilities.

c) Indicators of capital adequacy:

- Total capital / total assets;
- Capital assets / total assets.

d) Indicators of growth rates:

- Total assets growth rate;
- Interest bearing assets growth rate,
- Credit growth rate;
- Deposit growth rate;
- Income growth rate;
- Profit growth rate

e) Solvency indicators:

- Total credits / deposits;
- Total credits / deposits + capital.

f) In addition to the rate of returns on equity capital of the bank the following indicators are used in assessment of the bank's ability to earn and the quality of returns:

- Yield difference from other revenues and other expenditures;
- Yield before extra items and tax.

g) Other important indicators: [1], [7], [8]

- $(\text{Current deposits} - \text{Previous deposits}) / \text{Previous deposits}$;
- $(\text{Current credits} - \text{Previous credits}) / \text{Previous credits}$;
- Debts / Net value;
- Low credit quality / Low credit quality and discount;
- Credits / Deposits;
- Regulatory capital / Risk weighted assets;
- Revenues from sales / Number of employees in the bank;
- Profit before tax / Number of employees in the bank
- Net interest profit / average earned assets from interest;
- Reservations for credit losses / Average credit portfolio;
- General expenditures and reservations for losses / Average total assets;
- Operations expenditures / Average (assets);
- Regulatory capital / Risk weighted assets.

Strategically important is the analysis of the bank's market share in individual segments (e.g., short-term dinar deposits and foreign currency trading). Also important is the analysis of the bank's strategic plan, both from the aspect of the amount of investment into information system and from that of expanding branches, in order that proper estimates should be made on the future growth and strengthening the bank's market position.

Strategic management accounting is expected to provide a large number of indicators as regards the position of the competition, with special attention paid to market leaders, close and *slow* competitors. The reduced market share indicates the loss of the bank's competitive position, with the implications of the future fall in profits, whereas the increase in the market share indicates the improvement of the competitive position with prospects of increasing profitability in the future.

The *Balanced Scorecard* concept is also worth mentioning in the context of strategic planning. It shows the intention to preserve the balance between the short-term and long-term goals, between financial and non-financial measures, as well as between lagging and leading indicators. Namely, the point is that the manager should lead the bank towards achieving strategic goals [3].

In the bank's business performance assessment it is important to define the criteria from a number of aspects:

First – Financial perspective: revenue management, market share, profitability capacities, assets management;

Second – Client's perspective: reach the client before the others, client profitability, client retention, specific financial services;

Third – Prospect of internal business process – information system creation, information support to management, maintaining business quality.

Fourth – Prospects for learning and professional development of managers: knowledge and development of managers, team work, policy of incentives and rewards.

It is also important to mention the role of bank controlling that is used for an adequate information communication in the bank, so that the variance between the set strategic and operations goals and the achieved results should be as small as possible.

An adequate cost management requires an assessment of alternative strategies or plans that display all costs. The design of an adequate information model of the strategic management accounting requires the engagement of a variety of experts: management accountants, experts in planning and analysis of business operations, financial and other bank managers, information technology experts, etc. Monitoring the activities of the competition, especially in the domain of achieved performance, can help the management team position the bank in the future in relation to its competition.

A significant support to the improvement of the business performance of strategic business units is expected from the bank's marketing manager. Marketing research allows for the estimates of the future outcomes and results that make it easier to take decisions on various opportunities of costs assessed in accordance with the corporate goals. The managers engaged in management accounting attempt to identify the competition cost structure and then price the bank products, taking care to neutralize inflation effects upon the variables they take into consideration [13].

An adequate assessment of prices set by the competition begins with the cost analysis and continues to analyse the impact of possible changes in prices upon other competitors on the financial market, which needs an accounting analysis. This is followed by an analysis of the scope of the market share. Naturally, the competitive advantage cannot be expressed only by one variable, but rather by a group of indicators that reflect the competitive picture the strategic management will use to control whether the bank goes in the right direction.

Information on the costs of the competition enables the bank to identify when the competitor tries to change a relative competitive position, e.g., to manipulate prices. The strategically oriented management accountant is expected to anticipate business events from a financial aspect, that is, to create the business vision of the bank using management accounting information.

In many fields concerned with environmental protection there is an increasing interest in transparent calculations and analyses that frequently include not only economic, but also financial calculations. On the business system level, the so-called *Environmental (protection) accounting* is recognized as a segment of financial accounting, however, also as a segment of management accounting of a strategic orientation. Especially important for the bank reputation is the social responsibility in terms of financing environmentally sustainable projects, financing project that improve energy efficiency etc. Hence it needs information as basis for forecasting, both financial and non-financial in character. The fact is that the bank competitive advantages are achieved primarily by improving the logistic service, which means a more adequate availability of the bank product, which is in turn preconditioned by reducing the costs to as low a level as possible, without affecting its value.

Changes such as new cost allocation methodologies, new approaches to the money value assessment and a larger share in the budgeting process have initiated a more intensive communication between managers and accountants. Banks today focus upon a more productive budget, oriented towards profit from product

and reduced costs. Various information systems are implemented to different organizational levels. For example, in case of a five-year budget, profit planning and a five-year sales trend forecast, executives use the support systems – *Executive Information Systems*, whereas in case of the management-control level of the system for designing an annual budget and the analysis of capital investment and sales management, the management information system is implemented. On the same organizational level, in the analysis of profitability, expenditures and sales by regions, the *Decision Support Systems* are used. The accounting information system is part of the *Management Information System* and has the characteristics of a business information system that supplies various information to be used in achieving different goals.

Effective reports supported by adequate banking software on operations risk for the bank supply managers with detailed information necessary in strategic decision making. Such reports are also useful to the board of directors, the executive board, the operational *risk* managers and the executive *risk* managers and are of an early-warning character.

2. Bank controlling and bank strategy

The controlling in the bank is a type of information centre that synthesises and disposes of information important for the bank management, in order that the activities of organizational business units be synchronised and their goals be conformed to the general objectives of the bank. One of the earliest tasks of the controlling is the establishment of an adequate reporting system that is meant to provide information on the overall business operations of the bank.

The basic responsibility of the bank controlling is to create the infrastructure adequate to controlling attitude on all the levels of bank management, aware of the specific features of a particular bank, as well as ensure the implementation of controlling. In accomplishing this task, we recognize four significant segments of the bank infrastructure employed in the real bank controlling, as presented in Figure 2 [4].

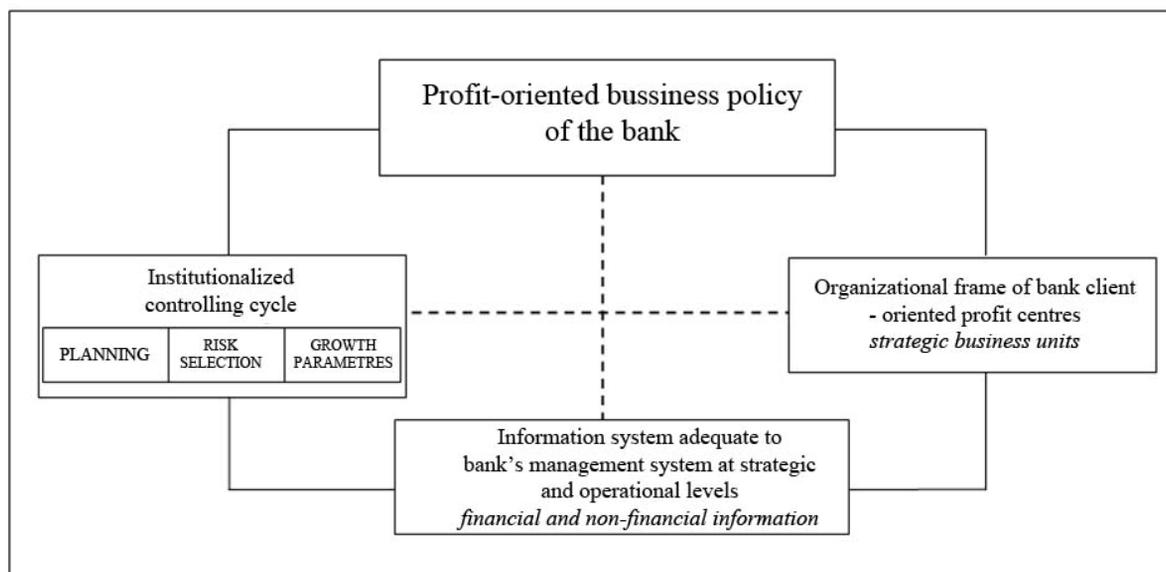


Figure 2. Bank controlling instruments

The key issue for the management of any organization is „how good is its performance“?

A profit orientation in the business philosophy, as basis of the controlling system, can be equalled to the bank management concept that puts profits into the focus of consideration in the business policy creating process. Only in this case can the controlling systems act efficiently.

Strategic business units are partly autonomous units responsible for their own budgeting, and the business strategy implementation that should be adjusted to the broader corporate strategies. In this sense, the following is expected from the institutionalized cycle of bank controlling:

Firstly, to formulate the strategic and operational goals underlying the profit oriented business philosophy and translate them into strategic and operational plan values;

Secondly, to systematically compare the achieved values with the planned values, on all the planning levels, and perform an analysis of deviation trends in the segments in which they are identified;

Thirdly, to assert or state precisely, from an organizational aspect, who is responsible for the planning, what should be planned, when and with which tools planning should be carries out and controlled.

The bank controlling system is simultaneously a managerial system where the activities of planning and control are not conducted in an isolated way, but are inte-

grated into a complex hierarchally structured regulation model, Figure 3.

The strategic bank controlling is a complex function that, in addition to planning, performs a selection of risks immanent to banking business, by which the reality and planning processes are simplified. All the bank profitability components as well as the risk and growth parametres that affect them are the referent points in the strategic controlling process, viewed in a long-term period. Hence it is important that risks are adequately identified so that the manner in which they will be measured (e.g., quantitative/qualitative), as well as the risk measuring method should be defined.

3. Profit centres as strategic business units in the bank

An important corner-stone of an adequately controlled infrastructute is the organizational structure of a bank since, in addition to pursuing a definite idea, there must be a concrete organizational framework within which the profit-oriented business philosophy on the market can be transformed. Here, decisions are primarily made as to the organizational principles by which individual sectors of a company are divided, and later coordinated again in their activities and also to what extent the decision authority should be delegated to lower management levels. Within one controlled *Controlling* system for credit providing institutions a client-oriented organization of profit centres is proposed, with a large-scale decentralisation of decision making, since it is generally compatible with requirements directed towards the

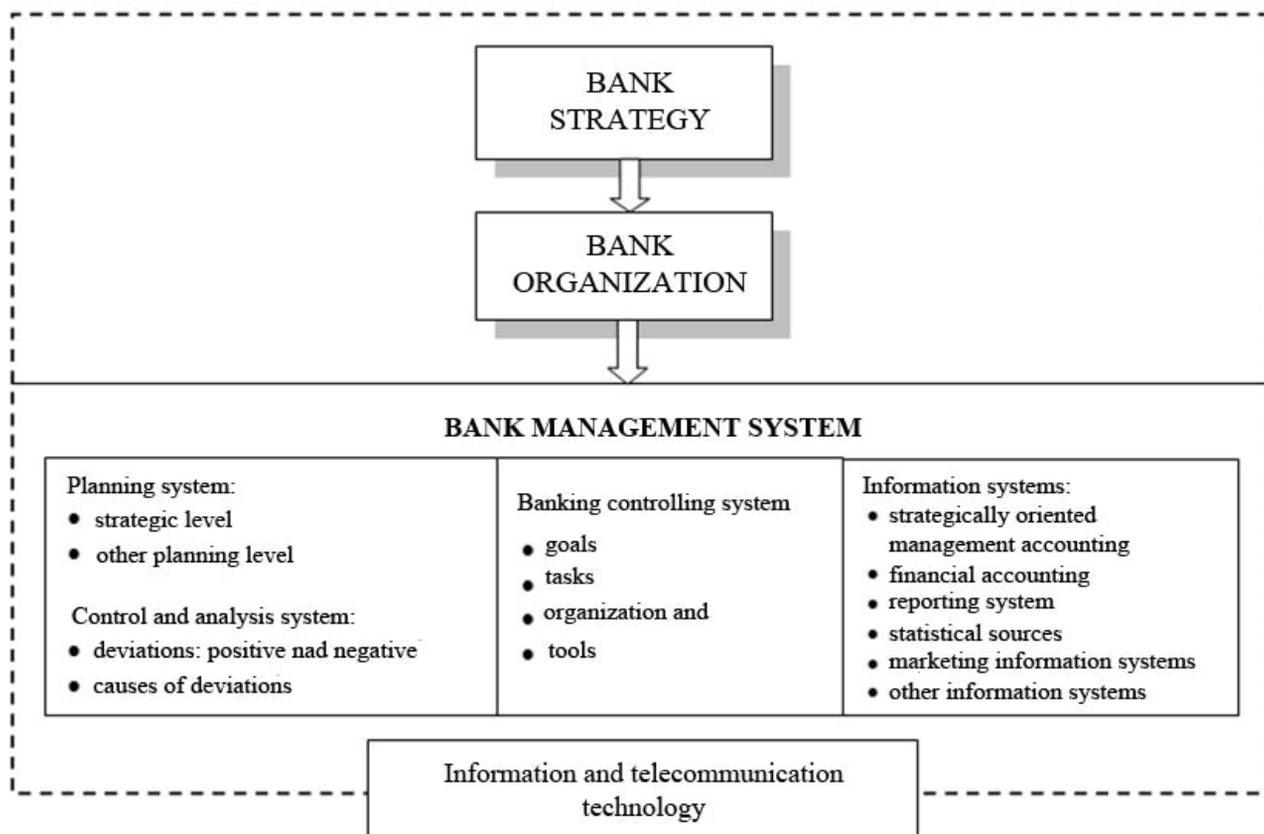


Figure 3. Institutionalized bank controlling cycle

organizational transformation of the concept focused upon profitability in bank management.

Strategic business units can also be viewed as organizational units with an access to competitive strategies. The key precondition for the compatibility of objectives between the managers of strategic business units and the goals of the banking institution as a whole is the definition of an adequate policy of financial incentives for the achieved business performance. The manner in which a strategic business unit will ensure a competitive advantage, achieving the goals of the bank at the same time, is defined by the strategic business unit plan. Strategic business units may be organized as profit centres that are the operational generators of the bank profits. A branch operates as a *profit centre* within the bank and has a responsibility to observe the principles of solvency, liquidity and profitability in its work. For example, one national bank has the following profit centres: (1) Profit centre – *solvency assets*, (2) Profit centre – *loans and investments*, (3) Profit centre – *retail operations*, (4) Profit centre – *external economic relations* and (5) Profit centre – *marketing*.

The client oriented organization of profit centres provides the organizational structure for a market field

that raises the orientation towards clients to a ruling organizational principle. Here the market fields are arranged according to the client characteristics (not according to income) since it is only in this way that a congruence is reached between the performance hierarchy and the company hierarchy, which means that individual performances of the bank institution sectors can be summed up to an aggregate that in their own sum conclusively present the total bank performance, without disturbing the responsibility for a complex market performance. The client orientation especially means that the client himself is viewed as a ruling source of choice. If the organizational structure should follow the path of the bank success, it becomes oriented towards clients as well, i.e., towards their needs. Thus the organizational framework has to be “built around the clients“. Namely, it is important to “entice the client before the others (competition). The clients of the bank are regarded as client-firms (standardized performance, individual performance and specific target groups). The reports today require a more intensified role of the financial control that should play a proactive role in the communication with all the managers in order that it should explain the reports per centralized fields of responsibility as well as per performance for selected groups of clients and offer answers to a large number of ques-

tions. Control is a complex process the purpose of which is that the bank management should see whether the decentralized units achieve the defined goals. The control process is conducted by the short-term measurements of the achieved financial performances and redirecting activities in case discrepancies appear between the real and the desired positions.

Conclusion

A new, dynamic role of the bank in a complex environment requires that the management develop a system of strategically oriented management accounting as a support to the strategic planning of the bank growth and development, i.e., to the strategic decision-making. The management accounting system in a competitive environment has to support the bank strategy which is not possible to accomplish if the elements of strategically oriented management accounting are not part of it. The focus is upon a strong connection between the management accounting and the bank strategy.

Marketing is to diagnose external market situations and communicate them to the strategically oriented management accounting. Everything is subject to change, the flow of events takes different courses. In order that these courses direct the events in an efficient manner, it is necessary that bank managers dispose of valid infor-

mation on the force of changing conditions that impact or will impact the events, both in the bank itself and in the environment in which it operates. The reports today require that the role of financial control be intensified so that it should take a proactive role in the communication with all managers to interpret the reports and give answers to different questions.

The strategically oriented management accounting is no revolutionary information model made up for the needs of management. It is rather a long-lasting systemic process that is continually adjusting and modifying to suit the changes in the bank, and especially in the environment in which the bank operates, and also to meet the information needs of the strategic management. There is no universal information concept or model of a strategic character for the needs of the management that could be used to provide valid solutions to all management problems in a long-term. Namely, it is difficult to anticipate the behaviour of financial institutions in a turbulent environment. An increased competition and the innovation level of bank products can be viewed as generators of bank development.

The knowledge of a relative market share and the cost structure allows for assessment and decision making in the light of the possible reactions of the competition.

Not only should the bank be compared to its competitors, but the advantages of its products should be assessed from the point of view of both its clients or users and the bank itself. Information used to make strategic decisions will have to be future oriented, not based on the past costs and the ability of adjusting to the changes on the financial market.

Banks can organize themselves into strategic business units on the basis of critical activities, accumulate accounting data for each of the activities, where they have to create reports for each of the strategic business units.

In the dynamic business conditions, in the conditions of economic crisis and in the conditions of general competition, the strategic information becomes the major driver of the bank's growth and development. Especially important indicators used to measure the bank's business performance are the following: returns on equity, returns on property (capital), net interest margin and earnings through commission.

The bank controlling concept emerged as a need to empower the management system oriented towards an integral profitability and risk management, and ensure the stability of the bank as a financial institution. Financial institutions are subject to permanent pressure to retain their clients, to manage risk in an adequate manner and to implement modern technologies as source of their competitive advantage. The market objectivity of the bank initiates change towards the innovation growth in the banking business, as well as towards the development of information systems to enhance the bank management. Strategic controlling is a type of logistic support to the bank top management, as it aids the bank to fulfill its mission and goals. It enhances the development of an integral information system and its basic segment – strategically oriented management accounting.

An important issue of a further bank growth and development in this country is creating an efficient and rational system of information circulation, so that they should be timely processed and implemented in the business decision-making process. Current practice has shown that so far, these problems have not been paid due attention in our banks; consequently, the quality of much information, especially the strategically significant information, permanently lagged behind the real needs of the bank management for an efficient and effective real-time decision making.

In view of the current situation in our banks, it is necessary that conditions should be first created for an adequate integration of the management accounting sys-

tem into the bank's information system, and then allocated a strategic dimension. Banking institutions should measure exact *outputs*, as well as any other *outputs* that may have an impact upon the bank.

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Planning of Social Corporate Responsibility Campaign with Multiple Special Event

UDC: 005.35 ; 005.511:659.1

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In an effort to achieve good operating results, business systems largely adopt precisely defined methodologies for business decision making. In a socially responsible business practice, the most significant areas of decision making are: the selection of initiatives that will support social goals and the selection of programme plans for their implementation. In this paper, the methodology of planning a specific campaign with a multiple special event of socially responsible business practice of the Insurance Company “Dunav Osiguranje” is presented. The Goal Programming model of the decision making process regarding the selection of the optimal campaign implementation method will be presented.

1. Introduction

Building connections with the social community is of paramount importance in the corporate and the public relation strategies. In the last two decades we have witnessed the emergence of an increasing number of organizational initiatives in the field of social responsibility, adopting the “do a good deed” concept as a corporate social norm and an evident transition from giving as an obligation to give to giving as a corporate strategy. Until the 1990s, the decisions on the selection of activities to promote the organization and earn a positive publicity were based on the need to “do something good in order to make a good impression”. In the 1990s, a large number of organizations turned to essentially differently motivated activities in building corporate identity, image and reputation, in accordance with a new model of corporate behaviour: “do what is best for the good of the society – act towards the society in a responsible manner” [1].

Adopting a new system of doing business has imposed the need to develop and introduce specialized methodologies for planning and conducting concrete campaigns. The methodology devised by the authors of this paper deals with the planning of a concrete activity of socially responsible business with the need for a continuous repetition of the same special event on different geographical locations, and in a given time period. It is to a considerable extent based on the fact that the decision-making process in a socially responsible business is performed on different hierarchal levels in different phases: strategic, executive and operational levels, as well as on the principles of the special event organization. In cases the event realization is conditioned with the time period longer than one day,

there emerges a problem of scheduling the event over a certain period of time.

In order to solve the problem of the time schedule of a socially beneficial campaign a unique mathematical model of goal programming was devised [2], and will be described in this paper. The time scheduling problem has already been solved using the goal programming (GP). The GP models that can be applied in college and university courses timetabling are described in [3] and [4]. The problem of time scheduling and balancing sports events over a large number of venues and its modelling using GP is described in [5]. The GP models of medical personnel distribution are presented in [6] and [7], whereas in [8] the problem of employee distribution is also dealt with applying the GP, this time in the field of marketing. In [9] the authors describe the GP model applied in the optimization of the time schedule of manufacturing processes to ensure a maximum performance and minimize the period of resources engagement. Due to the specific nature of the time scheduling problem in case of socially beneficial campaign events dealt with in this work, the time scheduling problem is defined as a system of distinct representatives (SDR) [10], [11] and [12].

This paper is organized in six chapters. Following the introductory part, the second chapter will highlight the importance of socially responsible business behaviour and the third chapter will describe a socially responsible campaign titled SVITAC (firefly). The fourth and the fifth chapters deal with the campaign objectives formulation and the goal programming model. The paper ends with the conclusive remarks and the description of the future research.

Planning of Social Corporate Responsibility Campaign with Multiple Special Event

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2. Importance of socially responsible business behaviour

The business entities in Serbia increasingly adopt the principle that being a socially responsible company does not mean just meeting the obligations one is legally bound to meet, but going beyond the imposed obligations to meet the needs of the community, investing into a healthy, thriving and modern society, into human resources, environment and developing good relationships with various social entities. Socially responsible business is a concept according to which the economic entities that adopt it consciously and willingly go beyond their primary function of profits earning and distribution and try to have a positive impact upon their work, and the social and natural environment. Socially responsible business is essentially the awareness of a new position and importance companies have in a global society and the responsibilities these impose.

As a modern approach to business, socially responsible business behaviour has an important impact upon the choice of values the company supports, as well as upon the manner in which the business programmes are defined, executed and assessed. Organizations increasingly choose to focus upon a smaller number of strategic values that suit their own values. They decide in favour of socially justified initiatives that support their business goals and consequently develop strategies to increase their market share or create a desired image and reputation. They assess tasks on the basis of their potential favourable impact in a period critical for the organization or their real positive impact upon creating adequate living conditions [13]. Similarly, the organizations that desire to achieve good business performance are aware of the impact the environment has upon their realization. Therefore they employ all their resources in the process of selection of adequate direction of business operations that will earn them a wide support in the implementation of corporate programmes and take on the responsibility to solve the issues that are deemed most important for the users, the employees and the community in general.

Socially responsible business behaviour has a favourable impact upon the company's image and reputation. When an organization adopts the concept of socially responsible business behaviour, it is necessary that an adequate perception of such organizational behaviour be recognized by the target public. It is in this respect that the public relations programmes must be conceived, in order to ensure that internal and external public should be informed on the socially responsible business behaviour of the particular organization. The

employees in the public relations sector should encourage the socially responsible behaviour within the organization, but also outside it, as well as present to the public the plain facts that prove that their organization tries to be a good member of the community. Prior to conducting any activity or campaign in order to send a message to the target population, the employees in the public relations sector of the organization have to anticipate the reaction of the public. The public relations experts often act as representatives of their organizations in communication with the environment and as such they have to be acquainted with all the events going on around them and inform the management on the current problems that may be of impact upon the target public's attitudes, either directly or indirectly [14].

Socially responsible behaviour is most easily recognized in the public relations activities. The major goal in this regard is improving the quality of business practices based on observing the rights of the employees, the customers and the community and thus enlisting the support of the public and building long-term relations based on trust and loyalty. The quality of business practices we mentioned above may be ensured by launching long-term investment programmes oriented towards school and university students and for the purpose of a better education and quality improvement of the future job applicants. Hence the connection between social responsibility and public relations as regards a given area.

Strategic engagement of public relations experts in the socially responsible business can be effected through the following phases [15]:

1. Selection of social goals to be supported;
2. Selection of initiatives to support social goals;
3. Design and implementation of programme plans and
4. Event assessment.

Selection of social goals to be supported. Social goals should be not more than a few and they should refer to solving the problems of the members of the community the company operates in. The organization's mission, values, products and services, as well as business goals should be adjusted to them; the completion of these goals should be the interest of all the stakeholders and they should enjoy a long-term support by the target public.

Selection of initiatives to support social goals. The selected initiatives should be best geared to the business goals and tasks; it is necessary that they meet the priority tasks of the social goal, that more than one initiatives be selected for one social goal, adding those that

are not yet included in the currently organized events. The selection of initiatives should be such that it offers the greatest possible potential for building partnership relations in the community; these should be the initiatives that are based on a certain amount of experience and that will make good use of the existing resources.

Design and implementation of programme plans. It is suggested that internal teams should be assembled to design plans. In addition to the employees, these teams will include the employees from other organizational units. Also, the community representatives from the external environment of the organization should be incorporated. It is important that tasks and measurable goals (outputs) are clearly set, both for the organization and for the society. The communication plan should be devised, and additionally required strategic elements should be agreed upon and planned. The planning techniques are to ensure an efficient completion of a single event, as well as improvement of the outcomes of those events that are repeated.

Event assessment. In order that the outcomes of the organized events be efficiently evaluated, we should first define the purpose of such evaluation, supply adequate resources for assessing and reporting, measure what is achieved on the basis of the resources invested and report on that; it is further necessary that outcomes be measured for both the organization and the society, on the basis of the set goals and tasks and the report be prepared. It is also important that the status of social goals promoted by the organizational initiatives be further supported.

3. Description of the socially responsible event titled “firefly”

The Serbian company Dunav Insurance (Dunav osiguranje) is a large, powerful and modern insurance company with a long and fruitful business tradition. A state-owned company, this insurance company is an important economic entity, however, also an important national brand in the field of insurance. Hence the Dunav Insurance Company is continually engaged in improving the environment, that is, the community in which it operates, conducting numerous activities in the field of socially responsible business. The socially responsible behaviour in the Dunav Insurance Company is adopted as a modern strategic approach to the business practice and, as such, it has a significant impact upon the selection of values it stands for, as well as upon the manner in which its business programmes are defined, conducted and evaluated. The business policy of the company is increasingly based on focusing upon a

smaller number of strategic fields of socially responsible business behaviour. Given that the company has developed a corporate awareness on the environmental impact upon the realization of business operations and hence on achieving the set business goals, much attention is paid to the decision-making process optimization. The company uses all its resources in the process of selecting the appropriate business orientation in order to ensure the support to implementing the social responsibility programme. Thus one field of decision making is the selection of socially justifiable initiatives that support the company’s business goals to a largest extent. Another decision-making field refers to the selection of the strategy of creating a desired image and reputation based on the socially responsible business practices, and consequently, increasing the company’s market share. It is in such a decision-making process that an assessment and selection of concrete tasks are made, on the basis of their potentially favourable impact upon the company’s image and reputation or its real positive impact upon ensuring adequate living conditions for the target public (community).

As mentioned above, when the organization has adopted the socially responsible business concept, it is necessary that an adequate perception of such behaviour should be granted from the part of the target public. Here, the process of making a decision on the selection of the communication strategy and the media as its most important segment is of highest importance.

In accordance with its policy of socially responsible business behaviour, the Dunav Insurance Company has decided to organize a campaign titled SVITAC (“FIREFLY”), meant for the youngest schoolchildren, the first-form elementary school pupils. The problem of children’s traffic safety, especially of the youngest ones, has often been the issue of debates, however, has never been completely resolved. In order to contribute to the solving of this ever present problem and reducing the number of accidents, the Dunav Insurance Company decided to organize a large-scope FIREFLY campaign and donate to the elementary schools in Serbia 80,000 “fireflies” – the glowing gadgets meant to ensure a better visibility of the youngest schoolchildren on the Serbian roads.

This donation of the Dunav Insurance Company is meant to contribute to the traffic safety of the youngest and most threatened traffic participants. The first-form pupils have proven to be the most critical group since it is their first time to participate in the traffic by themselves. In this way the Company wishes to call on all the other traffic participants to observe the traffic regula-

tions for the purpose of their own safety. Indirectly, the campaign is addressing all the other pupils in the elementary schools where this event is organized. A conclusion can be drawn that the attention in this project is focused upon: elementary school pupils, their parents and the community in general.

There are two major characteristics of the FIREFLY campaign. One is the need to plan the so-called multiple special event, that is, define a precise time schedule of special events that are equal in goals, contents and expected effects but differ by the venues they are organized in. The other characteristic, actually the basis of the process modelling, is a large number of participants in the process that took place in over 20 cities in Serbia. On the national level, the campaign included, in addition to the Dunav Insurance Company as the initiator, the following: the representatives of the Ministry of Education of the Republic of Serbia and the Ministry of Interior of the Republic of Serbia, the Minister of Education, the Managing Director of the Dunav Insurance Company and the Chief of the Directorate of the Traffic Police. On the local level, the participants were as follows: the directors of host schools, the directors of district schools, the heads of school directorates, directors of the Dunav Insurance Company branches, the representatives of the traffic police/heads of departments and the first-form pupils of the host schools.

The campaign was promoted in the media, too. Both national and local media covered the campaign extensively in all the cities in which it was organized. For the purposes of media coverage, the following activities were carried out:

- The special event of donating the first quota of the firefly gadgets was organized in Belgrade. In addition to the presence of special guests (public opinion leaders or popular persons), the media were invited to be present;
- The invitation letter to the media was written and distributed and an announcement for the media was distributed afterwards with photographs of the donation event;
- Media visits of the Company representatives were organized for the purpose of the campaign promotion;
- In case of donating the gadgets to the first-form pupils in other cities in Serbia, it was organized through the coordination of all the project participants, the invitation letter was prepared and distributed to the media, as well as a scenario and statement for the media, for each particular city. All the participants in the campaign, on the local

level, were acquainted with the entire material, among them: directors of the schools in which the gadgets were donated for the entire district, heads of school directorates, representatives of the traffic police and the directors of the Dunav Insurance Company branches;

- Prior to all these, a letter was sent to all the school directorates, on the basis of which the time of all the distribution events were scheduled for the territory of the whole of Serbia.

The first event was organized among the Belgrade elementary schools, followed by the similar events throughout the republic.

The distribution campaign started with the distribution of the first quota in the "Borislav Pekić" elementary school in the Novi Beograd municipality. The special event was organized at 9:30, 11th December, 2009. The gadgets were delivered in the presence of the Minister of Education of Serbia, the Head of the Republic Directorate of traffic police, the managing director of the Company and the directors of all schools in Novi Beograd. 150 first-form pupils of the "Borislav Pekić" elementary school participated, as well as a large number of representatives of all the relevant media – national and specialised.

On Wednesday, 3rd February, 2009, the quota of 2,733 glowing gadgets was delivered at 10:00 to the first-form pupils of the elementary schools in Vranje and the Vranje district. The delivery was organized in the "Vuk Karadžić" elementary school at Vranje, in the presence of the director of the main Dunav Insurance Company branch in Vranje, the educational advisor for the district, the representatives of the traffic police, the director of the "Vuk Karadžić" elementary school and its first-form pupils, directors of the district elementary schools and the local media representatives. Following the Vranje event, the special events were organized in: Leskovac, Kraljevo, Kragujevac, Užice, Kosovska Mitrovica, Novi Pazar, Kikinda, Ranilug, Zrenjanin, Pančevo, Valjevo, [abac, Loznica, Jagodina, Kruševac, Čačak, Sombor, Požarevac, Zaječar, Niš, Novi Sad. By the end of the month, the gadgets had been distributed to all the first-form pupils in Serbia.

Especialy important effect of the campaign is that the gadgets were warmly received by those they were meant for, the little first-form pupils. They promised they would always take the gadgets with them and try to observe the traffic regulations in order that they should be as safe as possible.

4. “Firefly” campaign planning methodology

Analysing the process of timetabling the distribution on the entire territory of the Republic of Serbia the authors of the paper have come to a conclusion that there is a need, and also an opportunity to improve the FIREFLY campaign by the optimization of the time schedule of the events. It is for that purpose that the planning methodology to carry out this socially responsible campaign was developed and it consists of three phases:

1. Defining the scope of the campaign;
2. Coordinating the participants in the campaign;
3. Time schedule of the campaign.

Each of the methodology phases is characterised by a different nature of the problem that is being solved within it and the people engaged in solving the problem or can affect its resolution.

4.1. Defining the scope of the campaign

A strategic decision is made in the first phase on the time period and the cities covered by the campaign. This decision depends on the corporate goals that are to be achieved by the campaign, therefore the major role in this phase belongs to the top management of the company.

When making a decision on the time period in which the gadgets are to be distributed, we must bear in mind that the period has to be short enough so that all the first-form pupils should get the gadgets at approximately the same time, however, long enough so that the duration of the campaign is ensured and the desired effect is achieved. The ruling criterion in both cases is the communication effect of the campaign that is a requirement set already at the strategic level of decision making in the company. The duration may be set to a week (e.g., the week of the “firefly”) or some other time period.

Since the campaign can be carried out only on work days, a set D can be defined on the basis of the period determined and it will represent the set of work days in the time period of the campaign, i.e., the set of terms in which the campaign can be carried out.

The number of cities in which the campaign is conducted depends on the Company’s financial and organizational abilities. When this decision is made, it is possible to define a set of k cities: $A = \{A_1, A_2, \dots, A_k\}$.

4.2. Coordinating the participants in the campaign

In the second phase it is necessary to coordinate all the participants of the campaign in a given city, that is de-

fine the terms (days) in which they are all available. This phase is part of operations planning and the major impact upon the solution is made by the participants in the campaign in a given city themselves.

Formally speaking, coordinating can be described in the following way. The campaign is carried out in k cities ($i=1, \dots, k$) and there are m_i participants in each of them. Each of these participants is assigned a set D_{il} , $D_{il} \subset D$ ($i=1, \dots, k, l=1, \dots, m_i$) which represents the set of terms in which the participant is available. In order that the campaign should be organized in the i -city, it is necessary that all the m_i participants are coordinated, that is, it is necessary to find the set of terms in which they are all available. Formally, it is necessary that the set $D_i = \bigcap_{l=1}^{m_i} D_{il}$ should be defined.

The result of the second phase is the set D_i , $i=1, \dots, k$, which defines a set of terms in which the “firefly” distribution can be organized in the i -city ($i=1, \dots, k$).

4.3. Time schedule of the campaign

In the third phase it is necessary that a concrete time schedule be created in which two goals should be achieved: continuity and uniformity in the conduct of the campaign. We will proceed to describe the formal definition of the set goals.

4.3.1. Continuity of the campaign

The continual character of the campaign is reflected in the fact that the “firefly” are distributed in the cities in a relatively equal time intervals in order that the company be permanently present in the media, i.e., that it is reported on continually. Let n be a number of elements of the set D , that is, the number of work days in which the campaign can be conducted, and let r be the parameter that represents the desired time interval between two distributions. The continuity can be formally expressed by the requirement that the time interval between two distributions be at the most:

$$r = \begin{cases} \left\lfloor \frac{n-1}{k-1} \right\rfloor & \text{for } n > k \\ 0 & \text{for } n \leq k \end{cases} \quad (1)$$

On the basis of (1) a conclusion can be drawn that the distribution will be organized in an interval not longer than the largest integer (number) that is smaller or equal to $\frac{n-1}{k-1}$ in case the number of days planned to

conduct the campaign n is larger than the number of cities k , that is, each day (even more distributions in the same day) when n is smaller than k .

The first problem to be solved here is to determine a different time term for each of k cities, that is, determine the different elements of the sets of possible terms for the “firefly” distribution in each of the cities, D_i , $i=1,\dots,k$. This problem, known as the *system of distinct representatives* – SDR, [16] and [17] is defined in different ways. Here it will be defined in accordance with the concrete problem of defining the time schedule for the campaign. The SDR problem is modified by the requirement that, if possible, the difference between the representatives, or the time interval between two distributions be not more than r . This problem is analysed in [18], where it got its name, the *system of distinct representatives*.

In accordance with the above introduced notation, let y_i be the term (date) in which the FIREFLY campaign will be carried out in the i -city, $y_i \in D_i$, $i = 1, \dots, k$.

The condition of continuity can be written as follows:

$$|y_i - y_j| \geq r, \quad i, j = 1, \dots, k, \quad i \neq j \quad (2)$$

In order to model the continuity requirement, it is necessary that $k(k-1)$ be introduced by binary variables δ_{ij} , $i, j = 1, \dots, k$, $i \neq j$

$$\delta_{ij} = \begin{cases} 1 & \text{if } r \leq y_i - y_j \leq m \\ 0 & \text{if } -m \leq y_i - y_j \leq -r \end{cases}$$

where m is the value that is always higher than $y_i - y_j$. In the problem of “firefly” distribution, the parametre m has a real interpretation and means a maximum time interval between two distributions. If timetabling is done for all of the n days, the value of the parametre m is $n - 1$. This parametre, however, allows for defining the time schedule for a shorter period as well. If $m = q - 1$, $q < n$, then, in the observed period of n days, with the respective values of the parametres r and p (see the subtitle below) the timetable for the period of q days will be obtained.

Now the condition that the campaign should be carried out on a different day and in relatively equal time intervals can be written as follows:

$$y_i - y_j - m \cdot \delta_{ij} + r \cdot (1 - \delta_{ij}) \leq 0, \quad i, j = 1, \dots, k, \quad i \neq j, \quad (3)$$

$$y_i - y_j - r \cdot \delta_{ij} + m \cdot (1 - \delta_{ij}) \geq 0, \quad i, j = 1, \dots, k, \quad i \neq j, \quad (4)$$

Since the variable is the term (date) on which the campaign will be carried out in the i -city, it is possible to define the arrangement between certain cities. Thus, for example, the condition $y_3 \leq y_7$ means that the distri-

bution in the city number 7 cannot be arranged before the distribution in the city number 3 is completed.

4.3.2. Uniformity of the campaign

The uniformity is seen in approximately equal number of distributions per term (day) if the initial parametres are such that a number of distributions can (have to) be organized in one day. This goal is set because of the condition of a uniform arrangement of organizational capacities. Let n be the number of elements of the set D , and let p be the parametre that represents the desired number of distributions in one day. The uniformity can formally be expressed by the requirement that the number of distributions in one day should not exceed:

$$p = \left\lceil \frac{k}{n} \right\rceil. \quad (5)$$

On the basis of (5) a conclusion can be drawn that the largest number of “firefly” distributions in a city in one day can be scheduled in case the number of days n scheduled for the campaign is larger than the number of cities k , that is, in the largest number of p cities when the number of days n for the campaign is smaller than the number of cities k .

In order that the uniformity requirement should be modelled, it is necessary to introduce auxiliary binary variables x_{is} , $i = 1, \dots, k$, $s \in D$ [19]:

$$x_{is} = \begin{cases} 1 & \text{if distribution is organized} \\ & \text{in city } i \text{ on } s \text{-day} \\ 0 & \text{else} \end{cases}$$

The condition of uniformity can now be written as follows:

$$\sum_{s \in D} x_{is} = 1, \quad i = 1, \dots, k \quad (6)$$

$$\sum_{i=1}^k x_{is} \leq p, \quad s \in D \quad (7)$$

The condition (6) ensures that the distribution is effected exactly once in each city, while the condition (7) ensures that the campaign is carried out in a uniform way.

5. Timetabling model formulation

The term plan of the FIREFLY campaign is meant to achieve two goals, as mentioned above. The success in achieving these goals depends on the ratio between the number of days n scheduled for the campaign and the number of cities k , as well as on the available terms in the cities (D_i , $i=1,\dots,k$). The FIREFLY campaign, how-

ever, will be carried out even if it is not possible to achieve the goals entirely, and even if the conditions (3), (4) and (7) cannot be satisfied. Hence the problem of timetabling will be modelled by the mathematical model of weighted goal programming (WGP) [20].

Prior to formulating the model it is necessary that additional parameters be introduced. In modelling continuity and uniformity two types of variables were introduced: the integer that represents the term (date) when the campaign will be organized in the i -city, and that denotes whether the distribution is in the city i on the day s or not. The relation that connects these two variables is:

$$y_i - \sum_{s \in D} s \cdot x_{is} = 0, i = 1, \dots, k \quad (8)$$

In the campaign participants coordination phase, a set D_i is defined, the set of terms in which the “firefly” distribution can be organized in a i -city ($i=1, \dots, k$). On the basis of all D_i , the parameter a_{is} , $i = 1, \dots, k$, $s \in D$ can be defined as follows:

$$a_{is} = \begin{cases} 1 & \text{if distribution is organized} \\ & \text{in } i\text{-city on } s\text{-day} \\ 0 & \text{else} \end{cases}$$

Now the condition that the “firefly” distribution can be organized in each city only on a day when it is possible can be expressed by the condition:

$$\sum_{s \in D} a_{is} x_{is} = 1, i = 1, \dots, k \quad (9)$$

On the basis of the already introduced parameters, goals and conditions, the following WGP model is formulated:

$$\min z = \sum_{i=1}^k \sum_{j=1, j \neq i}^k w_{ij}^- d_{ij}^- + \sum_{i=1}^k \sum_{j=1, j \neq i}^k w_{ij}^+ d_{ij}^+ + \sum_{s \in D} v_s^+ d_s^+$$

p.o.

$$y_i - y_j - (n-1) \cdot \delta_{ij} + r \cdot (1 - \delta_{ij}) - d_{ij}^+ \leq 0, \\ i, j = 1, \dots, k, i \neq j$$

$$y_i - y_j - r \cdot \delta_{ij} + (n-1) \cdot (1 - \delta_{ij}) + d_{ij}^- \geq 0, \\ i, j = 1, \dots, k, i \neq j$$

$$\sum_{i=1}^k x_{is} - d_s^+ + d_s^- = p, s \in D \quad (21)$$

$$\sum_{s \in D} x_{is} = 1, i = 1, \dots, k$$

$$\sum_{s \in D} a_{is} x_{is} = 1, i = 1, \dots, k$$

$$y_i - \sum_{s \in D} s \cdot x_{is} = 0, i = 1, \dots, k$$

$$y_i \geq 0, i = 1, \dots, k$$

$$\delta_{ij} \in \{0, 1\}, i, j = 1, \dots, k, i \neq j$$

$$x_{is} \in \{0, 1\}, i = 1, \dots, k, s \in D$$

$$d_{ij}^+, d_{ij}^- \geq 0, i, j = 1, \dots, k, i \neq j, d_s^+, d_s^- \geq 0, s \in D$$

The function of the goal is the minimum deviation from the set goals (3), (4) and (7).

5.1. Optimization results

On the basis of the available data on the cities and the scope of the campaign, the plan was devised for the FIREFLY campaign to be carried out in ten cities in Serbia in 2010. September was the time period for the campaign and three possible scenarios were analysed:

1. Campaign is organized during the whole month;
2. Campaign is organized during the first two weeks in September;
3. Campaign is organized in the last two weeks in September.

We contacted all the participants in the campaign and found out that all of them, with the exception of heads of school directorates, are always available. Given that the limiting factor is that of the heads of school directorates availability in the cities in which the FIREFLY campaign will be organized, the data were collected and systematized. The data shown in Table 1 were obtained in direct contacts:

Table 1. Availability of heads of school directorates

City	Days in the week
Valjevo	Friday
Zajecar	Tuesday and Wednesday
Zrenjanin	Monday
Jagodina	Wednesday and Thursday
Zvecan	Friday
Kragujevac	Wednesday
Krusevac	Wednesday
Nis	Monday, Wednesday and
Novi Sad	Monday and Tuesday
Pozarevac	Wednesday and Thursday

On the basis of the heads' availability criterion ,a date calendar was devised for September, when the campaign is possible to be organized in the chosen cities. Table 2 presents the table of input parametres that contains 21 work days. All holidays were left out, and so was the 1st September since on that day only the central celebration is held.

Table 2

Day No.	Date	Valjevo	Zajecar	Zrenjanin	Jagodina	Zvecan	Kragujevac	Krusevac	Nis	Novi Sad	Požarevac
1	2/09				1						1
2	3/09	1				1			1		
3	6/09			1					1	1	
4	7/09	1								1	
5	8/09	1			1		1	1	1		1
6	9/09				1						1
7	10/09	1				1			1		
8	13/09			1					1	1	
9	14/09	1								1	
10	15/09	1			1		1	1	1		1
11	16/09				1						1
12	17/09	1				1			1		
13	20/09			1					1	1	
14	21/09	1								1	
15	22/09	1			1		1	1	1		1
16	23/09				1						1
17	24/09	1				1			1		
18	27/09			1					1	1	
19	28/09	1								1	
20	29/09	1			1		1	1	1		1
21	30/09				1						1

The optimum time periods for the SVITAC distribution in the cities, for all three scenarios (Table 3), were obtained by applying the mathematical model of goal programming described in this paper. The values in the Table do not present the dates in September, but the ordinal number of the work day in September.

Table 3. Timetable of FIREFLY distribution

	Scenario 1	Scenario 2	Scenario 3
Valjevo	17	2	12
Zajecar	9	4	19
Zrenjanin	13	3	13
Jagodina	1	1	21
Zvecan	7	7	17
Kragujevac	15	5	20
Krusevac	5	10	15
Vranje	3	8	18
Nis	19	9	14
Novi Sad	11	6	16
Požarevac	17	2	12

Figure 1 presents the timetable of the 1st scenario by which the “fireflies” are distributed throughout September:

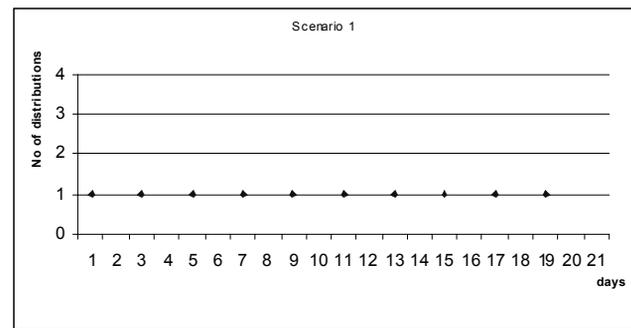


Figure 1. Solution to 1st scenario

Figure 2 presents the timetable of the 2nd and 3rd scenarios, the timetably by which the “fireflies” are distributed during the first (blue) or during the second (red) halves of September.

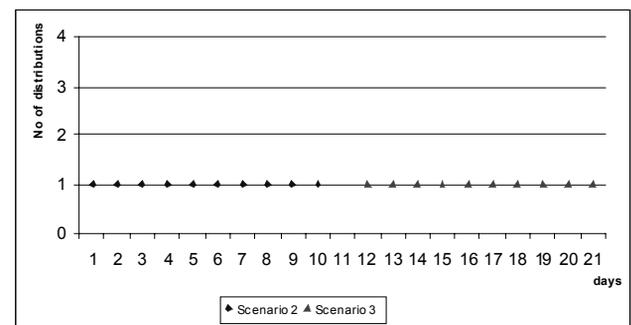


Figure 2. Solutions to 2nd and 3rd scenarios

Both goals are achieved by any of the three scenarios: the continuity and the uniformity of the campaign. The selection of the scenario to be implemented depends on the communication strategy, or on the identified primary target group of the public, the availability of the media and the coverage of a concrete event.

6. Conclusion

The paper described the methodology of planning the execution of a socially responsible campaign FIREFLY, with a multiple special event. The scope of the campaign is planned to be defined on a strategic level; the executive level is responsible for the coordination of the participants in the campaign, and the operational level is in charge of creating the timetable of the campaign.

The problem of timetabling is modelled by the mathematical model of goal programming which minimizes the deviation from the goal: the continuity and the uniformity of the campaign set for this particular campaign.

On the basis of the devised WGP model it is possible to simulate different scenarios for the execution of the FIREFLY campaign, and these refer to the scope of the campaign (the number of cities and the time period of the whole campaign). The possibility of the model implementation is illustrated by the plans of distribution defined for 2010.

The model defines the optimum time schedule for the given input data, however, the precondition for the success of the campaign is that the goals are qualitatively set in advance, which is not possible to include in the model itself. That would ensure not only the efficiency, but also the effectiveness of the campaign. The concrete effects are reflected in the timing of the campaign, that is, linking the beginning of the campaign with the concrete social situation, the need to specify communication goals for a particular city or region, etc.

In their future work the authors will experiment with different methods and methodologies in solving a given model and explore the possibility of the model implementation in a broader field of integrated marketing communication and management event.

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Measuring the Quality of Banking Services in Banks Operating in Libya

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The aim of the study is to measure the service quality of the banking system in Libya and to determine the importance of the service quality items. In addition, the study measures the relationship between the banking service quality and client's satisfaction. The sample of the study includes (325) questionnaires. The study concludes that understanding the client's expectations is very important in the provision of a better banking service quality as well as in achieving client's satisfaction. Furthermore, the measurement of service quality and the client's perception of the service are considered to be the main approach to the development and improvement of the banking service quality. In addition, the findings also show a significant relationship between the client's satisfaction and the service quality provided. Furthermore, the client's continuous dealing with banks and their loyalty depends mainly on the understanding of the provided service quality. In this paper we use the SERVQUAL model in order to measure the service quality that contributes to customer satisfaction and to his loyalty to a bank. Since there has been no studies dealin with this topic so far, this one will be very interesting and useful for the banking sector in Libya. The topic of this paper is a theoretical and practical analysis of measuring the service quality in the banking sector in Libya. Measuring the quality of banking services is one of the basic indicators of the bank's quality and it can contribute to the improvement of banking services. By using the various tools, advanced tools and modern technology in operations and marketing activities with regard to communications, marketing and information technology, service delivery and completion of marketing operations across multiple devices come to the forefront position of marketing banking services to the various parties through these means.

Introduction

During the past decade, the online service industry has witnessed tremendous growth, much of it spurred by the Internet revolution. Especially, the potential of the Web as a commercial medium is widely recognized and the growth in online service industries such as online banking has increased rapidly. In addition to the Internet companies, traditional organizations are investing huge amounts of money and effort into information systems to provide online services through the Web. There are many researchers in the world who have been interested in the topic of measuring the service quality. They have approached the topic from different angles bearing in mind the methods for measuring the quality of service, as well as the various relations between the bank employees and customers. All these contribute to the improvement of the service quality level which is meant to meet the customers' demands. The objective of this paper is to observe whether the service quality of banks in Libya is satisfactory or whether they need to improve it. This paper will be interesting for Libyan banks because it explains how to measure the service quality in the banking system. The measuring will improve their operations and attract more customers to their services. In this paper we use the SERVQUAL model and its five elements to show how the service quality can be measured. The measuring of service quality is contemporary in the world and

in our analysis we will follow the various activities in the contemporary trends in line with the current era and its variables. Intensifying competition and rapid deregulation have led many service and retail businesses to seek profitable ways to differentiate themselves. One strategy that has been related to success in these businesses is the delivery of high service quality and its measurement. This will be of great importance for the Libyan banking sector.

SERVQUAL model is used here as the optimum one for measuring the quality of services. The starting hypothesis was that SERVQUAL model can be adapted to measure the quality of service in the banking sector, using conventional and electronic channels. Also, the paper analyzes the hypotheses that the quality of services in the banking sector will affect the processes of providing services, consumer experience and the results of services provided, as well as that there is a difference in the level of banking services quality as perceived by consumers, depending on the age of the consumers and the number of years of bank's operations.

It is highlighted in the paper that SERVQUAL method describes the service quality as the discrepancy between consumers' expectations for a service offered and the consumers' perceptions of the service received, requiring respondents to answer questions about both their

expectations and their perceptions. For the purposes of the research, SERVQUAL model was used to assess the quality of banking services. The scale decomposes the notion of service quality into five constructs, as follows: tangibles - physical facilities, equipment, staff appearance, reliability - ability to perform service dependably and accurately, responsiveness - willingness to help and respond to customers' needs, assurance - ability of staff to inspire confidence and trust, empathy - the extent to which a caring individualized service is given.

Literature review

Firstly, in writing this study we used the literature written in Arabic. The first author that was quoted was Abu Moammar Fares who analysed the role of banking in investments in Palestine (2002). The next researcher was Al Jamal Ganam who researched into the consumers' perception of the quality of banking services in Jordan (1992).

The group of authors (Haddad, Shafiq, Mahfouz, Joda) did research about the impact of client motivation to stay loyal to commercial banks in Jordan (2003). Alhosun Mohamed Farid also examined the perceived quality of banking services - a field study to test the determinants and models used in the measurement (1994). A survey of bank customers about the services offered by banks operating on the territory of the Palestinian National Authority was studied by Nabil Kocaeli and this is also used in this study (1998). Also used in this paper is the study of Fallit Holud which deals with the impact of banking facilities on various sectors of economy - a study applied to banks operating in Palestine (2004).

The last study written in Arabic that was used was the case study of Nagy Mohal, where he examined the measuring of the banking services quality offered by commercial banks in Jordan (1998). This literature was mostly applied to Jordan and Palestine, but because the conditions of banking sector are very similar to the Libyan banking sector, the authors have found them relevant for this topic.

The literature that was also used in this study was the literature written by European and American authors. A reexamination and extension of measuring service quality was tested by J.J. Cronin and Taylor (1992) and therefore the authors found it very useful. An evaluation of SERVQUAL scale in a retailing setting was done in the USA by Finn and Lamb (1991). Another study about a service quality model and its marketing implications was done by C. Grönroos in 1984. The

study about the measuring of perceived service quality at the UAE commercial banks done by N. Jabnoun and H. Al-Tamimi (2002) was consulted when doing this research. The study about service quality determinants and the effectiveness in the real estate brokerage industry done by Johnson, L.L., Dotom, M.J. and Dunlop, B.J. (1988) was consulted at some points. One source was found in the paper written by Joseph, M., McClure, C. and Joseph, B. (1999) that dealt with the service quality in the banking sector. It described the impact of technology on service delivery. A comparison of customer expectations and perceptions was made by Kangis, P. and Voukelatos, V. (1997) and this can be directly applied to the banking sector in Libya. Some researchers from Singapore examined the measuring service quality in Singapore's retail banking. These researchers are Kwan and Lee (1994). Service quality perspectives and satisfaction in private banking was examined by Lassar, Manolis and Winsor in 2000. Customer' perceptions of service quality in financial institutions in the paper are noted as quite relevant, according to a research by Leblanc and Nguyen (1988). A serious research done by Lewis, R.C. and Booms, B.H. (1983) dealt with the market aspects of service quality. In order to deal with the service quality we need to understand it and to always keep improving it. This was pointed out by Parasuraman, A. and V. Zeithaml (2006). The same authors dealt with a conceptual model of service quality and its implications for future research (1985). Finally, quality attributes and choice behavior were analyzed by Richard M. D. and A. W. Allaway (1993).

Jednak S. and Kragulj D. (2010), in paper "Economy based on knowledge - base for economic growth and development", published in the Management journal, highlighted that economy development is a complex social process. By determining the impact factors on economy development and growth in different countries, they maintained that knowledge and experience can improve economy in other countries in the development process. Traditional determinants are work, capital and technology. Today, knowledge is pointed as an important factor of economy growth and development. The goal of the European Union countries is the development of new economy, based on knowledge, as well as of new technologies.

Malešević V. (2010), also published in Management journal, points out that the 21st century environment requires management teams to respond to the challenge in the management processes, the strategic management planning and the human resources management.

Modic D., Grivec M. (2009) analyzed e-trade, as a necessity. In this paper, published in the Management journal they claim that e-trade, as well as e-banking and e-marketing have to be a social responsibility.

Research Hypothesis

- 1) SERVQUAL model can be adapted to measure the quality of service in the banking sector, using conventional and electronic channels.
- 2) The quality of service in the banking sector will affect the processes of providing services, customer experience and the results of services provided.
- 3) There is a difference in the level of quality banking services as perceived by consumers, depending on the age and years of experience of the bank.

Methodology of research

The research sample consists of eighteen selected banks chosen on the basis of their status as community banks in Tripoli, Libya. The questionnaire was distributed in January 2011 through banks operating in the region of Tripoli, where data were collected and then discharged and analyzed. The study population consists of customers of commercial banks operating in Libya's (18) commercial banks, and included customers of commercial banks located in the Tripoli area only and did not include customers of commercial banks in the rest of the country. Each of the eighteen banks was asked to complete the banker's questionnaire, and return it directly to the researcher. Subsequently, the bank was asked to distribute those questionnaires to their customer. Normally, more important to the research is the number of customers and that eventually amounted to 325. The banks were not randomly selected, they were chosen because they had a number of customers of different backgrounds. The questionnaires were distributed to banks personally. Then, after the executives agreed to distribute them to their customers, they were shared among them. The executives saw the perspective of this research so they were willing to help. After some time we got the feedback from the banks. This feedback included the first filled questionnaires and after a certain period of time all 325 questionnaires were delivered to me. These questionnaires were used for the purpose of this research. The population of 325 customers was used, of different origin and status in the Libyan society. We believe that this contributes to the realistic impression that we can get from this research and that can be used to obtain the high quality of service in Libyan banks.

Result and Discussion.

The study is based on a set of assumptions which are aimed primarily to determine the impact of e-marketing on the quality of banking services in the commercial banks in Libya, as seen by members of the sample. The research that we have conducted dealt with the quality of service in the banking sector in Libya. The questionnaires were given to 325 customers and they answered different questions that proved the validity of the hypotheses that are put further on in the text. Various aspects of service quality in banks were taken into consideration and therefore this research will serve to help the improvement of SERVQUAL model in Libya. We measured the service quality by using 22 questions that showed the customer expectations and perceptions of service provided in banks.

H1: SERVQUAL model can be adapted to measure the quality of service in the banking sector, using conventional and electronic channels.

To verify the stability of the measurements coefficient alpha was used to indicate the degree of internal consistency between the contents of the scale in each of its dimensions. It was also used for specific expectations and the actual quality. The service table shows the results of the correlation of coefficient alpha in the dimension of the expectations and the perceptions. Table 1 shows that the degree of internal consistency of the contents of the first part of the list. The expectations of the clients are located in the acceptable range with the coefficient alpha of 0.71, while the degree of internal consistency of the actual performance is 0.74 .

Table 1
Correlation coefficient alpha

Quality factor	Expectations	Perceptions
Tangibles	0.79	0.77
Reliability	0.89	0.73
Responsiveness	0.68	0.71
Assurance	0.61	0.78
Empathy	0.60	0.74
Total	0.71	0.74

It is indicated that the existence of a relationship between all dimensions of the quality model is the most important indicator of validity. This is applicable when measuring the quality of banking services in the Libyan banking sector which will improve its business. This hypothesis will serve to obtain a better quality of banking

service in Libya which will immensely contribute to this sector.

H2: The quality of service in the banking sector will affect the processes of providing services, customer experience and the results of services provided.

Table 2

	choosing your current bank	Mean rank
1	Advertising	3.50
2	Location	3.81
3	recommendation of others	1.82
4	service charges or fees	1.73
5	service quality.	4.14
N		
N= 325		Kendall's w = .522 df = 4
		Chi-Square = 678.4 Asymp. Sig. = .000

Table 2 shows us that the value of Chi-Square is 678.4. It is statistically significant at the 0.000 level degree of freedom 4 and that confirms that the service quality influences the whole process of banking service in Libya. It has been found that the quality of services had the highest average level of 4.14. Therefore the researcher proves that the hypothesis is true and that the quality of

service has the impact on the process of banking service.

H3: There is a difference in the level of quality banking services as perceived by consumers, depending on the age and years of experience of the bank.

Table 3

AGES	N	MEAN RANKES				
		Tangibles	Reliability	Responsiveness	Assurance	Empathy
than21	21	162.05	190.14	207.50	143.88	157.90
21-34	123	160.70	164.90	168.23	164.93	161.03
35-49	92	163.00	157.80	161.13	166.27	166.80
50-64	77	168.94	163.14	149.11	163.01	165.92
65 t0 more	12	150.08	135.00	135.00	151.50	144.21
Chi-Square		.636	3.426	8.187	1.249	.849
df		4	4	4	4	4
Asymp. Sig.		.959	.489	.085	.870	.932

From the above table the results of the first part of the third hypothesis can be seen - that all the values of Ka 2 are not statistically significant at the 0.05 level, indicating that there was no difference in the provision of services to customers as regards their age in all dimensions

of the actual quality of services. The first part of this hypothesis has been rejected by the researcher because the opposite results have been proved. The research has shown that customers have the same treatment in banks and that it does not differ depending on age.

Table 4

years of banks	N	Mean Rank				
		P.Tangibles	P.Reliability	P.Responsiveness	P.Assurance	P.Empathy
1970-1979	139	196.55	190.32	193.96	204.54	203.96
1981-1989	13	191.35	169.81	171.35	199.73	226.69
1990-1999	39	175.82	163.73	146.40	150.29	128.27
2000-2009	134	121.71	133.78	134.91	120.04	124.44
Chi-Square		47.497		29.529	59.579	62.343
df		3	3	3	3	3
Asymp. Sig		.000	.000	.000	.000	.000

The second part of the third hypothesis takes into consideration the age and experience of the bank. Some customers prefer more experienced banks because they find them more reliable and confident. As it can be seen from the above table all the values of Ca 2 were statistically significant at the level of significance 0.000, which indicates the existence of differences between banks that have more years of experience especially when it comes to working on the level of service quality. The researcher agrees with the second part of the Hypothesis 3.

Recommendations

There is a need to focus on the strengthening of trust between the bank and its clients.

1. Listen to customers and receive their complaints and suggestions and speed resolution.
2. Pay attention to marketing, banking and explain the policies of the banks to customers.
3. Provide information on services offered by banks as well as customer training on the use of them.
4. Speed up the response to the wishes of customers and their expectations.
5. There is a need to do practical studies to identify the scale of understanding of customers about banking services.
6. There is a need to focus on speed and accuracy in

providing the service as well as to comply with the promise of being by the client as well as to ensure the absence of records relating to customer errors.

7. The banks need to focus on achieving the complete satisfaction of customers through the achievement of total customer satisfaction and also focus on the quality of banking service delivery and how to conform with or even exceed customer expectations.

8. Banks need to focus on staff training related directly to customers to ensure attention to both aspects of service performance or the final moments of truth during the interaction between the service provider bank and the client.

9. The government has to use this model in order to improve banking in Libya. This will contribute to better service in banks around the country.

10. As service quality influences the banking service in general, more efforts should be made to improve SERVQUAL.

11. The paper suggests that the Libyan government have to take and apply the banking service from abroad as this will reflect positively onto the Libyan banking sector.

Conclusion

This paper gives a theoretical and a practical approaches to improving the quality of banking services, as a base for developing e-banking practice, in accordance

with new trends on the financial markets. The aim of this paper was to analyse the banking services quality evaluation for the purpose of the development of e-banking in Libya. It is known that e-banking is one of the basic concepts of modern banking services and this approach improves the quality of banking.

In Libya, e-marketing and e-banking are new approaches which banks need to accept, according to banking changes in world markets. This paper presents a contribution to the development of these approaches in the banking sector in Libya. This approach should increase the efficiency of Libya's economy to make the quality of their products and services higher and their consumers more satisfied.

SERVQUAL model was used as the optimum for measuring the quality of services. The starting hypothesis was that SERVQUAL model can be adapted to measure the quality of service in the banking sector, using conventional and electronic channels. Also, the paper analyzed the hypotheses that the quality of services

in the banking sector will affect the processes of providing services, consumer experience and the results of services provided, as well as, that there is a difference in the level of the quality of banking services as perceived by consumers, depending on the age of consumers and the years of bank's practice.

It is highlighted in the paper that SERVQUAL method represents a service quality as the discrepancy between consumers' expectations for a service offered and the consumers' perceptions of the service received, requiring respondents to answer questions about both their expectations and their perceptions. For the purposes of the research, model SERVQUAL was used to assess the quality of banking services. The scale decomposes the notion of service quality into five constructs as follows: tangibles - physical facilities, equipment, staff appearance, reliability - ability to perform service dependably and accurately, responsiveness - willingness to help and respond to customer need, assurance - ability of staff to inspire confidence and trust, empathy - the extent to which a caring individualized service is given.

The research done in this paper confirmed the first hypothesis, SERVQUAL model can be adapted to measure the quality of service in the banking sector, using conventional and electronic channels. The results show that banks need to improve their tangibles, reliability, responsiveness, assurance and empathy as this will contribute to a better service quality. Also, the second hypothesis has been confirmed, the quality of service in the banking sector will affect the processes of providing services, customer experience and the results of services provided. The third hypothesis was: there is a difference in the level of quality banking services as perceived by consumers, depending on the age of consumers and the years of bank's practice. The first part of this hypothesis has been rejected by the research, because the opposite results have been proved. The research shows that consumers have the same treatment in banks and that it does not differ depending on age. The second part of the third hypothesis takes into consideration the age and experience of the bank. Some consumers prefer banks with more experience, because they find them more reliable and

confident. The second part of the third hypothesis has been confirmed.

According to the above results, it could be concluded that banks in Libya need to improve the quality of their services by focusing upon improving the quality of banking services, as base for developing e-banking.

According to world experience on financial markets, it is proved that consumers of banking services expect from banks a highly increased use of information and Internet technologies, and therefore e-banking will impact the improvement of the quality of services in the banking sector in Libya.

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Climate Changes and Green Information Technologies

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The control of climate changes is one of the greatest historical challenges facing humanity in the 21st century. All economy sectors need to contribute as much as possible, and clearly the information technologies (ITs) have a key role. ITs are recognized as important enablers of the low-carbon transition. They offer mostly untapped significant potential to mitigate our emissions, empower energy users and create completely new business opportunities. However, ITs have also a carbon footprint. Due to significance they could have and hazardous effects that they can cause, ITs are subject to international and national regulations. An increasing number of laws define the principles, establish standards, stipulate jurisdictions and prescribe penalties for those who violate the law. The entire network of regulations is being established in order to minimize environmental problems. Moreover, the Republic of Serbia is not that much behind and nowadays is increasingly included in the network.

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 [17, 18].

A growing awareness of the necessity to reverse the process of environmental degradation and move toward sustainable business practices currently appears [8]. In spite of a burgeoning list of ecological problems, a lot of people, including the leaders of the most influential organizations, think that environmental problems are not detached from their everyday business lives and behavior patterns.

Further, the fact is that 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 (e.g. the managers make business decisions in an environment characterized by a network infrastructure, both the hardware and the software used in communication) [13]. For instance, as organizations leverage their productivity with an ever increasing rate of information technology and system (IT/S) use, they often become part of the larger problem of environmental sustainability [13]. The use of IT/S is exploding, growing two times faster than the Gross World Product [21], and consuming larger fractions of business' energy costs. In most cases, more than half of this energy is wasted by inefficient technologies, poorly designed systems, or uninformed behaviors.

IT/S might have a detrimental influence on the environmental organizations' footprint [16, 18, 21]: IT/S have short product life spans (e.g., laptops 3–4 years; networks 5–7 years); their manufacture and disposal have resulted in toxic hotspots; and a large portion of organizations' electricity costs (and concomitant greenhouse gas emissions) due to IT energy use (e.g., office buildings 26%; data centers 95%) [13]. Thus, IT energy spending has important implication for the environment.

2. Environmental impact

Environmental sustainability is defined as “development that meets the needs and aspirations of the present without compromising the ability of future generations to meet their own needs” [26], and therefore, is linked to ongoing economic growth and development.

Although, several papers already discussed organizations' environmental impacts, the precise meanings of this construct often remains unclear and badly-defined [8]. Possible reason for this ambiguity is that perceptions of environmental impact “differ depending on one's view of the environment and the components of the environment that one values” [19]. In this paper, a definition of environmental impact that focuses solely on issues related to the natural environment, rather than the triple-bottom line that also includes financial and social impacts is adopted. Further, environmental impact is defined as the degree to which an organization's business processes, activities and operations positively or negatively affect the natural environment. Environmental impact is the consequence of the organization's actions in relation to the quality and cleanliness of air, water and soil and, more generally, to the short-term and long-term health of Planet Earth's global ecosystem.

3. Climate changes

Over the last several decades, evidence of human influences on climate change has become increasingly clear and compelling. There is indisputable evidence that human activities such as electricity production and transportation are adding to the concentrations of greenhouse gases that are already naturally present in the atmosphere. These heat-trapping gases are now at record-high levels in the atmosphere compared to the recent and distant past.

Warming of the climate system is well documented, evident from increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. The buildup of greenhouse gases in the atmosphere is very likely the cause of most of the recent observed increase in average temperatures, and contributes to other climate changes.

The majority of scientists today believe that climate change is caused by human-induced emission of greenhouse gases to the atmosphere. Greenhouse gases in the atmosphere absorb and reemit some of the outgoing energy radiated from the Earth's surface, causing that heat to be retained in the lower atmosphere. Some greenhouse gases remain in the atmosphere for decades or even centuries, and therefore can affect the Earth's energy balance over a long time period. Factors that influence Earth's energy balance can be quantified in terms of radioactive climate forcing. Positive radioactive forcing indicates warming (for example, by increasing incoming energy or decreasing the amount of energy that escapes to space), while negative forcing is associated with cooling. The most common greenhouse gas is carbon dioxide (CO₂) which is emitted as a result of consumption of fossil fuels in the energy sector. All sectors of society require energy to perform their function - thus contributing to climate changes.

The effect of climate changes is global warming that causes melting glaciers, rising sea-levels, floods and droughts, more extreme weather events and so on. Climate changes refer to any significant changes in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate changes might result from natural factors and processes or from human activities:

- **Human causes** include burning fossil fuels, cutting down forests, and developing land for farms, cities, and roads. These activities all release greenhouse gases into the atmosphere.

- **Natural causes** include changes in the Earth's orbit, the sun's intensity, the circulation of the ocean and the atmosphere, and volcanic activity.

The term "climate change" is often used interchangeably with the term global warming. Global warming refers to an average increase in the temperature of the atmosphere near the Earth's surface, which can contribute to changes in global climate patterns. However, rising temperatures are just one aspect of climate changes.

As greenhouse gases trap more energy in the Earth's atmosphere, average temperatures at the Earth's surface are expected to rise. However, because climate changes (both natural and human-driven) can shift the wind patterns and ocean currents that drive the world's climate system, some areas might experience more warming than others, and some might experience cooling. Changes in air temperature can, in turn, cause changes in sea surface temperature, precipitation patterns, and other aspects of climate.

At the current rate, the Earth's global average temperature is projected to rise from 1.6 to 2.7°C by 2100, and it will get even warmer after that. As the climate continues to warm, more changes are expected to occur, and many effects will become more pronounced over time. For example, heat waves are expected to become more common, severe, and longer lasting. Some storms are likely to become stronger and more frequent, increasing the chances of flooding and damage in coastal communities. Climate changes will affect different regions, ecosystems, and sectors of the economy in many ways, depending not only on the sensitivity of those systems to climate change, but also on their ability to adapt to risks and changing conditions. Throughout history, societies and ecosystems alike have shown remarkable capacity to respond to risks and adapt to different climates and environmental changes. Today, effects of climate change have already been observed, and the rate of warming has increased in recent decades.

For this reason, human-caused climate changes represent a serious challenge - one that could require new approaches and ways of thinking to ensure the continued health, welfare, and productivity of society and the natural environment.

Climate changes and global warming are the effects of unsustainable consumption patterns in an industrialized world. And most people are by now convinced that we need to solve the problem, to avoid severe consequences on the environment and on our livelihoods.

Stabilizing greenhouse gas emissions requires the transformation of patterns and practices of society into a low-carbon society. It is the solution that allows societies to develop and thrive based on sustainable and resource efficient principles, without negatively impacting the environment or causing further climate changes.

4. Responses to climate changes

The observed climate changes across the world force us to initiate responses in order to avoid nature disasters. People react at two levels - to mitigate the problem by reducing emissions of greenhouse gases, and by adapting to the problem, by making communities more resilient to the occurring changes. Mitigation and adaptation are both crucial. Neither adaptation nor mitigation alone can avoid all climate change impacts; however, they might complement each other and together significantly reduce the risks of climate changes.

4.1. Adaptation

Adapting to climate modulations is necessary for all society sectors in order to respond to changes that have already happened and also to prepare for the changes that will occur in the future. As already stated, there will be a great variety in how hard different geographical areas could be hit by climate changes - developing countries generally are in the centre of the worst changes.

A number of actions need to be taken, to prepare societies and sectors for following events. New structures, such as new infrastructure and early-warning systems – supported by new technologies and knowhow need to be established. Both technology transfer and knowledge dispersal, including education and capacity building, are required in order that indigenous people should be empowered to help themselves and their livelihoods.

4.2. Mitigation

The evidence suggests that with the current climate changes mitigation policies and related sustainable development practices, global greenhouse gas emissions will continue to grow in the next few decades. Continued greenhouse gas emissions at/above current levels will cause further warming and induce many more changes in the global climate during the 21st century that will possibly be a lot worse than the ones observed during the 20th century.

The urgent need to mitigate emissions of greenhouse gases is intensified by the fact that greenhouse gases stay in the atmosphere for hundreds of years. Therefore, global warming will continually increase in the future due to the time scales associated with the cli-

mate processes and feedbacks, even if greenhouse gas concentrations are stabilized. In order to stabilize the greenhouse gases concentration in the atmosphere, emissions need to peak and thereafter decline. The lower the stabilization level is, the quicker this peak and decline would need to occur.

Many impacts can be reduced, delayed or avoided by mitigation. However, mitigation efforts and investments initiated over the next two to three decades will determine the speed of global warming, in order to achieve lower stabilization levels. Delayed emission reductions significantly increase the risk of more severe climate change impacts. Technology will take us far in mitigation efforts, and will surely support stabilization of emissions towards 2020. Stabilization can be achieved by deployment of technologies portfolio that are either currently available or expected to be commercialized in coming decades, assuming that appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion, as well as addressing related barriers.

Yet, no single technology can provide all of the mitigation potential in any economy sector. The potential economic mitigation can only be achieved when adequate policies are in place and barriers removed. A wide variety of policies and instruments are available to governments due to create the incentives for mitigation action. But their applicability depends entirely on national circumstances and sector context.

5. The low carbon society and information technologies

In the low-carbon society, industrial processes have been optimized; energy production has been turned green (based on renewable energy) and consumption in general has been transformed to a more sustainable path. The low-carbon society is characterized by low consumption of fossil fuels - thus keeping greenhouse gas emissions from sectors at a low level. The low-carbon society is the first step to the zero-carbon society - where production and consumption are entirely based on renewable energy sources. Reaching the low-carbon society is a matter of changing production and consumption of energy to a more sustainable path. It is about changing the energy system away from fossil fuels to renewable energy sources as well as a matter of making energy use more efficient and saving energy in general. Changing the energy sector is vital to support green growth, cleaner development and creating new consumption patterns, as changing the energy production system will enable feed-back to all other sectors of

the economy that consumes energy - by feeding them with sustainable energy.

The low-carbon society is about integrating all aspects of the economy, from its manufacturing, agriculture, transportation and power generation etc. around technologies that produce energy and materials with little greenhouse gas emission - thereby forcing change in populations, buildings, machines and devices, which use those energies and materials. Low-carbon societies are not emission free, as there will still be a minimum of emissions for instance from livestock and food production that is based on nature and living animals - and therefore can never be completely free of emissions.

The change to a low-carbon and resource efficient economy is not going to be easy. There are no readily available one-step solutions or obvious choices that will take us there. Yet, IT plays an important role in the transformation stages due to its potential to further optimize processes and routines. Also, the IT sector will play a major role both in wider dispersal and use of renewable sources and in energy efficiency - and for this reason greening IT will be a solid base for the low-carbon society.

6. Defining green information technologies

The concept of Green IT consists of two main building blocks - "green" and "information technology". Information Technology refers to computer-based information and communication systems, particularly software applications and computer hardware. In our context "green" is in relation to the environmental problems due to climate changes and greenhouse effects. The "green" in Green IT refers to the environmentally sustainable application of Information Technologies. Therefore, Green IT describes a situation where Information Technologies support reductions of greenhouse outcomes.

Traditionally, Green IT discussions have been focusing on how to make the technology itself greener, e.g. reducing energy consumption. However, this paper mainly deals with the process of Greening IT, which is about using technology to green the society. Greening IT is based on the application of Green IT, but Greening IT is not only associated with the application of the technology, it is a much progressive process that educates and transforms our entire society.

The definition of Green IT is thus rather wide - firstly, it can be applied to situations where IT enables greenhouse gas emission reductions (Green IT) and second-

ly, to situations where IT enables structural modulations that lead to changes in broader societal patterns, which takes us closer to the low-carbon society and leads to further emission reductions (*Greening IT*). In this sense, Greening IT is used to explain the process of "Greening society with IT".

In contrast to harmful effects on the environment, "Green" IT can have positive impacts, with the potential to reduce global emissions by 15% [22]. Green IT refers to information technology that addresses environmental sustainability [21]. The effects of Green IT, which have the potential to be substantial, can be either direct - by reducing negative IT impacts on the environment - or indirect - using IT to support other business initiatives in reducing their negative environmental significance. The IT components of Green IT have been distinguished based on their focus and impact on the environment. Green IT, addressing energy consumption and waste associated with the use of hardware and software tends to have a direct and favourable impact. Examples include improving the energy efficiency of hardware and data centers, consolidating servers using virtualization software, and reducing waste associated with obsolete equipment [23, 1].

The IT industry has recognized the issues and identified a variety of consulting opportunities [6, 9, 11, 12, 14, 21], such as IBM's Green Sigma consulting practice [10]. Nevertheless, the gaps in actual practice still remain. In addition, very little data exists [1, 3, 16] and that is a reason why Green IT is suitable for further research.

7. International regulation

The environment abuse has led to accelerated activities of numerous international organizations such as the United Nations, OECD, EU, Council of Europe, the International Labor Organization, World Trade Organization, World Health Organization and many others. They form separate, specialized bodies and agencies, aimed to investigate monitor, analyze, warn and prepare the appropriate legislation governing environmental problems, defining rights, duties and responsibilities or sanction certain behaviors that degrade the environment. Thus, to date, for example, only the UN have over 15 different expert programs, working groups, bodies, agencies, specialized organizations [2], such as: the Global Programme on Globalization, Liberalization and Sustainable Human Development, United Nations Environment Programme and International Centre for Genetic Engineering and Biotechnology; Geographic Information Working Group; as well as The Working Group on

Environmental Monitoring and Assessment within the United Nations Economic Commission for Europe that was organized in Belgrade in 2007, as the Sixth Ministerial Conference “Environment in Europe” or the Division for Sustainable Development, Commission on Sustainable Development and the Environment Management Group. All these bodies are preparing a new United Nations Conference on Sustainable Development (Rio +20) in 2012. Recently, dozens of international acts (resolutions, recommendations, declarations), organized independently or in cooperation with other international organizations, world summits that have discussed the issues related to the endangerment and protection of the environment (e.g., together with OECD held in 2009. “Climate Conference”) are adopted. OECD is an international organization that has for long meticulously studied environmental issues and climate changes and their impact on the global, local and individual levels. It adopted over 350 different documents regulating various questions and solve many problems. Thus, in its organization in 2010, “Innovation, Jobs & Clean Growth” forum was held. During the Forum a special Green Growth Strategy is defined, preceded by a Declaration on Green Growth (adopted at the Meeting of the Council at Ministerial Level on 25 June 2009), as an effort to provide direction to overcome the world economic crisis through investment in Protection and restoration of green innovation (Eco - innovation) and implementation of green technologies. The act obligated a number of member states (and invited those who are not) to [4]:

- **intensify efforts** in implementing green growth strategies as part of crisis response;
- **encourage green investment** and sustainable management of natural resources. Thus, it was decided to make further efforts in the field of efficiency and effectiveness of climate policy mix, including market instruments, regulations and policies in order to change behaviour and encourage the involvement of private sector;
- **encourage national reforms and policies**, in order to avoid or eliminate those that are environmentally harmful and opposed to the green growth;
- **ensure coordination** of green growth measures of labour market policy and human capital formation as well as international cooperation of participants.

During the 2011 OECD already organized several meetings and conferences that directly or indirectly affected the information society, the low-carbon society, climate change and the use of Green IT [4]:

05-Jan	<i>Climate Policy and Technological Innovation and Transfer: An Overview of Trends and Recent Empirical Results</i>
03-Feb	<i>Fisheries and climate change: governments must plan for social and economic consequences</i>
11-Feb-	<i>Cities central to climate change response</i>
14-Apr-	<i>Cities and Carbon Market Finance</i>
19-Apr	<i>Cities and carbon markets: Press conference and roundtable event</i>
06-May	<i>The age of carbon is over. Renewable energies are the only viable source if we want to protect life, says Ángel Gurría, the 25th Anniversary of the Spanish Energy Club, Madrid</i>

European Union for many years tried to confront and counter the numerous agents which disrupt the environment. Till the major incident in the Italian town of Seveso that caused a different approach to the environment and the excesses of its violation, this struggle was not equal or efficient. Soon after, the first act of the Seveso Directive 82/501/EEC Original (“Seveso I” Council Directive of 24 June 1982 on the major-accident hazards of certain industrial activities) was adopted and initiated the entire explosion of activities [2].

Green information technologies, rapidly after the formation of awareness of their risk to the environment have become the subject of EU regulation. In fact, since 1960, EU pays special attention to “series of new policy initiatives to address further negative environmental and human health impacts of hazardous substances,” including the waste electrical and electronic equipment [19]. In 2002 it brings: EU WEEE and RoHS Directive (Directive 2002/96/EC on waste electrical and electronic equipment - WEEE, Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment - RoHS), and Waste Framework and the REACH directive [5]. The following amendments in 2003 and 2008, as regard implementing power conferred the Commission, Proposal and Directive for waste electrical and electronic equipment. In March 2011. Council of the European Union adopts Revised rules on recycling of electronic devices.

In addition to these key documents Commission adopted a series of decisions in which they act, such as: decision 2004/249/EC of 11 June 2004 concerning a

questionnaire for Member States reports on the implementation of Directive 2002/96/EC of the European Parliament and of the Council on waste electrical and electronic equipment; Decision 2005/369/EC of 3 May 2005 laying down rules for monitoring compliance of Member States and Establishing data formats for the purposes of Directive 2002/96/EC of the European Parliament and of the Council on waste electrical and electronic equipment (notified under document number C (2005) 1355); Decision 2004/312/EC and Council

Decision 2004/486/EC, as well as acts related to the accession of new Member States, provide for some derogations, limited in time, as concerns the targets set by Directive 2002/96/EC (WEEE), Regulation (EC) No. 282/2008 on recycled plastic materials and articles intended to come into contact with foods and amending (Regulation (EC) No. 2023/2006).

They are followed by studies, research, comparisons of situations in the Member States, such as: study for the simplification for RoHS/WEEE, whose aim is “...

identifying proposals to revise the Directive with a view to improving its cost effectiveness while maintaining the same level of environmental protection. The proposals need to make the legislation less burdensome, easier to apply and therefore more effective in achieving its goals and aspirations to accept the proposed solutions and extend to non-member countries (China, Japan, USA), that have a different approach to these problems. Actually, all measures are grouped into four groups and related to: Scope and Standards (clarify scope and careful monitoring); IPR (Ensure producer responsibility and common approach); harmonization (eup - eco-design, opening registers, the EU Centralized registration system, reporting, labeling and information, disassembly and recycling); competition (increased market surveillance, collective compliance schemes, waste trade) in order to minimize the adverse environmental impact of hazardous products and properly manage their waste [22]”.

Therefore, in the last decade, many international organizations initiated the generation of network norms, formulated principles, established standards to define concrete solutions to the growing problems and thus, enabled forming a basis for the international environmental law. It was the expected result of growing global environmental problems and their impacts. However, the development of international environmental law shows a tendency of parallel growth in the global and regional levels, so policies and the environmental protection are not just limited to pollution control at the local level, but have an overall global impact, that is very difficult to control. The global ecological balance every day becomes more and more prominent, requiring the application of appropriate instruments. Although the global pollution problem has worldwide scale, the primary responsibility to solve it is the duty of the developed countries [2].

In addition, many no-government organizations (NGOs) participate in the battle for a healthy environment and green development. Some of them just point to problems, while others are active in making decisions and solving the problems. Either active or passive their role is even more important if the forms of threats are more diverse and far-reaching.

National laws increasingly respond to environmental problems by making specific laws and regulations or by the adoption and ratification of international acts.

Common is that the problems of electronic waste and the impact of IT on climate and other changes in the environment have complex, multidisciplinary access

and aspects: Technologies and Market Developments, Environmental Impacts, Economic Impacts (Administrative Burden, Quality Costs); Social Impacts etc.

8. The republic of Serbia – possible solutions

In Republic of Serbia the importance of environmental protection has been confirmed in the Constitution and defined in the fundamental human rights, the article 74: “everyone has the right to a healthy environment.” In addition, the Constitution guarantees to citizens full data about the state of the environment. On the other hand, it is determined that everyone, especially the Republic of Serbia and autonomous regions, are responsible for environmental protection. Finally, the Constitution establishes the obligation of all citizens to preserve and enhance the environment.

Furthermore, legal framework of environmental protection in the Republic of Serbia is mostly based on the laws (e.g. Environmental Protection Law, Environmental Law, Law on Strategic Environmental Impact Assessment, Law on Integrated Prevention and Control of Environmental Pollution). With these legislations, the current frame become sub-laws and other regulations that are enacted to enforce these laws.

In order to join the European Union, Serbia has for several years managed the process of harmonization of the national law with the European law, and among the important areas are environment and its protection. The table of compliance, compiled by the Office of European Integration of Serbia, in accordance with Article 111 of the Stabilization and Association Agreement, expresses the country’s commitment to cooperation with other countries in the field of the environment in effort to stop its degradation. National Program for EU integration and sustainable development strategy is defined to be one of national priorities “to protect and promote the rational use of natural resources.”

The problem of waste management, as well as hazardous electrical and electronic, is regulated by special law and the small number of under-laws. Adopting the Waste Management Law in 2009 and changes in the 2010 provided the integrated, efficient and systematic waste management in accordance with European principles. In Article 1 of the Act are defined: “the types and classifications of waste, waste management planning, waste management entities, the responsibilities and obligations in waste management, waste manage-

ment organization, management of specific waste streams, and conditions permitting, cross-border movement of waste reporting Waste and databases; financing of waste management, supervision, and other issues of importance for waste management". All are identified as an activity of general interest. The management practice of special types of waste and liabilities of entities with their handlers are next. Further regulation is anticipated with detailed by-laws. Still missing is special treatment of electrical and electronic waste, as well as strategy for the development of Green IT.

The Strategy of Information Society in the Republic of Serbia, adopted in 2005, in key strategic issues have not defined the further development of these technologies and established a low-carbon society. This failure has a significantly negative effect on other regulations and their implementation.

However, the biggest problem is not legislation, but organizational and other measures to implement it in the regulation of the current situation and prevention of future risks, as well as defining the responsibilities of the division, building capacity, ensuring financial and other resources and tools [2].

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Certification of Project Managers Based on IPMA and PMI Models Through Conforming to ISO 17024:2003¹

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The paper presents an analysis of the certification of project managers based on IPMA and PMI models, with special emphasis on their coconformity to the ISO 17024:2003 standard.

1. Introduction

An increasing number of companies finds that a significant portion of their business operations is conducted implementing the project approach, hence the importance of engaging professionals competent in this field. A specific discipline that comprises management of varied aspects of a project, regardless of whether it is implemented in economic or non-economic industry, is project management. The project management approach in business has been present for several years so far and according to [6] it is no longer considered to be merely an approach in planning and monitoring the execution of a project, but also a means to achieve strategic goals of a company in a business environment. Its importance is further highlighted by the fact that the first organizations in the world were established as early as the 1970s, to gather together the professionals from the field of project management and to contribute to the development of the field on both the national and the global levels, via numerous initiatives, meetings, knowledge and experience exchange.

Some world renowned organizations that did a lot in the field of project management development are the following: IPMA – *International Project Management Association*, PMI – *Project Management Institute*, APM – *Association for Project Management*. They went a step further by developing the certification programs for project managers, intending to offer the individual managers an opportunity to verify their existing and newly acquired knowledge, affirm their competence as project managers and become engaged on the on-going and the future projects worldwide.

The project management organizations, both international and national ones, are conceived in such a manner that they welcome individuals and organizations that employ the project approach in their operations, organize congresses, symposia, meetings, on which oc-

casions the participants will share and exchange their knowledge and experience. In the project managers certification programs, in which these organizations are also involved, individuals get an opportunity to affirm their competence in a certain segment of project management.

Given that projects today are actually large enterprises that are not executed on only one location, under the direct supervision of the project manager but are rather conducted from a distance, both temporal and geographical; that is, virtually, it will be an advantage if the project manager or a member of the team have a formal certification of their competence. According to the SRPS ISO 10006:2007 standard, “project organization is to be supplied with complete staff” (item 5.2.4) since “the quality and performance of the project depend on the staff that participate in it” (item 6.2.1)

In this paper we will draw attention on a substantial activity in the field of organization and activities of the project organizations themselves, as well as on the organization and conduct of their programs for certification of project managers; this is the activity of making the organization and the certification programs comply with the requirements of relevant international standards. In case of this type of organizations these are primarily the ISO 9001:2008, Quality Management Systems – Requirements and ISO 17024:2003, Conformity Assessment – General requirements for bodies operating certification of staff.

2. Implementation of project management project

The implementation of project management concept allows for the company management to efficiently execute the projects that comply with its strategic goals. Managing the project execution, the manager deals with the key factors, manages the total time span re-

¹The paper presents the findings of the research on the project of Basic research, register number 179081, financed by the Serbian Ministry of Education and Science

quired to complete the project, the financial assets and other resources. All these factors have to be planned and controlled in order that the project should be completed efficiently. Managers are daily faced with various problems and obstacles; in order that they should do their job more efficiently and complete the projects within the planned time, with planned costs and quality, the organizations are established to aid them.

Some of the organizations and areas that need to implement the project approach and engage project managers are as follows: construction firms, engineering and project organizations, ministries (project management units), marketing agencies, consulting firms, research organizations, etc. An important segment in each of these areas, calling for attention, is the project quality management. There are two aspects of its implementation, one dealing with the project processes, and the other, concerned with the project product. In case either of the aspects fails to be accomplished, it can affect the product of the project and its quality, the satisfaction of the project results users and of other stakeholders, as well as the project organization itself.

According to [9], achieving quality goals is the responsibility of the management, and demands commitment to achieving the goals concerning quality that are set on each of the levels within the organizations involved in the project. The project manager combines his knowledge, skills, personal traits and attitudes to focus upon the project goals accomplishment. According to [1], his competence in this context is viewed as the ability to conduct the activities in the project that will lead to a desired result based on the standards adopted. As a discipline, project management is developing steadily and fast, it connects with other management disciplines producing new trends. The project management concept whose potentials of implementation are high and whose advantages are many, is a virtual project management. Projects are managed from a distance, either geographical or temporal, or both, the members are geographically dispersed and communicate via modern information and communication devices. The advantages of the virtual project management are the following: faster communications, hence a more efficient work of project teams, cost reduction in using space, travel, etc., and higher productivity at work. In forming such a team it is important that the selection of members be good; a further advantage is that the project manager or a team member has obtained a formal certification of his/her competence in the form of a valid, internationally recognized certificate.

3. Certification of project managers

In order that the organizations such as IPMA or PMI, or their accreditation bodies as national associations, should conduct their programs of project manager certification in an efficient manner, they undergo a process of adjusting their organization, the manner in which they work and the requirements themselves to the requirements of the relevant international standards on the basis of which the organizations can later be certified or can accredit their certification bodies. Simultaneously, the quality of the program is affirmed and a higher credibility is awarded to the holders of the certificates, together with a greater trust the organizations that employ them feel about the importance of the certificate.

According to [4], the organizations of this type certify the implemented system of quality management in the organization on the basis of ISO 9001:2008 Quality Management Systems – Requirements, whereas a certification body is accredited according to ISO 17024:2003 Conformity Assessment – General Requirements for certification bodies operating certification of staff. According to the classification of standards in the field of CASCO – on individual standards for conformity assessment, ISO 17024:2003 refers to bodies operating certification concerning staff. The standard was devised by the ISO/CASCO committee for conformity assessment, and developed by the Committee for standards in the field of quality management system KS A176. In this country, the standard is published as SRPS ISO/IEC 17024:2005 Conformity Assessment – General requirements for bodies operating certification of persons (ISO/IEC 17024:2003 – *Conformity Assessment – General requirements for bodies operating certification of persons*). As quoted in [4], ISO 9001:2008 and ISO 17024:2003 are compatible standards, where the implementation of their requirements enhances the quality of the certification program elements.

The certificate serves to confirm that the candidate has achieved a certain level of knowledge, experience and skill to perform his job, in accordance with the requirements of respective standards and the ethics of a given profession. Depending on the certification program, certificates are valid for a certain period of time (e.g., five years). Upon the expiry of this period, the program offers the project managers the opportunity to undergo a recertification procedure to extend the validity of their certificates, where they are expected to submit the documents proving that in the previous period they have implemented the acquired knowl-

edge, improved their knowledge, managed projects and that they desire to work and improve further in their respective fields.

The certification process proves to all parties that the candidate has achieved and that he/she further develops an acceptable level of professional knowledge, skills and competencies, where the certification body is the party that verifies the candidate's knowledge and achievement. The benefit of certification is assumed to be manifold. For the project personnel, it is an internationally recognized certificate of qualification and competence in project management; for the organizations providing the project management services it is the proof that their employees are professionally competent, whereas for the clients it is a higher confidence that they will get a quality service. Competence can also be viewed as an evident ability to implement knowledge and skills, while according to [2], the project manager's competence has three dimensions: knowledge, personality and performance.

4. IPMA association

International Project Management Association – IPMA is an international project management association seated in Zürich, established in 1965. IPMA includes more than 50 national project management associations worldwide, whose objectives are development, training, cooperation and promotion in the field of project management. One of its full members is YUPMA – Project Management Association of Serbia, which includes the certification body YUPMA Cert whose purpose is to establish, conduct, improve and maintain the project manager certification program in this country, on the basis of the IPMA model.

4.1. Certification system and basic documents

Over the years, IPMA has developed a leading world certification program and had an important role in improving and development of the project management field. As quoted in [5], the IPMA Council confirmed in Ljubljana, 14th June, 1998 that a four level IPMA certification system was established, previously approved of on 28th February the same year, on Bled. It is then that the certification bodies of the associations-members of IPMA commenced their certification programs. IPMA certifies project and program managers, awards successful project teams and individual and issues numerous publications in the fields of project management.

IPMA has developed a certification program where, in order to acquire the IPMA certificate, the candidates are expected to show a required level of knowledge, un-

derstanding and practical experience in the field of project management. The certification system according to the IPMA model is based on competence assessment (technical, behavioural and contextual), making use of two documents as a basis: one is the *IPMA Certification Regulations and Guidelines* – ICRG, and the other is the *IPMA Competence Baseline* – ICB.

These documents are used by authorised national member associations of IPMA (*Member Association – MAs*) and certification bodies (*Certification Bodies – CBs*), engaged in establishing and managing the certification program on four levels. The purpose of the ICRG document is to define the policy, the structure, the procedures and the practical execution of certification on four levels, giving not only the guidelines for the certification of individuals, but also for forming and validation of certification bodies.

The ICB document presents a set of knowledge and experiences expected from project, program and portfolio managers. It contains basic terms, the presentation of management skills, functions and processes that are part of good practice of project management, but also the knowledge and experiences of experts that can be implemented in a variety of situations. The candidates also use this material in preparing for the examinations. National associations and their certification bodies are authorised by IPMA to translate and use these documents titled *National Certification Regulations and Guidelines* – NCRG and *National Competence Baseline* – NCB, for the purpose of forming the bodies and the design, implementation and maintenance of the programs of project manager certification in their respective countries.

The implementation of the program of project manager certification by the certification bodies and within the national associations – members of IPMA has to conform to the IPMA policy, procedures, practice and requirements of the internationally recognized ISO 17024:2003 standard. These standards are accepted as adequate, the standards that can improve the quality of the process. The quality management system treats the certification body as a system whose elements: organizational structure, rules, processes, documents, are process-oriented and interrelated, so that all the certification activities can be conducted and controlled at any moment. The activities have to be internally and externally comprehensible and conducted to the purpose of maintaining a certain quality level and continual improvement.

According to [4], the quality management system in the certification body is documented within the *Quality*

Management Manual. The documents of the certification body describe the organization, procedures and forms, all in accordance with the ISO/IEC 17024:2003 standard. As stated in the ICRG document, the certification and recertification processes are to conform to the principles of this standard. As stated in [5], it is IPMA's recommendation that each certification body has a management system accredited by a national institute that should be a member of the *European Accreditation* and the *International Accreditation Forum*.

The implementation of ISO/IEC 17024:2003 standard requirements may be a solid basis for the establishment of certification bodies and project manager certification schemes. The standard specifies the requirements for the body operating in certification of persons, including the development and maintenance of the schemes for certification of persons, setting specific requirements that ensure that the certification bodies perform the certification work in a consistent, comparable and reliable manner. The requirements in this international standard should be deemed as general requirements for the bodies operating the certification of persons.

In order that the certification process should commence in a certain country, it is necessary that a certification body be established, that First Assessors should be appointed and that adjustment of ICRG and ICB to NCRG and NCB be effected. As quoted in [4], the national first assessors have a mentor, an experienced assessor from the already existing certification body. Item 5.2.1. of the ISO 17024:2003 standard stipulates the general requirements for assessors:

- They should be knowledgeable of the respective certification scheme;
- They should have a comprehensive knowledge of the respective examination methods and exam documents;
- They should be competent in the field in which the examination is conducted;
- They should be capable of communicating in the exam language, both orally and in writing;
- They should be free of any interests so that they should be capable of making impartial and non-discriminatory decisions (assessments). [4] [8]

Additional requirements for the assessors defined by IPMA, stipulated in [4] are as follows:

- They should hold one of IPMA certificates at the moment of engagement (except the first assessor);

- They should be nominated by their assessors;
- They continually work on their professional development;
- They undergo a certain training.

The elements and requirements of the ISO 17024:2003 standard are implemented by IPMA in the ICRG document, however with some modifications given below:

- 1) Instead of the term "examination" (item 3.9. in ISO 17024:2003), the term "assessment" is used, and instead of the term "examiner" (item 3.10. in ISO 17024:2003) the term "assessor" is used. [4] [8]
- 2) According to [8], item 4.2.3. is defined as follows: „The certification body is formed by the Council on Certification, liable for the development and maintenance of the certification scheme for any type of certification. It is the obligation of the Council on Certification to represent the interests of all the parties involved in the certification scheme, justly and on equal basis, without giving preference to special interests of any party. Where the certification scheme is developed by other organizations, other than the certification body, each of such development agents is obliged to comply to the same principles“. The modification of this item, according to [4], is in that the Council on Certification offers recommendations, rather than takes responsibility for the development and maintenance of the certification scheme.
- 3) In [8], item 4.2.5. is defined in such a manner that: "the Certification body is not allowed to offer nor conduct any training, nor aid others in preparation of such services, unless it proves that such a training is independent of assessment and certification of persons, in order that it should not violate the confidentiality and impartiality of its certification". According to the modification of this item given in [4], the certification body should not be in a position to offer nor provide training, nor aid others in the preparation of such services.
- 4) Item 4.3.5. is, according to [8], defined as follows: "Excessive financial or other constraining conditions, such as membership in the association or a group, shall not be a barrier to certification. A successful completion of the training course may be a requirement of a certification scheme, however, the recognition/approval of training courses by the certification body shall not endanger the impartiality nor reduce the need for assessment of requirements for certification". The modification of this

item within [4] is that the certification body should not insist on a successful completion of any training as a condition for the certification of the candidate.

- 5) In item 4.5. regarding the possibility of subcontracting, i.e., hiring an external body or individual for certain segments of work in the certification process (e.g., examination), stated in [8], the modification stated in [4] is about the requirement that certification bodies retain full control over all the core activities concerning certification.

There are some further adjustments made by IPMA regarding the implementation of the ISO 17024:2003 standard requirements, and given in the ICRG document. They are:

- The assessment of the candidate is to be performed by the certification body on the basis of information collected exclusively during the certification process.
- The assessor does not participate in the preparation or training of the candidate undergoing the certification process.
- The candidate that completes the certification process successfully is awarded a certificate and is entered into the IPMA Registry of certificate holders.
- The validity of certificates is 5 years, upon which period it is necessary that the recertification process for the same level, or the certification process for a new level are commenced.

The validation and revalidation of certification bodies is the responsibility of the *Certification Validation Management Board*. The purpose is to certify that the validation process complies with the IPMA regulations, that the ICRG and ICB documents are implemented correctly and to ensure that the quality level remains constant. According to [4], the validation process is divided into: the first (initial) validation, the periodical tests and the revalidation. In case the certification body is accredited in accordance to the ISO 17024:2003 standard, the periodical tests are not necessary.

4.2. Certification levels of the IPMA program

The IPMA certification programme has four levels (*a four-level-certification – 4-L-C*) and is devised as a continuous process of project manager competence development. Each of the four presented levels comprises and verifies an adequate education of the candidate and his/her competence (Figure 1).



Figure 1. *Competence levels in the IPMA model*

- **IPMA level A[®]** – *Certified Projects Director* shall be able to manage a complex portfolio of projects or program.
- **IPMA level B[®]** – *Certified Senior Project Manager* shall be able to manage complex projects.
- **IPMA level C[®]** – *Certified Project Manager* shall be able to manage projects with limited complexity.
- **IPMA level D[®]** – *Certified Project Manager Associate* shall be able to apply the knowledge in project management as member of the team in a project under way.

The validity period of the certificate for each of the four levels is limited to 5 years, upon which time it is necessary that the validity of the certificate be renewed through a recertification process. The certification and the recertification processes are conducted in the English language, as well as in the mother tongue of national associations, members of IPMA which operate the certification and the recertification processes in collaboration with the IPMA association.

According to [6], by the end of 2009, more than 110,000 certificates following the IPMA model were issued to project managers and assistants all over the world, and the number of certified candidates planned for 2010 is presented per levels in Figure 2.

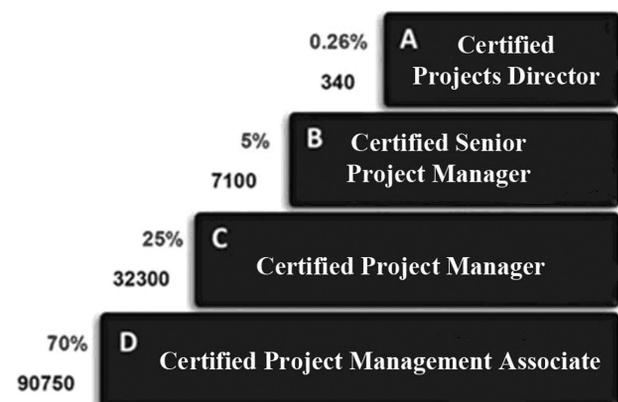


Figure 2. *Number of IPMA certificates planned by the end of 2010, per levels [16]*

As quoted above, the certification body YUPMA Cert operates within the Serbian Project Management Association – YUPMA and conducts the program of international certification of project managers on the original program and under the contract with IPMA. This body is the only authorised body to issue official project management certificates on the IPMA model in this country. The certificate the candidate is issued upon a successful completion of the program is fully valid and fully correspondent in all the countries members of IPMA, and is recognized and accepted in those countries that are not direct signatories of this agreement.

5. PMI organization

The *Project Management Institute* – PMI is an organization established in the U.S.A. in 1969 with the aim to proactively develop the practice and the profession of project management, working towards ensuring that organizations adopt and implement the project management concept and succeed in achieving their goals. At the moment, PMI has around 420,000 members and certified individuals.

Since 1984, the PMI organization has been engaged in the development and implementation of the project manager certification program, for the purpose of improving the project manager profession and recognizing the achievements of the professionals in this area. The first certification program commenced in 1984 was for a PMP® – *Project Management Professional*; today, approximately 370,000 professionals in this field are the holders of this certificate. Certificate holders need not be PMI members.

5.1. Certification on the PMI model – PMI certificates for project managers

As an international organization with more than 40 years of experience in supporting the project management profession, PMI offers an opportunity to individuals educated and experienced in this field to acquire an internationally recognized certificate of their competence. The *family of credentials* consists of:

- Certified Associate in Project Management – CAPM®
- Scheduling Professional – PMI-SP®
- PMI Risk Management Professional – PMI-RPM®
- Project Management Professional – PMP®
- Program Management Professional – PgMP®

The PMI certificates certify a person's skill and commitment in doing the work in the field of project management. In order that the candidate be issued a certificate, he/she is expected to meet certain educational and experience-related requirements set by PMI, so that he/she can implement the knowledge in the field of project management to answer the examination questions and offer adequate response to certain situations and scenarios. To revalidate the CAPM® certificate, the candidate is expected to pass the exam to extend the certificate validity upon its expiry after a five-year period, whereas to revalidate the other PMI certificates the candidate is expected to constantly express his/her professional commitment to the project management field by satisfying the *Continuing Certification Requirements* – CCR program.

PMI also took into consideration the need to adjust the manner of work to the requirements of international standards, therefore the PMI certification program for PMP® – *Project Management Professional* was accredited in 2006, following the ANSI/ISO/IEC 17024:2003 standard requirements. Thus PMI became the world's first project management organization whose one program is accredited in conformity to the requirements of this standard. As maintained in [15], the accreditation was performed by the *American National Standard Institute* – ANSI, whereas the *PMI's Certification Program Department* had already certified their own quality management system implemented in conformity with the requirements of the ISO 9001:2000 standard. This fact is further corroborated by the statement of Roy Swift, the Program Director for Personnel Certifier Accreditation of the American National Standards Institute, quoted in [15]: "It has become evident on an international level that it is necessary that certification programs of persons should be accredited since it is services, rather than products, that contribute to the global economy". According to [13], ANSI is an official representative of the U.S.A. in the ISO and also a member of the *International Accreditation Forum* – IAF.

The certification programs accredited in conformity to the requirements of these standards contribute to the affirmation of quality in the PMP programs development and management and, naturally, boost the credibility of the holders of these certificates and the confidence of the organizations that hire them as regards the importance of the PMP certificate. Moreover, they verify the fact that a certain policy is implemented to ensure that all candidates will be treated as equal, that the examination is consistent and fair and that quality improvement is especially taken care of.

The PMP® program was introduced in 1984 with the aim to identify the persons that are capable of implementing the knowledge of project management in practice, of leading and directing the project team and accomplish the project task with constraints in the schedule, in the budget and in the resources. The candidates seeking the PMP® certificate are expected to be:

- responsible for all the project aspects during the project's life-cycle;
- able to coordinate the operations of multi-functional teams engaged in the project execution;
- able to demonstrate the necessary knowledge and experience in the implementation of certain methodologies in project management.

The PMP® holders thus earn a large number of benefits:

- the PMP® holder's reputation is higher both in their organizations and in the global project management community;
- the organizations that employ the PMP® holder can thus make use of the PMP program accreditation on ISO 17024:2003 requirements as an argument that makes that person more qualified and more competent and capable;
- it is ensured that the PMP® holder will be recognized within the global business community. [14]

The interest in acquiring the PMP® certificate is increasing worldwide in the last years, and this is further proved by the facts on the number of PMP® holder presented in Figure 3. It is clear that, since this type of certification was introduced in 1984, the number of persons that recognize the importance of being a PMP® holder constantly increases. This means that the advantages of this certificate in this profession is globally recognized.

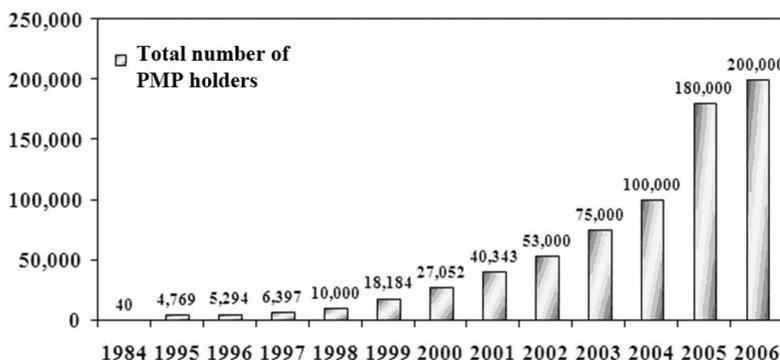


Figure 3. The trend of interest in PMP® certificates [7]

According to the PMI research in 2007 concerning the income of project managers, PMP® holders, in the U.S.A. and the differences in earnings as regards being or not being a PMP® holder, Figure 4 shows that the difference is a significant one.

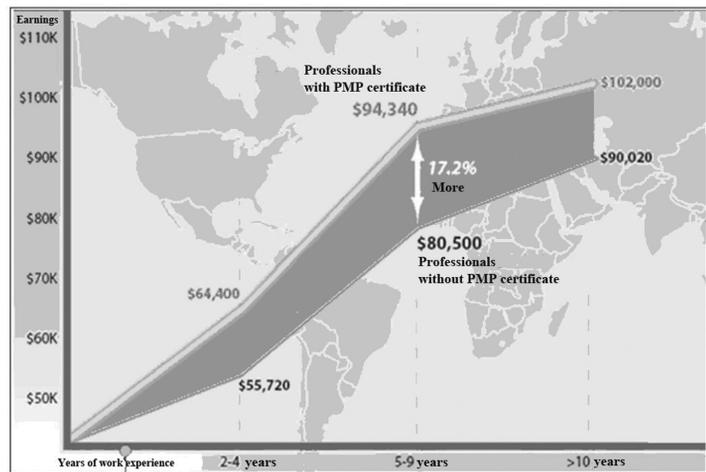


Figure 4. Difference in earnings of project managers, PMP® holders and non-PMP® holders in USA, PMI survey, 2007 [7]

Reaccreditation after every 5 years is an imperative and so is the obligation to maintain the certification program quality in order that the credibility of professional certificates should be preserved. According to [15], two more PMI programs will be included into the accreditation process following the ISO 17024:2003 in the next cycle: Certified Associate in Project Management – CAPM® and Program Management Professional – PgMP®.

6. Conclusion

The conduct of the project manager certification programs by authorised associations worldwide helps persons verify their existing and newly acquired knowledge, affirm their competence as project managers and contribute to the development of the profession. The project today is increasingly an enterprise that is not executed on only one location, under the direct supervision of the project manager and the team, but is rather managed from a temporal and geographical distance, i.e., virtually. Managing such projects requires that virtual teams should be formed, those that will plan, coordinate, supervise the execution from a distance, therefore it is an advantage if a project manager or a team member has a formal certificate of his/her competence, since it contributes to its recognition.

A noteworthy contribution in the development of the project management field and the project manager profession in the last decades has been the work of the international organizations IPMA and PMI. Not only do they initiate things, organize meetings, programs and other forms of improvement, exchange of knowledge and experience, but they have also launched the project manager certification programs, to be followed by the associations members and their certification bodies worldwide. In order that the certification program be performed and that the candidates get a valid certificate, these international project management organizations recommend that the associations and their certification bodies, as well as the certification programs should be organized in conformity with the requirements and principles of the relevant international standards. In case of associations and their certification bodies that perform the project manager certification programs, the quality management system certification is performed in accordance with the requirements of the ISO 9001:2008 standard – Quality Management Systems – Requirements, whereas the accreditation of the certification bodies is based on the ISO 17024:2003 – Conformity Assessment – General Requirements for Certification bodies operating the certification of personnel.

The paper presents the elements of the project manager certification programs on the basis of IPMA and PMI models, especially highlighting the segments where the requirements of the ISO 17024:2003 standard are implemented, as this standard defines the work of the organizations operating the certification of persons. The fact is that both IPMA and PMI organizations recognized the importance of the implementation of requirements of this standard and incorporated them into their certification models; it is obvious that they thus confirm the quality of the program and earn a higher credibility to the certificate holders, as well as higher trust into the certificate by the organizations that hire them.

It is in this context that IPMA defined the *IPMA Certification Regulations and Guidelines – ICRG* document for establishing certification bodies, launching and conducting the project manager certification programs on the basis of the ISO 17024:2003 standard. This document is translated and applied by national associations – members of IPMA under the title: *National Certification Regulations and Guidelines – NCRG*, for the purpose of establishing their own certification bodies and developing certification programs, since in this way they can later commence the accreditation process.

In establishing the YUPMA Cert certification body and creating the project manager certification programs in Serbia, the Serbian Project Management Association – YUPMA, as a full member of IPMA, has applied the guidelines given in this document. At present, the Association is engaged in preparing the documents required to commence the accreditation process of the certification body and the project manager certification programs on the basis of the requirements of the the SRPS ISO/IEC 17024:2003 standard by the Accreditation Body of Serbia, the only body authorised in the Republic of Serbia, under the Accreditation Act (article 5), to accredit a certification body operating accreditation for persons. [12]

The difference in the approach and the implementation of the requirements of the standard is evident in that IPMA incorporated the requirements of the ISO 17024:2003 standard into the above mentioned document which serves as basis for establishing certification bodies and developing certification programs; it is in this manner that all four levels of certification are included, whereas in PMI attention is paid only to certain programs. Namely, PMI also had to conform their way of operation and programs to the requirements of the standard, however, one PMI certification program out of five was accredited on the basis of the ISO/IEC 17024:2003, for PMP® – Project Management Professional. One reason may be that it is this program that project managers worldwide are interested in, since a certified project management professional is the person responsible for each of the aspects of the project during its life-cycle, able to lead a project team and complete the project task burdened with constraints in time, budget and resources. Other PMI certification programs cover certain aspects, such as planning or risk management and they attract less interest, which cannot be said for the PgMP® – *Program Management Professional* and CAPM® – *Certified Associate in Project Management*; hence these two programs will be included into the accreditation process on the basis of the ISO 17024:2003 in the next reaccreditation cycle.

All this highlights the interest the project management professionals' show in certification, as well as the recognition of the importance of the certificate the organizations that hire them show. Therefore it is the interest of international organizations such as IPMA or PMI, as well as national associations, to offer the prospective candidates an opportunity of certification, devised and conducted on the basis of world standards.

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Hidden Markov Models for Analyzing Medical Time Series in Order to Detect Nosocomial Pneumonia

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Pneumonia - as an inflammatory illness of the lung - is a dangerous and often fatal disease. A special subclass, the ventilator associated pneumonia (VAP), is affecting up to one fifth of the patients at Intensive Care Units (ICU). Based on a two years dataset, collected at a large ICU, we investigate a new method for time series processing in order to develop an early warning system for developing pneumonia. The system focuses on the pre-onset phase of the disease to extrapolate the future's course. We utilized the functionality of Hidden Markov Models and the stacking paradigm to categorize and forecast given time series of a patient. Finally we demonstrate the benefits of our approach with a set of real patient data.

1. Introduction

The increasing use of information technology in hospitals and medical facilities of any kind led to an ongoing demand of exploiting the stored data to gain more knowledge about diseases, course of diseases, possible treatments methods etc. Especially critical environments like ICUs have a high sensibility for this issue. Here, 8 to 20% of the patients develop a VAP (N.N., 2005) what leads to mortality rates ranging from 20 to 50% or even 70% (N.N., 2005) (Heyland et al, 1999) (Tejerina et al, 2006). It is clear that an early and accurate diagnosis of VAP has a high relevance. An accurate diagnosis - and hence a faster recovery - shortens the patient's stay at the ICU and reduces both unnecessary stress for the patient and avoidable costs for the hospital (Oroszi, 2008). Besides this, physicians are overwhelmed by the massive amount of data recorded every day. Therefore new methods of utilization are needed. Data mining methods offer possibilities to transform pure and raw data into knowledge and can lead to a progress in treating methods.

This work is part of an interdisciplinary project between researchers from the department of information systems of Friedrich-Schiller University (FSU), Jena, an intensive care unit (ICU) and the hospital pharmacy of the same institution (Oroszi, 2008). The project, which followed the standard process model for data mining (CRISP-DM)(Chapman et al, 2000) has the aim to apply data mining techniques to the ICU database. In this paper, we will concentrate on time series processing, which is one important research scope of the overall project. The data we analyze are time series of an aggregated score value which have been generated

during an early phase of the project (Oroszi, 2008). The particular goal of this work and other investigations within the project is to identify promising appendages for pneumonia prediction for further research. A crucial question regarding the project is: Are there differences between the pre-onset course of disease of patients with and without pneumonia? Furthermore the question arises, that if there are differences, are they trivial like "If the measured value reaches a certain point, the next day a pneumonia disease will be manifested" or if the course of disease contains more complex patterns to disclose? So if these patterns exist, data mining methods may be able to utilize them for an early warning system. A treating physician faces various types of data and information input to develop his diagnosis. With the increasing availability of computer generated and digitally stored data, treating physicians need tools to process this input in an effective and efficient way. An early warning system has to deliver reliable and intelligible information to support physicians in their daily work to ensure the best possible diagnosis through a diagnosis support system.

The paper is structured as follows:

In Section 2 we will give an overview of the given data and its structure. In Section 3 the theory and functionality of Hidden Markov Models is briefly illustrated. A simulation in Section 4 demonstrates the ability of the system to mirror a patient's stay at the ICU. Afterwards Section 5 illuminates our test arrangement to show how the components interact with each other. To complete the work we present the results of our investigations and highlight some perspectives for future research.

2. Data

All data was collected during an early phase of the project in the years 2004 and 2005 and was already pre-processed. The whole dataset exceeded more than 4,000 variables. Unfortunately there exists no single clinical manifestation to diagnose VAP, but several methods with diverging performance (Rea-Neto et al,

2008). We concentrated on time series of the clinical pulmonary infection score (CPIS) which have been calculated for every patient during the years 2004 and 2005. CPIS is a score value which was developed to ease the diagnosis of pneumonia and was first proposed by Pugin et al. in 1991. Although CPIS has some limitations regarding its moderate performance, it is a helpful tool in diagnosing VAP (Rea-Neto et al, 2008).

Table 1: CPIS Input Valuation

Input Feature	Score Point		
	0	1	2
Tracheal Secretions	Rare	Abundant	Purulent
Radiographic infiltrates	Absent	Patchy or diffuse	Localized
Fever (°C)	≥ 36.5 and ≤ 38.4	> 38.4 and ≤ 38.9	> 38.9 or < 36
Leukocytosis	$\geq 4,000$ and $\leq 11,000$	$< 4,000$ or $> 11,000$	$(> 4,000$ or $< 11,000)$ and ≥ 500 band forms
Oxygenation (PaO ₂ /FIO ₂)	> 240 or accurate respiratory distress syndrome (ARDS)		≤ 240 and no ARDS
Microbiology	Negative		positive

As shown in Table 1 the CPIS is an integer score containing 6 score components (tracheal secretions, radiographic infiltrates, fever, leukocytosis, oxygenation, and semi-quantitative cultures of tracheal aspirates - microbiology) (Pugin et al, 1991). Every component adds an integer value between 0 and 2. Hence the CPIS has a maximum value of 12 - if all features add the value 2 - and a minimum of 0. According to international practice we consider pneumonia diagnosed, if the CPIS reaches the value ≥ 6 (Rea-Neto et al, 2008). The first day of pneumonia is in the following named "reaction day". Based on that convention, two groups of cases could be identified, cases with and without pneumonia. We will use this information later to evaluate our model. A first data overview showed a disadvantageous distribution especially in the group of cases with pneumonia. In this group we could extract 325 CPIS time series for the years 2004 and 2005. Due to the fact that the majority of the measured values occurred within a period after the reaction day was reached, only 79 time series with altogether 425 single CPIS values could be considered for processing in this group. According to our goal to analyze the pre-onset phase of pneumonia, data within this early period of the disease's course is essential. In the group of cases without pneumonia sufficient data was available. For instance, 147 cases with altogether 995 single CPIS values for the year 2004 and 138 cases with altogether 827 single CPIS values for the year 2005 could be extracted. Furthermore various

time series contained gaps and were extremely sparse as many stays on the ICU were very short. Moreover the data was highly unbalanced as the group of non-pneumonic cases is extremely overrepresented. On top of that, the duration before a reaction day is reached was concentrated in the range of very short lengths in the group of pneumonic cases. Due to these limitations, there are methods required which can process this kind of data.

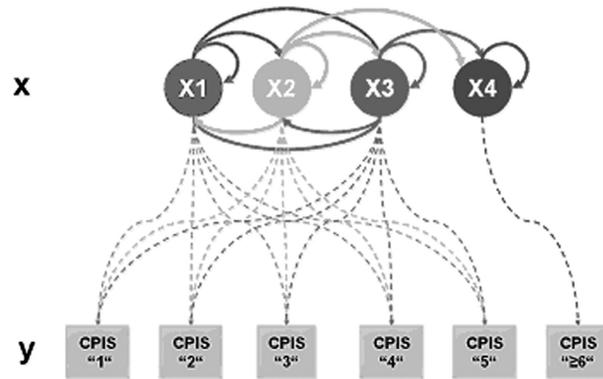
3. Hidden Markov models

The approach to investigate a possible forecast of pneumonia - based on CPIS time series - uses largely the functionality of the Hidden Markov Model (HMM). As many other methods have difficulties in processing time series of arbitrary and different length, HMM offer possibilities to process time series with a challenging characteristic. HMMs have been successfully used in data mining for many decades in speech recognition (Rabiner, 1989)(Manning and Schütze, 2005) as well as many other subjects, for instance bioinformatics (Gascuel and Moret, 2001) (Bystroff and Krogh, 2008). The mathematical description of HMM will largely follow Rabiner and Juang, 1986. The stochastic model of HMM is characterized by the combination of two random processes. An origin process with N different states $X = \{X1, .., XN\}$ is non-visible ("hidden"). This process can't be measured, but there exist M observable emissions $Y = \{y1, .., yM\}$ which offer in-

formation about the origin process. A patient's health state can be clearly understood as a random process. Within this process the patient's health state changes from time to time. Usually the health state is verbally described as "good", "bad" or "stable" etc. So obviously this process is hard to operationalize and hard to measure directly. Every treating physician uses symptoms and other available information to make a diagnosis about the patient's physical constitution. Now we make the assumption that the state of health can be represented by the hidden state of a HMM.

In a typical environment HMMs are used to classify temporal signals like continuous speech or gene sequences. Normally a signal is divided into blocks (frames) in a preprocessing step. In our case, one CPIS value represents one block. Due to the limitation that a CPIS measurement is only possible once a day, the frame rate is one day.¹ Hence a whole CPIS time series can be interpreted as emission symbols and represent the measurable symptoms. These time series allow estimations about the - hidden - origin process and furthermore the state of health. Picture 1 shows the structure of the HMM used to represent the course of disease. In this test arrangement, we assumed four origin states named: "green (X1)" for a stable state of health, "yellow (X2)" for an unstable state of health, "orange (X3)" for a dangerous condition of the patient and "red (X4)" for manifested. Three states (excluding "red") were considered the minimum necessary to model a disease development. The random variable $x(t)$ is the hidden state at time $t(x(t) \in \{X1, X2, X3, X4\})$. Each state $X1, \dots, X4$ has a transition distribution represented by the solid arcs in Picture 1. The transition distributions of every state build the $N \times N$ transition matrix a_{ij} which is unknown until the model has been trained. Here a_{ij} is the probability of transitioning from state i to state j in the next step. Moreover the random variable $y(t)$ is the emission at a time $t(y(t) \in \{y1, y2, y3, y4, y5, y6\})$. Every state has a probability distribution over the possible emissions $y1$ to $y6$. The output probabilities - represented by the dotted lines in Picture 1 - build the $N \times M$ emission matrix, which defines the probability of every output token according to the actual hidden state of the model. So $b_i(k)$ is the probability of observing the token y_k when the process is in state i . Furthermore a N -dimensional vector $\pi \in \{\pi1, \dots, \pi N\}$ with initial probabilities for every state is given. Hence a HMM can be referred by λ , where $\lambda = (X, Y, a, b, \pi)$.

¹This is resultant to the temporal measure limitations of some components of the CPIS.



Picture 1: Structural graph of the HMM

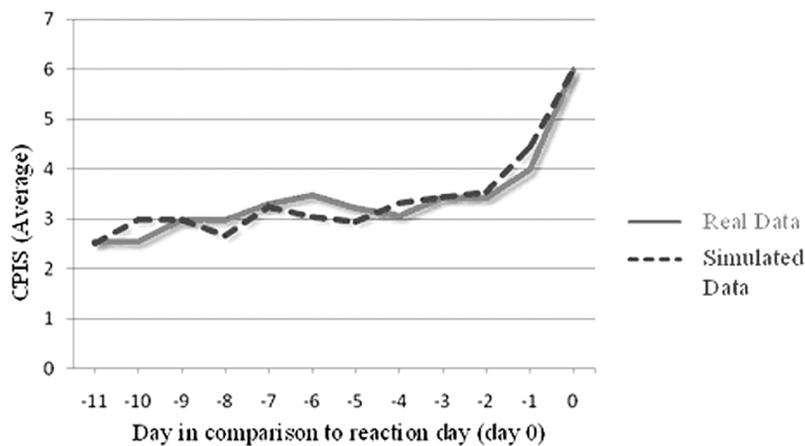
Regarding our assumptions in Section 2 we defined a CPIS of ≥ 6 equal condition "red". Furthermore we allowed no transitions from state "green" to state "red" and set all transition probabilities of state "red" to 0, except the transition to itself. The initial probability for state "red" was set to 0. Other assumptions or restrictions have not been made. According our research interest, four problems/issues regarding HMM arise:

1. Given a set of CPIS observations O with sequences o_1, \dots, o_L and a HMM λ , how to adjust the model parameters a, b and π to maximize $P(O|\lambda)$ (We will from now on call this issue training). We will use the Baum-Welch algorithm (Baum et al, 1970) to solve this problem.
2. The most likely CPIS emission sequence, beginning at any point in time. We will use the forward-backward algorithm (Rabiner, 1989) to solve this problem and use this information to forecast the course of disease and predict the outbreak of pneumonia.
3. The most likely hidden state at a certain point in time and therefore also for a future emission. This problem is solved by using the viterbi algorithm.(Forney, 1973)(Rabiner, 1989) Thus we can gain more information about the course of a pneumonia disease.
4. The likelihood of a given CPIS sequence using the forward-backward algorithm which will be used to classify sequences. A description of this set of well known algorithms is given in Rabiner, 1989.

4. CPIS simulation

If proved that the stochastic properties of CPIS time series are represented correctly by the trained HMM, it would be possible to immediately start the forecast and count the correct predictions. To get an idea how accurate HMMs can model the development of pneumonia we assume that only if the model is able to simulate a

CPIS course, it can later predict that course properly. Therefore we trained a HMM as introduced in Picture 1 with a training set of cases with pneumonia. Picture 2 shows the average course of pneumonic patients and the average course of multiple simulations. The simulation for a particular sequence started with a first random emission and was stopped if a $CPIS \geq 6$ was observed. In consideration of the fact that the generated sequences have different lengths, all sequences were aligned around the reaction day. Compared to the real time series the simulated sequences achieved a percentage deviation of 6.95% of average CPIS. This result makes clear, that the model is suited to adapt the stochastic properties of the given time series.



Picture 2: Simulated vs. Real Time Series

5. Test arrangement

The test arrangement shall adapt and simulate the course of pneumonia and deliver the likelihood of pneumonia in the future. If this functionality is achieved, the system could be transformed into an early warning or "traffic light" system. According to that, the model could offer a decision support system for the treating physician to strengthen his diagnosis. The test arrangement is supposed to forecast a manifested pneumonia - condition "red" - exactly one day before reaction day. For all other points in time the forecast shall be a state of "green", "yellow" or "orange". The architecture of the model is guided by medical evidence that patients showing high pneumonia predisposition will contract and develop the disease much faster than average (Oroszi, 2008). The model mirrors this concept by implementing the stacking paradigm as shown in Picture 3. Two modules operate in series: one separating high- and low-risk patients (classification), the other doing the actual forecast for each of the two groups (prediction). The theoretical foundations of stacking have been outlined in relevant literature (Wolpert, 1992). Stacking is a method of using multiple serial or parallel models to achieve

greater predictive accuracy (Ting and Witten, 1997). The design of the susceptibility prediction model was guided by the following requirements:

- Supervised learning should be used. This requires the concept of susceptibility to be broken down to observable quantities. As a first approximation, we used the ultimate outbreak of pneumonia according to the CPIS as a class variable. As an extension one might use a hidden variable that arises from Structural Equation Modeling (SEM) (see for example Buncher et al, 1991).
- The model should make probabilistic predictions with parameters that allow for easy adjustment of its α and β errors. It is the interaction in the different parts of the model that will eventually determine the system's performance.
- The model must handle highly unbalanced learning samples, as the high susceptibility group is much smaller than the group of low susceptibility patients.

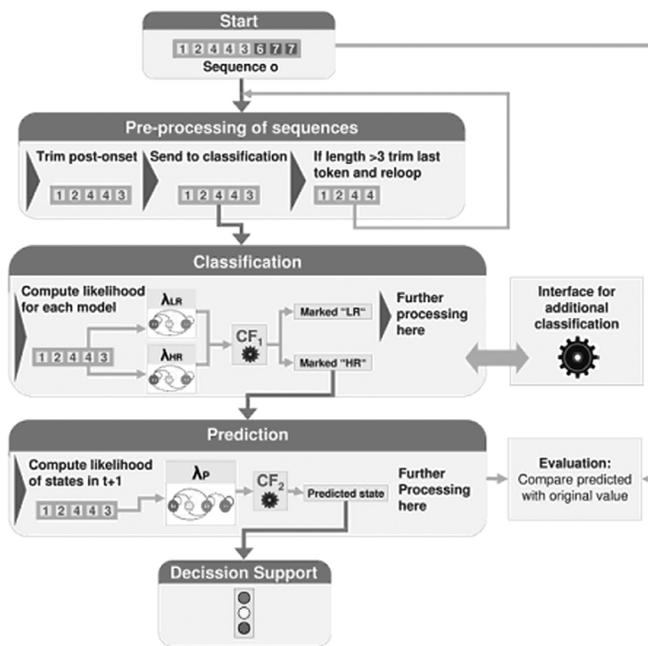
Classification The developed model is a combination of Hidden Markov Modeling and Bayesian reasoning. In the classification part, showed in Picture 3, two HMMs are derived, one for high risk patients (HR-patients - λ_{HR}) and one for the rest (LR-patients- λ_{LR}).

In a Baum-Welch training each model adapted the characteristics of cases with pneumonia (λ_{HR}), respectively the cases without pneumonia (λ_{LR}). In both cases, the time series used for calibration will exclude the reaction day. Moreover the HMMs of the classification and the prediction model slightly differ in the number of states according to the fact that a condition "red" does not exist in a pre-onset phase for the classification model. To classify a patient's time series o , it will be fed into both calibrated HMMs, and the forward-backward algorithm will give the probability of this sequence occurring under the λ_{HR} and λ_{LR} -Model ($P(o|\lambda_{LR})$ and $P(o|\lambda_{HR})$ respectively). Bayes' formula will yield $P(HR|o)$:

$$P(\lambda_{HR} | o) = \frac{P(o | \lambda_{HR}) \cdot P_{HR}}{P(o | \lambda_{HR}) \cdot P_{HR} + P(o | \lambda_{LR}) \cdot P_{LR}} \quad (1)$$

P_{LR} and P_{HR} are the usual a priori probabilities taken from general health statistics at the ICU. To get a valid result, the structure (X, Y, N, M) of both HMMs λ_{HR} and λ_{LR} has to be equal. Additionally a threshold level

or Certainty Factor CF_1 is introduced (see Picture 3). A *HR* classification thus is accepted, if the likelihood of $(P(o|\lambda_{LR}))$ reaches a certain level. This offers the ability to set a minimum lower bound for accepting a *HR* classification. Focusing on *HR* cases in this work, the decision rule (which in turn will influence the α and β errors of this stage) is to label a case *HR*, if its a posteriori probability $P(HR|o)$ exceeds a threshold CF_1 . Cases classified as *HR* will pass through the classifier. Strictly speaking, an analogue predictor/processor is needed for the *LR* cases as well. Due to substantially lower risk of developing pneumonia in this branch, we have not developed this model yet. At this point the benefits of the stacking paradigm become once more obvious, as every sequence classified correctly will directly decrease the number of β errors in the further steps. We return to the issue of unbalanced training data. Due to the fact that each HMM is trained independently, there is no restriction for equally balanced groups as long as sufficient training data exists. This illustrates once again the usability of HMM for classification.



Picture 3: *The test arrangement*

Prediction After a sequence o passed the classifier and was labeled "HR", a prediction model consisting of one HMM λ_p generates a forecast based on the characteristic of o . Having the four issues of Section 3 solved, it is easy to give a first one-day forecast from day t to day $t + 1$. From the time series of signals observed for each patient, the probability of the hidden state at t being i can be calculated. Knowing the (hidden) transition probabilities a_{ij} the probabilities for each hidden state at $t + 1$ can be calculated, which can be transformed in-

to the probabilities for the observed emission at $t + 1$. Onset of pneumonia is forecasted, if the probability for reaching hidden state "red" or observed emission "CPIS > 6" exceeds a threshold, i.e.

$$- P(\text{"red"}, t + 1) > CF_2 \text{ or}$$

$$- P(\text{"CPIS"} > 6, t + 1) > CF_2'$$

More sophisticated rules can be formed such as: $P(\text{"red"}, t + 1) > CF_2 P(x, t + 1)$ or for all other hidden states x and a relative threshold of CF_2

We shall limit our discussion in this paper to the first case. The system could in principle be extended to give forecasts beyond $t + 1$. Given incubation times of two or three days for the case of pneumonia, this seems futile effort for the case of this disease, but is interesting from the general perspective. Summing up, we define a complex model $\kappa = \kappa(\lambda_C, \lambda_N, \lambda_P, CF_1, CF_2)$ containing all sub models and parameters. To finally measure the projection quality we split the whole dataset into a training set and a test set. The training set was used to train the classification models and the prediction model using the Baum-Welch algorithm. The system processed the test set and the prediction results could be compared with the real data² not known by the system. According to Picture 3 the whole process works as follows:

1. First of all, the system trims a test sequence o with the length T , leaving the pre-onset phase (o^* with length T^*). Time series with a pre-onset length ≤ 3 have been ignored due to a missing significance of short time series.
2. Clearly a decision support system shall not only predict the reaction day of pneumonia but also avoid false predictions before that day and in general for cases without pneumonia. A single pneumonia time series thus also provides snippets ($o^*I, \dots, o^*T^* - 2$) taken from times before the onset that should in turn be correctly identified as "no reaction day" series (reloop o^* to step 1).
3. Classification for "HR" and "LR". If sequence is tagged "HR", proceed with prediction. At this point additional methods and models, as mentioned before, may be plugged in.
4. Predict the next state according λ_p and CF_2 .
5. Compare the predicted state with real state.

Tuning the system To finally run forecasts, the model faces another crucial question:

How shall Errors be treated correctly to gain an optimal result? The model has to predict a pneumonia at

²Meaning the real condition the patient was in.

the right time and avoid a false alarm before that point in time simultaneously, reflecting the α and β errors. Parameters CF_1 and CF_2 are the fundamental design parameters that may be tuned for "optimal" performance. A fundamental trade off may be seen between three types of errors:

- Error Class 1 - false negatives: The system has failed to identify the reaction day.
- Error Class 2 - false positives 1: The system has identified a reaction day for a pneumonic patient at the wrong point in time.
- Error Class 3 - false positives 2: The system has identified a reaction day for a non-pneumonic patient.

Medical practice will rank class 1-errors more serious than class 3 and both far more serious than class 2. In clinical terms, some class 3-errors might not even be regarded as ill-classified, as the distinction between pneumonia and other forms of pulmonary diseases such as severe bronchitis is blurred and the boundary defined by $CPI \geq 6$ is in reality a fuzzy one. In order to solve this problem we already introduced the two parameters (CF_1) and (CF_2). CF_1 and CF_2 can now be used to, for example, shift the arrangement to a more "false negative avoiding" behavior, paid with an increasing number of unnecessary treatments what is regarded less of a problem here. Now two possible ways in defining CF_1 and CF_2 exist, as a first solution, the treating physician may define the two parameters as a fixed constant. The disadvantage of this method is that a black-box like defining of the parameters is very abstract and not intuitive as the consequences are not obvious immediately. The other possibility is to optimize the parameters according to the given training data to get the best success-error relation. Therefore an optimal error-success relation has to be first operationalized. To solve this problem we introduce a target function $F = F(CF_1, CF_2)$ in which 3 different quality functions have to be weighted to meet the user's pretensions:

- Quality function QF_1 , representing the percentage of correct predicted reaction days on conditions: model κ and values CF_1 and CF_2 .
- Quality function QF_2 , representing the percentage of false predicted reaction days for cases with pneumonia on conditions: κ , CF_1 , CF_2 .
- Quality function QF_3 , representing the percentage of false predicted reaction days for cases without pneumonia on conditions: κ , CF_1 , CF_2 .

It is clear that all quality functions directly depend on the choice of CF_1 and CF_2 . For instance, if CF_1 is set to 1, a classification to "HR" is virtually never accepted and

therefore the reaction day will be hardly predicted. On the other hand no false prediction will occur. Additionally 3 parameters P_1 , P_2 and P_3 are added to the target function to penalize the 3 quality functions if their values do not reach a minimum level. This can be used to set lower bounds for the arrangement's accuracy.³

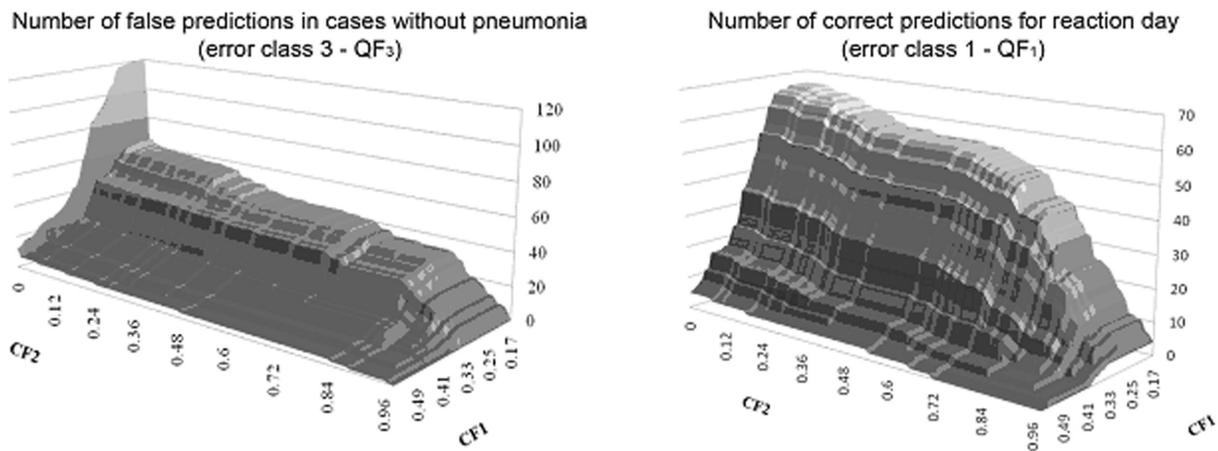
$$F(CF_1, CF_2) = w_1 \cdot QF_1(k | CF_1, CF_2) - w_2 \cdot QF_2(k | CF_1, CF_2) - w_3 \cdot QF_3(k | CF_1, CF_2) - P_1 - P_2 - P_3 \quad (2)$$

The target function F reflects the trade-off in having many predicted reaction days paid with many false predictions on the other hand. Now F provides an easy way to operationalize the user's needs in defining one's requirements. In a verbal expression a user may define: "The system has to identify at least 40% of all reaction days (P_1) and the correct prediction of reaction days (QF_1 and w_1) is twice as important as the avoidance of false predictions for non-pneumonic patients (QF_3 and w_3)". In this case, for instance, it makes sense to weight the avoidance of error class 1 (w_1 for QF_1) higher in order to prevent a missed treatment. With the definition of the weights w_1, \dots, w_3 the target function F delivers a definite target value for every combination of CF_1 and CF_2 . Thus, the system can produce scalar optimal combinations of CF_1 and CF_2 according to the definitions of the weights. The definition of the weights for every parameter cannot be investigated in this paper as it is a complex medical decision. Instead of presenting one optimal solution we will demonstrate the error/success relation for any parameter setting and some exemplary results.

6. Experimental results

Picture 4 illuminates the effect of α and β error as it confronts the number of correct predicted reaction days and the number of falsely predicted reaction days (in the group of cases without pneumonia) depending on the value combination of CF_1 and CF_2 . Obviously the shape shows a certain correlation which mirrors the $\alpha - \beta$ error trade off. With a decreasing number of correctly predicted reaction days, the number of false predicted reaction days decreases as well. Nonetheless, the shapes show differences which allow an adjustment of these two parameters. Especially the range of low values of CF_2 showed a dramatically increase in errors going along with a more or less stable number of correct predictions.

³ e.g. penalizing a result with too much failed predictions



Picture 4: Optimization surfaces of QF_3 and QF_1

Table 2 depicts the results in every error class. In the first section we show how the system could decide whether a time-series belongs to a case with or without pneumonia based on different training methods. With a true positive rate around 82-83% the system is able to mark time-series as pneumonic or non-pneumonic. In the second section we used a set of 3 different weight settings to point out the mode of operation of our model in the α - β error trade off. As weight setting 3 (from an actual physician) exemplifies an increase of reaction day forecast, accuracy may be sacrificed in favor of a reduction of type 3 errors. As a reference we used two naive forecast strategies to compare the results. The

first naive method predicts a reaction day in $t + 1$ if a CPIS value of "5" is reached in t . The second naive method computes the slope of the time series based on the values of t and $t - 1$. As seen in Table 2 naive method 1 is in fact a rather powerful forecast that has strongly influenced the way the CPIS score is constructed. It is an advantage of our method that (through the choice of threshold CF_1 and CF_2) the value of α can be adjusted, which will also determine β (vice versa). The method moreover shows, that an adjustment of α errors is possible with simultaneously having a remarkable stable β error. The concrete trade off between the two types of errors may thus be explored.

Table 2: Experimental results

Classification model			
Training method		Cases with pneumonia (N=79)	Cases without pneumonia (N=285)
Standard Baum-Welch Training		82%	69.8%
Enhanced Training (Genetic Algorithm)		83%	73.5%
Overall results			
Method	Reaction Day correctly predicted	Error class 2: Reaction day was predicted too early	Error class 3: Reaction day was predicted wrongly
κ , Weight setting 1	41.6%	6.9%	6.5%
κ , Weight setting 2	63.8%	11.6%	9.3%
κ , Weight setting 3	43.2%	20.1%	6.5%
Trivial method 1 ($y_5, t \rightarrow y_6, t + 1$)	44.3%	21.7%	13.8%
Trivial Method 2 (Slope)	31.6%	15.2%	10.4%

Summary

The test arrangement introduced in this work can be understood as a novel approach for processing and predicting medical data. However, the present research is a first attempt to analyze pneumonia using HMM and has some limitations. The computations are based on a two years dataset with 79 (cases with pneumonia) and 285 (cases without pneumonia) time series only and should be tested with data from other years to evaluate the quality. Furthermore the data belongs to one ICU and it is not clear if the results could suffer from local effects and if other ICUs may show different results. In order to predict a VAP we concentrated on processing time series of cases with pneumonia. Reckoning the classification model, there is no subsequent processing for sequences marked with "LR" at this point. In order to deploy a holistic system, further work at this point is needed. Furthermore the implications that led to the structure of the HMM (Number of states etc.) may be questioned and examined closer. The target function used to deliver an optimal result may be extended in order to consider economic issues like concrete cost rates for medication. Another benefit of this investigation is to corroborate knowledge on pneumonia disease. According to our results, the assumption of a short incubation time of pneumonia could be confirmed. On the other hand, the results reveal some limitations. Regarding the CPIS frame rate of one day, a prediction is strongly limited within this context. A higher frame rate would be helpful. Furthermore the system was based on an elaborate data preprocessing of two years data. Unfortunately this data is still quite insufficient due to the problems mentioned in Section 2. Hence, an integrated early warning system must be based upon a holistic a priori embedding in the hospital's real time data infrastructure. If not already realized, the pre-use phase will demand a lot of resources. The installation of such a system is both time consuming and costly but warranted by its multiple uses. If such systems do exist, the pneumonia forecast itself drains very little resources in daily operations. It can and should be incorporated into a patient's "one paper" that gives an overview of the patient's disease history which is a handy tool for treating physicians. Extensions in several points are evident. The system could be evaluated with other diseases with a higher incubation time. In the classification level other methods like Bayesian networks could be implemented. As other concepts of predisposition revealed high potential (Oroszi, 2008), further a priori methods should be explored, e.g. SEM. Within the framework of the stacked architecture of our system this can be easily achieved.

In conclusion, we have shown that data mining methods offer a high potential approach in disclosing a significant benefit in stored medical data. Apparently a fully automated "out-of-the-box" solution will not deliver. Nonetheless, the system demonstrates how a stacked use of different methods enriches the disclosing of potentials, hidden in stored data.

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Cloud Computing in Science and Higher Education

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This paper presents a model of IT infrastructure systems for scientific research and education in higher education institutions based on the concept of cloud computing. Cloud computing is an area of computing where IT capacity provides scalable service delivery over the Internet. In the theoretical part a model of IT infrastructure which, in addition to the control and data security, fully scalable in relation to requirements changes in educational and scientific-research activities. The model fully supports the new standards in economics of data centers, Green IT, by optimizing the operating costs of users for electricity, air conditioning and space. In the practical part of the work described is part of a system of e-learning on Faculty of Organizational Sciences, distance learning, which is an implemented virtualization technology. This solution is based on the proposed model of IT infrastructure systems for scientific research and electronic education.

1. Introduction

The research processes nowadays need a most advanced computing technique in order that we should accomplish the activities of processing a large number of data, as well as the activities of intensive calculations and ensure a simple and fast communication among the researchers. Due to the lack of access to expensive computing infrastructure and software tools many a researcher remains far from the mainstream of international scientific events and activities. The development of IT equipment and software tools only deepens this digital gap daily, however, it is perceived in many fields of science [1].

With the rise in the number of users and their needs for new services and educational contents, the electronic education systems in the higher education institutions face problems of scalability, reliability and optimization of allocated resources, with the requirements for dynamic competitiveness, with an increasing need for data storages or repositories and the need to control the costs of such systems. All these results in the requirements for the electronic education system architecture designing and implementation becoming increasingly complex [2] [3].

In this paper we attempt to analyse a possible approach to ensure a reliable and scalable computer environment for scientific research and educational processes in higher education by introducing the concept of Cloud Computing (hereinafter: CC) as a technological platform. The major goal of this work is to devise an efficient and cost-effective solution using the resources that are already at disposal.

2. Technological background

The CC concept is an entirely new business model and technological platform, a result of evolution and convergence of many seemingly independent computing trends (Utility Computing, Commodatization, SaaS, PaaS, IaaS, XaaS, Distributed computing, Internet Delivery, Web 2.0, Virtualization, IT Outsourcing, Grid Computing SOA, Storage, Data Center Automation). CC is defined as a model that allows for a network access, to configurable computer resources, at request (e.g., networks, servers, storage, applications) from available community resources that can be easily provided or destroyed with minimum management or interaction from the part of service providers [4]. Basically, the CC is a style in computer using in which dynamic and virtualized resources are offered via the Internet as a service.

One of major properties of the CC concept is scalability, and the key technology that ensures it is virtualization [2]. Virtualization separates the physical IT infrastructure from the services and applications it contains, thus allowing for a greater efficiency and flexibility. The fact that the hardware capacities of a large number of servers are far from being used up to their optimum capacities makes the basis for the implementation of virtualization. The virtualization allows for a simultaneous launching of a large number of systems on one and the same server, which results into a higher amount of utilisation of the existing hardware and reduces the need for new physical servers. The implementation of virtualization reduces the costs – fewer physical servers require less space, lowers the expenses for electric energy supply and air-conditioning of server rooms. Launching virtual servers on a smaller number of physical servers results into a surplus of servers that can then be discon-

connected and thus save directly. Thus disconnected physical servers can be used or connected to the system in the periods of higher demand for a service or when any available resource is needed to deliver a service to clients [1] [5].

Depending on which technologies are delivered to the user, the CC services can be classed into three basic categories, as shown in Figure 1:

- a) IaaS – Infrastructure as a service comprises delivery of standardized infrastructure services via the network such as servers, data storage systems, routers,
- b) PaaS – Platform as a service is an integral computing platform consisting of operating system, middleware and a set of application solutions,
- c) SaaS – Software as a service is the realization of a complete application solution used as a service at the request of the user.

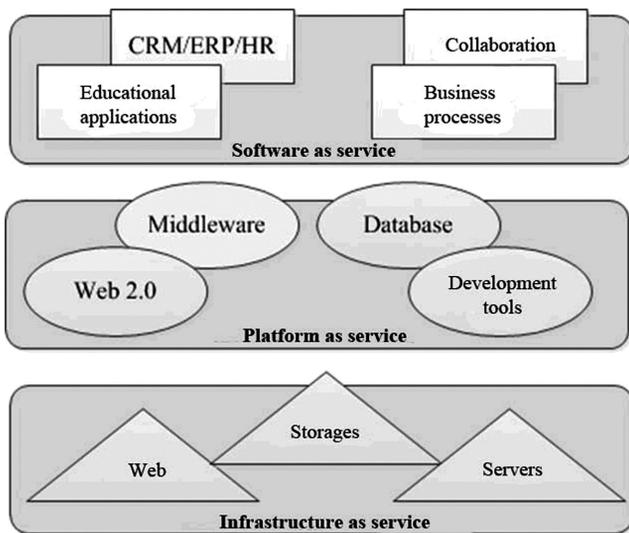


Figure 1. CC categories

CC is merely the latest step in the process of computing centres virtualization and server consolidation, the process of data storage and networking devices in order to, among other things, dispose of the surplus of the equipment and reduce the space it occupies. In literature, technologies related to the migration of the computing centre into the CC environment, in addition to the collaboration related technologies, are described as technologies that will ensure a continual improvement in the field of information technologies, regardless of economic conditions [11].

The CC introduction and implementation models , Figure 2, are the following:

- Public CC – publically available services are actually an outsourcing concept, i.e., the idea that organizations (institutions, companies, ...) should only rent cloud services from the providers, without being engaged in administration and maintenance. It is in this way that one CC is used by a number of organizations, hence its title: public;
- Private CC (internal cloud or compan’s cloud) – internal services that take advantage of the CC technologies, where they themselves are owners of their own private CC and administrate, maintain and use it by themselves;
- Hybrid CC – a combination of public and private clouds. Certain services make use of outsourcing, using a public cloud, other are still in the internal control domain.
- Community CC – services are controlled and are used by a group of organizations sharing mutual interests. The community members share the access to data and applications in the cloud.

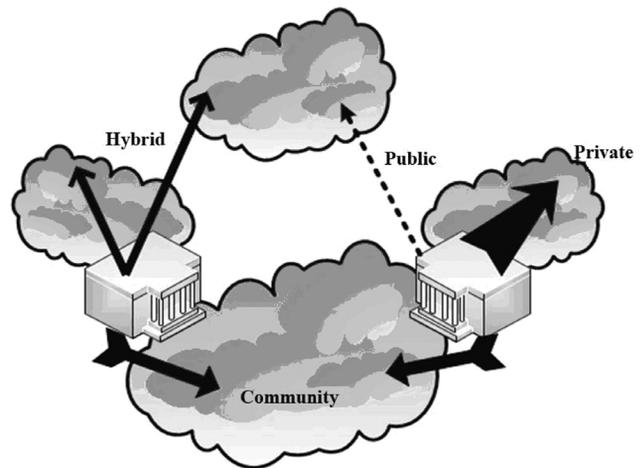


Figure 2. CC introduction and implementation models

3. Cloud computing in science and higher education

Electronic education is a complex system that includes distance learning, distance teaching, teaching materials in various electronic formats, individual and group learning processes, tutorial and interactive work.

Nearly every higher education institution has its own computing centre designed and constructed for its particular use and whose capacities become inadequate over time to meet the requirements of scientific research and educational activities, and are at the same time ex-

pensive to maintain. In every term (semestre), laboratory practice and practical projects the students are engaged in require a hardware with specific software requirements and a large number of computers, mainly with a most advanced hardware. The key issue is how we can ensure the scalability and reliability of hardware and software applications of such information systems indispensable in lecturing and research and educational processes. The problem becomes especially alarming when such a system of electronic education is accessed by an increasing number students and lecturers [6] [7]

The best answer that information technologies can give to users of higher education institutions and their computing centres is to develop an IT infrastructure model based on the CC concept. The CC concept and its characteristics can aid a higher education institution to improve its productivity and ease the management of various hardware and software resources necessary for a smooth flow of electronic education, scientific and research activities and students' projects [8].

Simultaneously, the introduction of distance studying and the way of higher education institutions financing will soon result into higher education institutions being positioned as market subjects. In such conditions, the establishment of the IT infrastructure model to ensure educational and scientific and research activities using the advantages of CC will become an interesting orientation of any institution that wishes to achieve competitive advantage on the educational institutions market.

The implementation of CC, contrary to hosting and resource management on a local level, such as faculty or university computing networks, offers numerous advantages to educational institutions. In higher education,

CC can ensure a direct access to a broad range of different educational resources, research applications and tools. In October 2007, IBM and Google joined forces to aid students master the skills necessary for the development of Cloud applications. In 2009, IBM launched the IBM Cloud Academy, a global forum for teachers, researchers and staff from the information technologies in educational institutions in order that they should continue the research and the development of the CC. IBM and Google provided a large cluster of several hundreds of servers for this program; this cluster is planned to expand to include several thousand servers over time.

The majority of higher education institutions face the problem of substantial costs, on an annual basis, to maintain and innovate the computing and software infrastructure. The CC implementation would reduce these costs to a minimum. The development of the computing centre for a higher education institution implementing the internal CC concept would enable all students and lecturers in the institution to have their own data and applications in a manner that is considerably more economic, safer and simpler to manage compared to the classic approach in using computing resources. The private CC offers the opportunity of data control and security, with the flexibility that requires continual changes in the present education, at low maintenance costs. Each user of the higher education institution would thus have his/her own virtual computer that is less expensive than the standard computer, and where the functionality and comfort of the virtual and the physical computers are identical. The students will access their virtual computers both from their higher education institution and from their home, even using their mobile phones. The logical architecture of the private CC model is presented in Figure 3.

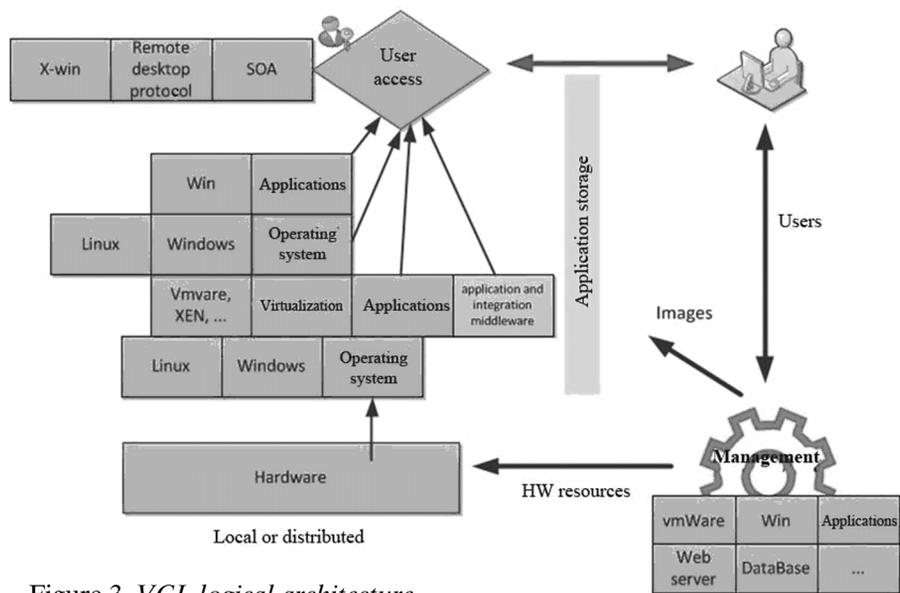


Figure 3. VCL logical architecture

The implementation of this system allows for constructing virtual classrooms with students sitting behind their computers or in their higher education institutions, enjoying the advantage of having the best lecturers and using the most advanced hardware and software. Such an electronic education model will enable students to work on a variety of projects which their teachers will be able to manage in a simple way and assign tasks to all students from one source. This would allow for collaboration between various higher education institutions throughout the country in the teaching, research and educational activities for the purpose of shaping a unique European higher education field and thus contribute to achieving the goals of the Bologna process [9] [15]

4. IT infrastructure model in higher education institution

The teaching process at the Faculty of Organizational Sciences at undergraduate academic studies level in the distance education regime is organized with the implementation of the virtualization concept. The distance education system is conducted via the implementation of the Moodle LMS software solution. The Moodle (Modular Object-Oriented Dynamic Learning Environment) is an open-source system of managing a learning process. It is implemented by universities, schools and individual instructors, for the purpose of improving teaching. According to the research findings, Moodle is an LMS with the largest number of functionalities and services [9] [14].

The present system, presented in Figure 4, has functioned successfully for the past year and is currently used by the first-year undergraduate studies students, teachers and associates at the FOS. The infrastructure for the realization of the distance learning education system is made up of one computer – server with the Fedora operating system with a Linux kernel module KVM (Kernel Virtual Machine) that allows for the creation of three virtual servers:

- Database server on which the PostgreSQL is installed;
- Web server on which Apache with the PHP and the Moodle LMS are installed;
- Server for web conferences on which Open Meetings is installed.

The server has: an adequately powerful processor, a large memory and storage space. The system also includes the network storage that serves to transfer digital materials for the lectures as well as to store the safety copies of the base and the Moodle code itself. The implemented electronic education model on the FOS we present is based on the server virtualization [10] [12]. In this way a server consolidation is achieved and the “one application – one server” paradigm is avoided. Even with the organization of a database for storing all the options and information concerning a thus established system, the management and tuning of the virtual infrastructure remains a problem. Evidently, it is necessary that a virtual machine management layer be implemented into the system, as presented in Figure 5, all in order that scalability and reliability of the system should be achieved [5].

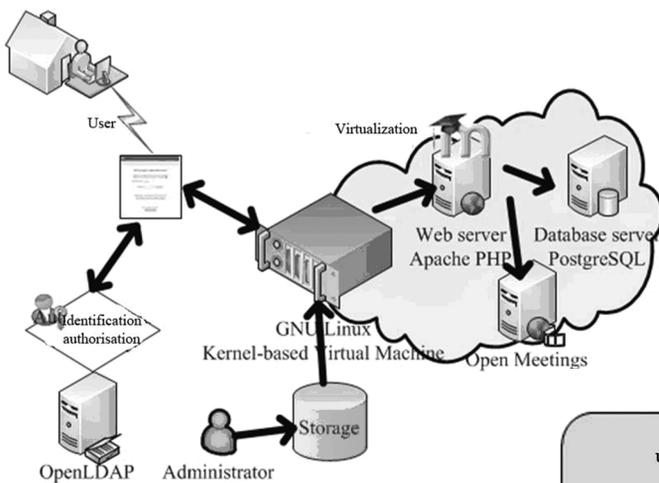
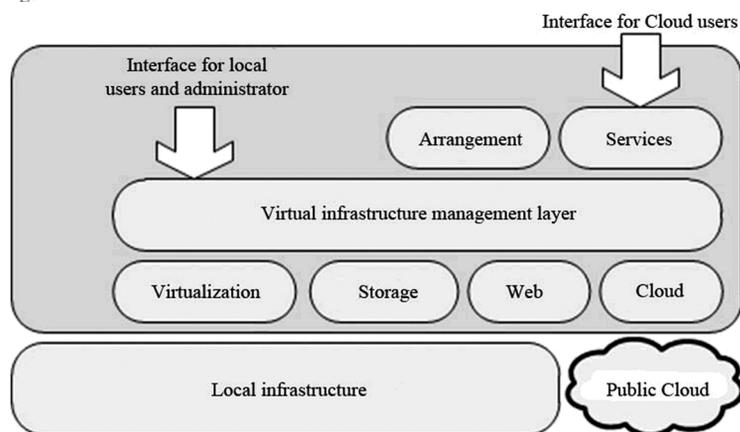


Figure 4. The present distance learning IT infrastructure model

Figure 5. Virtual infrastructure management layer



The model proposed, presented in Figure 6, consists of: front-end server and one or more node servers that can be in a cluster. The front-end server is used in managing the nodes, i.e., virtual machines. The user accesses the front-end computer and his/her claim is automatically transferred to one of the nodes by the cloud controller. The node then performs all the actions. If, however, the claim to make changes in the database is sent, the change is effected by the storage controller on the front-end computer. The model is expected to provide support for the transfer of the virtual machine from one physical node to another without any failure in the work of the service or a downtime of the virtual machine, which would help solve a large number of the present problems in server environment management. The proposed model would enhance the IT system agility, since it is possible to transfer the virtual machine to another physical node and thus gain on the performance and response of the operating system and applications, without any negative impact upon the users connected to that virtual machine at the moment [13].

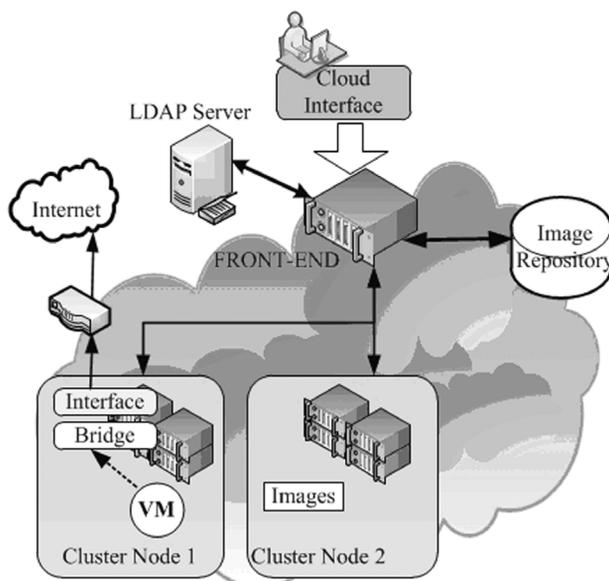


Figure 6. Proposed distance studies IT infrastructure model

The key advantage of the model described is that, due to the front-end server, i.e., virtual machine management layer, it allows for an efficient implementation and management of virtual infrastructure. The presented model offers an opportunity for a comprehensive management of virtual machines in the cloud, having in mind that the virtual infrastructure as a whole have to be ensured.

5. Conclusion

This paper presents an analysis of new opportunities and solutions in the CC area related to scientific, research and educational activities in higher education

institutions. CC is realized as distance studying infrastructure at the FOS, with the implementation of the existing infrastructure and without additional investments. We presented an IT infrastructure model that is expected to become a dominant manner of linking resources of educational and scientific and research institutions in the future. The aim of this work is to highlight the evident advantages CC offers, but also the threats emerging on the way. Also presented are the steps made which are necessary for such a model to function, and this is the model that fully supports new standards in the economics of computing centres and helps achieve scalability and enhances the reliability of the IT system. Further work will require that the implementation of the proposed model be effected and the mechanisms that secure the confidence into the CC architecture be devised. The future trends of development mean launching interinstitutional initiative fo build a prototype of the CC infrastructure that can be divided and organized for educational and scientific and research purposes.

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Assesment on Implementation Basel II rules in Serbian Banking Division

UDC: 339.972:336.71(497.11)

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Process of transformation is evident in developed and less developed countries and covers all areas of industry and social life. In accordance with it, the transformation of banking sector is absolute, and it touches our country. The dynamics of transformation depend on the level of country development and happenings in the world economy and politics. The happenings on the world financial market in the last decade, aimed at pure profit increase (without analysis and respecting present risks), resulted from the world economic crisis by the end of 2007. It indirectly makes the process of transformation of the Serbian banking sector more difficult, due to the fact that it depends on creditworthiness and development strength of own customers and socio-political factors in the country. Local banks are organized in a modern way, which is determined by the EU and Basel Committee Rules, and have modern electronic equipment and mainly professional staff. Stronger competition in the local market will make differences between banks more visible (such as high structural imbalance in terms of financial strength and business results, general level of business efficiency is at low level), which makes space for further mergers and acquisitions of the banks, as a way of faster capital strengthening of the banks, and have other advantages connected to the organization and technical support with direct impact on the efficiency and effective use of the funds.

1. Introduction

The last decade of last century and the first year of this century pass in the transformation of non-market economies of the world in terms of market economy. This process affected and is affecting the developed and less developed countries and all areas of economic and social life. Accordingly, the transformation is inevitable in banking. The process of transformation was no exception for our country. The transformation rate depends on the level of development of the country itself and the events in the world economy and politics.

Unreadiness of participants on world financial markets, to have the unexpected losses in the previous century, influenced to a much more systematic and serious approach to managing risk in the financial business. Institutionalized approached to solving the problems was made, and most was done in the development of risk management in banking, where the Basel Committee formulated the general standards and guidance of supervision, and proposes examples of best banking practices in anticipation that the legislative bodies in individual countries will take measures for their implementation so that they match the specific characteristics of domestic systems in the best possible way. In this way, the Committee encourages all member states to respect the general principles and standards of business with no direct attempt to harmonize the techniques used by supervisory authorities. Only af-

ter the adoption of national legislation, the Basel Committee recommendations become binding and legal for countries that have decided to implement them.

Decisions made by the Committee represent the commitment of many other countries outside the G-10 countries, given that there are also representatives of other countries. These decisions are related to various financial areas, but they are one of the most important areas related to the harmonization of differences in international supervision in order to make use of two basic principles: that no internationally active bank can not avoid the supervision and that the process of supervision should be adequate.

In 1988, the Committee has decided to introduce a system for measuring capital adequacy, popular as the Basel agreement I. Based on extensive cooperation with banks and other financial institutions, on 26th June 2004 the Committee released a new agreement on the capital, known as Basel II. Revised agreement on the capital, widely accepted and known as Basel II, was officially adopted on 26th June 2004 by the members of the Committee. The aim was to accept the Basel II in the national legislation by the end of 2006, by that time the parallel implementation of existing and new agreements on capital is expected. Also, the plan was to from the end of 2007 to implement the most advanced approaches for measuring the required level of capital.

This paper presents a new set of standards for establishing minimum capital adequacy for banks. Maintaining an adequate level of capital to promote the general safety in the banking system.

Basel II is an upgrade to the agreement from 1988 in that part that it takes the infrastructure needed to calculate the level of capital, but by increasing the sensitivity to the risks to which the bank is exposed. This is primarily achieved through closer harmonization of capital requirements with risk of losses on the individual placement and through the introduction of a new request for the appropriation of capital for the risk exposure that is caused by deficiencies in the daily operations of the bank (operational risk). In addition, the main innovation of Basel II refers to the introduction of new activities that relate to the requirement for minimum level of capital and these are: the function of monitoring (supervision) and market discipline, which is roused by the risk management improvement .

We can conclude that the main reason for the introduction of a new agreement on capital is the need for greater flexibility and sensitivity to risk. The new Basel Agreement includes three interrelated pillars, which together should contribute to increasing overall stability and security of the financial system. In this, the first pillar has the task to significantly improve the methodology for determining the minimum capital adequacy ratio, while the second and third pillar are the innovation of the supervision process of banks. The first pillar: Request for a minimum amount of capital, which includes credit, market and operational risk. The first pillar of the new Basel agreement defines ways to determine the minimum capital in that way that it gives a possibility to each individual bank to adjust the amount to the actual level of risk from economic losses which the bank is exposed to. The adequacy ratio of the capital can not be less than 8%. The second pillar: The supervision review process, which sets the framework for the supervisory function of the banking system. According to the new Basel agreement the monitoring process or the supervision review, is based on a series of guidelines that indicate the need for banks to assess their capital adequacy in relation to the overall risks they are facing and the need for supervisory authorities to carry out an overview of the process and implement specific measures in response to the adequacy of methods of assessment. This means that the supervisory process is not only focused on the provision of capital adequacy which ensures that risk-taking by a bank, but also to motivate banks to develop and perfect techniques used in the risk management of banks. The third pil-

lar: market discipline, which is a framework for public publishing of the business data of the banks.

In general, the data that the bank will publish should be consistent with the manner in which the bank management evaluates and manages its risk. The publishing of certain sets of business data should provide more effective public information on the types and extent of risks to which the bank is exposed, and provide a consistent and clear basis for comparison, which will result in a more advanced system of risk management and greater security in the financial markets.

Parallel in the EU are the activities in the stronger implementation of Basel II and rounding of the single market of financial services (a key factor in the development and modernization of the entire financial system and economy the EU as a whole) mainly through the unification of legal rules. EU common market seeks the affirmation of the completion of the four great freedoms: freedom of movement of persons, goods, services and capital. The fourth freedom is circled at the least rate and for the last few years has been the focus of the European institutions. Integration of financial markets is a key factor in the development and modernization of the entire financial system and economy as a whole. Validating the fact that the financial services sector deals with the money of its clients, not its own, the first movement was with the regulation of banks, then other financial institutions ¹. It is important to stress that there has not yet been reached a sufficient system of unification and integration of European financial markets. EU member states should by the end of November 2010 create a single payment area (Single Payment Area). EU members are currently working on the harmonization of regulations related to the movement of capital, appropriate financial structures, tax treatment, competition policy, consumer protection policy, and in the field of payment (clearing and settlement). EU countries have passed 42 legislative measures and a variety of different directives. The most significant is the MiFID Directive (Markets in Financial Instrument Directive) amending the existing Investment Services Directive and allowing the companies that are registered in one member state to conduct business freely throughout the EU - the so-called single passport. EU establishes a minimum framework around which there is consensus, and the member states are the ones to further regulate a given area with their regulations.

¹ Directives, as the most important documents in EU, during the harmonization of the legislation, are based on Basel II.

2. The banking market of the rRepublic of Serbia

Benefits of development of the banking market in Serbia in the past, is the dependence and conditionality on socio-political situation and economic changes in the country. Also, a unique feature for the entire period of development of the banking market in the country, is that the banks and credit survive as an indispensable entity of the financial and economic system.

The period of transition in Serbia began in 1992, but the most significant changes take place after the political changes in 2000 when there are conditions for the arrival of foreign investors. A transition period in the development of the country begins, which includes a variety of turbulence. The fastest growth is in the banking sector. Legislation goes towards supporting the development of domestic banking and adaptation to modern trends.

The transformation is a permanent process that aims to convert the economic entities from state-planned system into a system of market regulation or corporate governance and business².

In the core of the transformation are the changes in the way of thinking, business behaviour, decision-making and action of all subjects of economic and social life. The transformation of banks, includes changes in property relations, the organization, management, finance, human resources and monitoring of modern technology. All these changes are aimed at more efficient operations, the creation of quality banking products, meeting the needs, demands and desires of contemporary users of bank services, raising the level of services / products, and thus achieving greater profits.

The transformation process is complete and it makes sense if all its parts are implemented, ie. ownership, management, organizational, technological, financial and human resource transformation. Only transformation carried out in all its aspects, will contribute to more rapid development of market economy and increase the level of competition.

When there is talk about transformation of the domestic banking system, it refers to its recovery, the entry of foreign capital and financial market development. This

means: the maintaining of restrictive monetary policy by central banks, increasing the degree of independence of central banks, the introduction of hard budget constraints in state spending, recovery of the banking system and privatization of banks, opening for entry of foreign banks and other financial institutions and the introduction of hard budget constraints in companies.

Commitment to a market orientation involves improving management functions at the level of banks, which contributes to adequate credit and risk analysis, the introduction of internal quality control, proper management and monitoring of assets and liabilities of banks. Objective process runs in parallel with the process of financial market development in transition countries.

Currently there are 34 banks operating in Serbia, 20 of which are foreign-owned banks that participate with 76% of the total balance amount i.e. 60% of the total equity of the banking sector³. On the domestic banking market there is an extremely high level of competition. The first five banks (in terms of total assets and invested credits) have 46% of the market share (e.g. in Croatia, the first two banks have that percentage of the participation), while the top twelve banks have 69% of the market share. Two banks on the first place have more than 10% market share.

In early 2000 in our country there were 108 operating banks, which indicates that the number of banks decreases, and that same trend will continue in the future. On the one hand, the state does the integration of banks that are state owned (with the aim to create a development bank), while on the other hand there is a takeover of banks in private hands, both at local and regional level. It is important to emphasize that the majority of foreign banks coming to Serbia pointed out that they want to win the minimum 10% of market share, which in the current framework for those who came later can only be achieved by buying other domestic banks, but not organic growth.

Serbian banking sector recorded a positive financial result to the end of 2008 (slow profit growth starts in the last quarter of 2008 because in Serbia in October 2008 there are the effects of the global economic crisis starting to be felt; for the first nine months of 2009

² In the light of current world crisis, developed countries, primarily the US and EU, move into the process of nationalization of banks and bank conversions from private property in the state-planned (Marx's position in the "capital" on the road to communism is reviving), to rescue the banks and preserve customer confidence in the banking system primarily because of loss of strict separation of investment and commercial banking (primarily in the business management of high yield without considering the effects of potential risk). On the other hand the problems faced by banks in the state-planned economy are the efficiency of financial resources, problems securing financial resources, and accumulated losses and problems.

³ Source: web site The Association of the banks of Serbia and the National bank of Serbia.

nine banks reported profit). The profit for the banking sector amounted to 34.9 billions of dinars (8 banks operated with a loss).

Domestic banks are well capitalized, allowing the NBS to have the proactive measures ready for the first and second wave of global economic crisis. Total capital of the banking sector on 31/12/2008 amounted to 4879 million. Capital adequacy is 23% on 31/12/2008. If there should an account be made of the ratio according to Basel II, it would amount to 19% (according to analysis of NBS), which is significantly higher than the EU countries (average of 8% -10%) and environment (15%).

Also, in the previous year there was a high level of collection of loans invested. In 2008 the degree of non-payment claims in the area of population amounted to 1.5%, while the level of nonpayment claims in the area of the legal entities amounted to 6.3%.

It should be noted that in the previous period, business banks mostly played with the level of reservation in the sense that they released them, to show better business results (since 31/12/2006). Also, the level of reservation indicates that banks have not adequately classified their placement, or did not implement an appropriate percentage of reservation for a specific placement.

Domestic banks earn very high salaries in the repo business (as much as 30% of placements of banks located in these matters), indicating their exclusive orientation toward the profit (given the fact that placements bring to customers less returns and carry greater risks) and selfishness.

At the same time, there is a high level of cross-border credits granted directly to local legal entities through the head offices of domestic banks with foreign capital or specially established investment funds in particular countries with which Serbia has signed an agreement on avoidance of double taxation. As on 31/12/2008 the companies have accumulated amount of foreign debt of about 11.5 billion euros, an increase of 350% for a period of three years (40% placed cross-border loans went through two commercial banks)⁴.

It is important to note that the growth rate of the placed housing loans in ratio to the growth of national gross domestic product (2.9%) indicates that Serbia is in the early phase of transition of the financial sector (due to the fact that the indicator in the EU countries is on average 50%)⁵.

It is important that local banks are organized in a modern way, arranged by the example of the EU and the rules of the Basel Agreement, and have electronic equipment and generally professional staff.

The problems faced by domestic banks are inefficient management, quality management team and the leadership, knowledge of banking processes and technologies, required additional knowledge in management and the increase the degree of risk.

Key issues for effective management of domestic banks are: the ability to change management, strategic planning and strategic management approach, flexible organizational structure and a strong marketing orientation.

In 2009 level of credits in the use of is slowly growing, both in the segment of the population and economy, thanks to the stimulating and pro-active measures of the NBS to support credit activity of banks and to relax the borrowers who have come to the problem of loan repayment. However, the economy and population are faced with:

1. reduced liquidity as a result of the way of funding in previous years (which will result in difficult servicing obligations to banks and business partners). In terms of reduced liquidity of the real sector (as a result: reduced domestic and foreign demand, problems in the collection of outstanding claims, less availability of new sources of funding, and funding structures not adequate in previous years) servicing liability during 2009 will be subject to potential companies to renew their loans or willingness of foreign lenders to keep their exposure to Serbia, and the effects will depend on financial support to countries and international financial institutions (such as the Vienna initiative, the loan arrangement with the IMF, the support of the Government of Serbia to the economy providing subsidized credit lines to mitigate the effects of the global financial crisis in the amount of 122 billion di-

⁴ Source: web site of the National Bank of Serbia and the Banking, special edition No. 3 – The Serbian banking 2008, The association of the banks of Serbia, Belgrade, 2009

⁵ Source: Wolf&McGill, Serbia Real Estate Market Projections, Belgrade, March 2008.

nars, etc.). It should be noted that prior to the global economic crisis, banks were stable source of funding for companies⁶.

2. increased currency (the basic element of market risk), interest rate and credit risk, which affect the difficulty in payment of obligations and deteriorating the quality of the portfolio⁷.

Accordingly, the expected asset quality experiences deterioration (some banks on 30/06/2009 increased the level of reservation four times), and the currency induced credit risk remains the main risk to the stability of the banking and real sectors. Also, there is the increase of importance of the national money market. In the first wave of the crisis, domestic commercial banks to preserve the liquidity advantage of available funds, used the free means placed in the repos in the National Bank of Serbia.

Liquidity ratios indicate that the same one by the largest number of banks is between 1.5 and 2.5 which should confirm a satisfactory level of liquidity.

Active and passive creation of the interest rates from October 2008 was determined by the liquidity of banks. Problems with liquidity increased importance of the domestic money market. Banks' lending interest rates have increased due to increased risk premiums, while passive rates continue to rise.

Taking into account the developments in global and domestic financial market, banks should in future period focus on the collection of its outstanding claims (placed credits) and restructuring of the placement for which there is a problem of charging, as customers' delay at the start of the year increases (in the segment of legal entities is 9.7% and 3.9% in the segment of the population as of 30/11/2009)⁸.

It is important to note that the efficiency and effectiveness of the use of total assets are involved at the unsatisfactory level (0.05% and 0.15%), and therefore there are also low rates of profit of own capital and total assets engaged (8.3% and 1,97%). The overall level of the efficient business is at a lower level due to the high

structural imbalance between banks in terms of financial strength and results of operations. Strengthening of the competition in the domestic market will make these differences more visible, which expands the space for summing up the domestic banks through the process of mergers, acquisitions and privatization, as ways of strengthening the capital, which carry other advantages of the organizational, technical and technological origin, and ease the way to economical operations and efficient use of resources.

Experience shows that the state is helping the banks, not the economy. Subsidized credit lines banks are taking advantage of refinancing their own loans to legal entities. The banks have: ensured that the classification placement occurs in a lower category (and on that basis increase the reservation level), provided a better line of credit for themselves (part of the risk transferred to the state, lower credit costs - for the reserve and the margin that the state subsidizes) and for the client (a new lower interest rate loans from the previously used), shut down the existing credit obligations on time and the issue of payment of claims prolonged to the next calendar year.

3. Conclusion

National Bank of Serbia at the end of the first quarter of 2008 published the National Strategy in accordance with the Basel II agreement. The main objectives of the introduction of Basel II standards in Serbia are to further strengthen the banking sector and financial system, improve the process of risk management in banks and the process of supervision based on risk, increase transparency and market discipline, align with business conditions in the international market, harmonize with EU regulations - EU Directives 48/2006 and 49/2006, and create stronger links between capital requirements and risks exposure at the level of the bank.

The operating plan for the introduction of international standards in the field of prudential banking supervision, is defined based on the fact that in the previous years actual macroeconomic conditions necessary for the introduction of these standards were made (such as the liberalization of financial markets, stabilization of

⁶ Up to 7th April 2009 170 million euros of loan subsidized credits were confirmed. Banca Intesa a.d. Belgrade has been a leader and placed in the first quarter of 2009 112 million euros of the subsidized line (most of it was refinance of its own portfolio). The next was Commercial Bank a.d. Belgrade. It should be noted that the credit arrangement with the IMF was signed for a period of three years, and its payment is predicted to take place at once at the end of the use period of loans. The question is from which sources will the Republic of Serbia pay this back.

⁷ The banking sector in Serbia, closing with 31/12/2008, kept a low indicator of foreign exchange risk of 8% (which is considerably less than 14.7% from 2007).

⁸ Source: web site of the association of the banks of Serbia

the financial system, restructuring of the banking industry and its capital, strengthening the supervisory functions of the National Bank of Serbia, the introduction of international accountant standards, etc.). Also, in the last three years, at the request of the National Bank of Serbia, the bank began to meet certain quality standards of qualification, as a first step in preparation for the implementation of the Basel II agreement (eg, improving the internal management structure, clearly defining the strategies and policies for risk management, developing and promoting the culture of risk management including internal revision and compliance, the developing of an effective system of monitoring and internal reporting). The success of the first step allows creating a framework for managing risk in the bank, and the selection and application of models

for the calculation of economic capital, as the highest point in the process of risk management.

Operating defines two phases of implementation of Basel II:

1. Complete harmonization of regulatory standards of the Basel II agreement by 2009
2. Application of standards of the Basel II agreement in practice of the domestic banks from 01/01/2011.

Reviewing the results of the questionnaire on the implementation of the Basel II agreement (by the business banks) in Serbia, it can be concluded that the following problems arise in the implementation: the high costs of staff training and building of an information

system, improvement of technology, development of models (including the decision on the best approach in accordance with the risk profile of the bank) and databases (the quality of databases, including the time, keeping historical data, understanding data, developing systems for reporting), and a lack of personnel⁹.

Also, considering the transparency of the process of introducing the Basel II agreement in Serbia, we can say that there is no official data on the progress of the first phase of the Operational Plan, i.e. that deadlines for the adoption and approval of legislation are not met. i.e. there are not any blueprints for the majority of regulations at the site of the National Bank of Serbia. It also does not have the information whether the National Bank succeeded to hire adequate staff on topics relevant to testing of the suitable models for quantify of the risk in accordance with Basel II and the granting the rating to the credit agencies. Therefore, the question is whether we will manage to implement the Basel II agreement in the domestic banking practice starting from 01/01/2011.

In the coming period the steps necessary for Serbia to integrate into a single EU financial services market should be circled. It is very important to be consistent in implementing and applying if we want to be integrated into a single market. It should be noted that the integration of financial markets is a key to the development and modernization of the entire Serbian financial system and economy as a whole. It is realistic to expect that this project will be implemented in determined steps of phases and the dynamics for Serbia's EU accession and EU Directives in the field of finance and banking (primarily the new rules for cross-border payments - revised rules version 256/2001). There is no currently available information about the project on the web site of the National Bank of Serbia.

Finally, it should be noted that the sectors have a high level of structural imbalance between banks in terms of financial strength and operating results, and the overall level of efficiency of business because of that is on the

lower level. Strengthening competition in the domestic market will make these differences more visible, which **expands the space for summing up the domestic banks through the process of mergers, acquisitions and privatization**, as well as faster ways of strengthening the capital, carrying other advantages of the organizational, technical and technological, and economical way to facilitate operations and efficient use of resources. Therefore, in Serbia it is necessary to start the process of complete transformation of domestic banks. Also, state should consider that banks will merge into one development bank (three or four banks), which will be sold to other domestic or foreign banks for a period of one year.

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⁹ Source: web site of the National Bank of Serbia

Interest of the Population in Electronic Communication in the Health Services Provision – Research Results

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The subject of this paper is to present the results of the implementation of electronic communications in one segment of the electronic health system that is currently under development in the Republic of Serbia. For an insight into the readiness of the Serbian population to adopt the electronic communication between doctors and patients, a research was conducted at the Center for testing hemostatic disorders, Blood Transfusion Institute of Serbia, in patients who were administered an oral anticoagulation therapy. The survey was conducted on the basis of data collected on patient health, using application solution that is made specifically for this study. The collected data were analyzed and presented in statistical control charts. The introduction of electronic health systems is a long and arduous task, aimed at creating a functional and modern health care system that will contribute to „improving the health of the population“.

1. Introduction

The electronic health-care system comprises the implementation of information and communication technologies, especially the Internet, for the purpose of improving and ensuring health, on one hand, and the health-care system, on the other [1]. It can be described as a system that is complementary to the traditional system of health services delivery; it eliminates paper as a medium and ensures that all the data on the patient and his/her health status are recorded in an electronic format and are accessed promptly and efficiently via a computer network – the Internet [2] [3].

2. Information and communication technology implementation in communication in the provision of health services

Information and communication technologies offer great opportunities and have an impact upon national economies and the global competition. Originally, they served as support to administrative activities (personnel, payroll, material and financial affairs, warehouse maintenance) and the activities in statistical reporting (health status assessment, work of health-care centres, data from the research of concern for the country, the region, and the like), however, the implementation of information technologies in the segment of support to its core activity significantly lags behind.

The potentials the information and communication technologies have in the health-care system can be employed to help citizens and health-care workers ensure a safer, higher-quality, more rational and better integrated health-care. Information and communication technology is a means to achieve strategic goals in the health-care system [4], namely:

- development and improvement of management in all the elements of the system through decision making based on the facts provided by health-care workers, users, mediators and politicians;
- providing conditions for sustainable financing of the health-care system;
- measuring the key dimensions of the health-care system, such as availability, equality, quality, efficiency and sustainability.

In planning and implementation of information and communication technology solutions into health-care we have to bear in mind the interests of: citizens, health-care workers and any other social concern. The basic principles of information and communication technologies are:

- preservation of privacy and confidentiality of the data on the health status of an individual;
- efficiency and usability of the health-care information system;
- promotion of an optimal usage of health status data; and
- high quality of health-care related information.

3. Research into the implementation of application solution in the health-care system

The health-care system is one of the most complex systems in a state. Due to its importance and its impact upon the health status of the population of each state, as well as due to its relevant economic influence, the state implements a large number of measures in health-care system planning and management in order to ensure steady financing and a rational and quality health-care

system, with an intention to ensure the basic health protection to its citizens within the available resources [7].

3.1. Subject and goals of implementation of application solutions

When seeking the necessary information, the user becomes aware that the weaknesses in the health-care system are many and he/she wastes a lot of time to find and organize information. The basic data can be found in paper documentation, however, they are not easily accessible, nor are they included into an integrated format so that a general insight into the treatment and care of the patient can be obtained.

This weakness concerning the accessibility of information is rather widespread. It often happens that health-care centres have to deliver a health service to an individual without knowing what has been previously done; thus the patient may receive the treatment that is not necessary, effective, or that may even endanger his/her health.

The lack of accessibility of all the information on the patient, e.g., laboratory findings, may result into medical errors or into an unnecessary repetition of laboratory tests. This problem can be easily solved by using information systems that can communicate.

It is for these reasons that a research has been conducted into the willingness of the Serbian population to adopt an electronic type of communication between the physician and the patient. The research was based on an application solution of the health-care system segment meant for the patients receiving an anticoagulant therapy.

The anticoagulant therapy is a medicament therapy that is meant to prevent forming and/or activity of thrombin and thus block the coagulant cascade. The treatment of such patients requires a timely measurement of INR (*International Normalised Ratio*) values in the blood, which is the ratio between the patient prothrombin period and the prothrombin control time.

The application solution devised for this research was designed in accordance with the basic model of the health-care system. The solution is based on the establishment of electronic communication between the physician and the patient.

The goal of the application solution implementation is to collect and analyse the data on the patients and on the extent to which they implement the application. The method used in data collection is the implementation of information and communication technologies

such as web applications and SMS services. The implementation of these helps obtain the following [8]:

- a better and more direct exchange of knowledge and information between physicians, on the basis of patients' electronic medical records;
- a more easily accessible patient-physician communication;
- a mass and interactive education of citizens in the field of disease prevention and treatment of patients;
- a more rational employment of capacities and a higher efficiency of use of equipment and technical resources through an automated integration of diagnostic and therapy information in the patient's electronic medical record.

The gathered data were submitted to analysis on the basis of the statistical process control.

The idea was to use a relevant number of service users that implement the application and find the percentage of users that adopt the electronic health-care system as a novel method of health-care service delivery. The solution to the application can be implemented in all medical facilities whose core activity is medical care provision.

The precondition for a fruitful physician-patient communication is the identification system. The solution proposed means that basic parameters have to be defined to identify the target group of users, and these are:

- unified patient identifier;
- unified physician identifier; and
- unified health-care centre identifier.

The unified patient identifier serves to link data, regardless of where they are stored, on which locations, i.e., on different media. The unified physician identifier allows for a unified identification of medical workers in the health-care system as well as records of their treatment related to individual patient and his/her health problem. The unified health-care centre identifier serves to unambiguously identify the existing operating state and private health-care institutions.

3.2. Functional organization of data flow in the application solution

The key precondition for this application solution is the data flow organization. The data flow organization architecture is built on the needs of the basic categories of system users (physicians and patients) and provides the exchange, processing, storage and use of the data. The data flow organization architecture is presented in Figure 1.

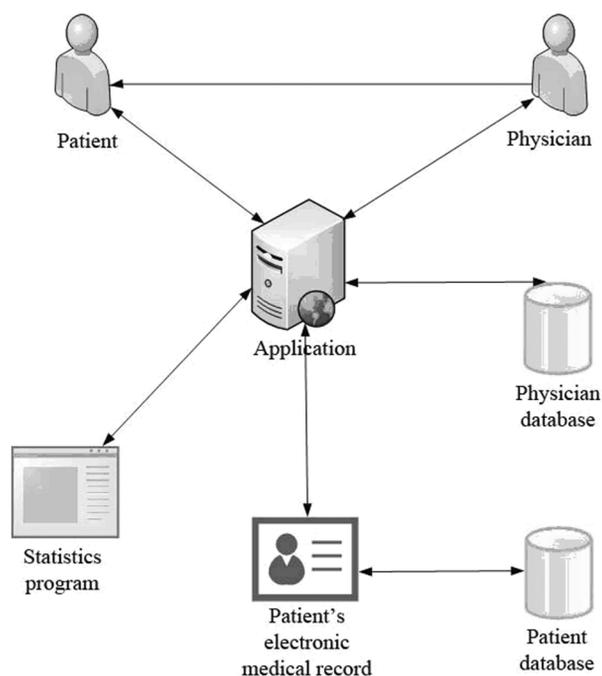


Figure 1. *Data flow organization architecture*

In the application solution the communication starts from the patient. The patient first has to register with the system and then enter the data into the application. The system receives the data and enters the identified patient into the documentation. The data are then recorded into the electronic medical record as well as into the patient data base. The physician also accesses the application. He checks the entered data on the patient and makes sure that the medication dose is adequate. In case of emergency, he has to contact the patient by phone.

The communication in the model is two-way – the user and the system exchange the data in both directions. The data are transferred via the web service or via the mobile phone. The information and the functions of the system are accessible only to authorised and authenticated individuals that function in the roles of the authorised physician and the patient.

The application solution allows for a statistical tracking of data that make an individual and group observation of patients, controlled by the observation period and the values of the parametre observed. The application contains a database with the data entered:

- textual data – basic data on the patient;
- numerical data – laboratory values.

The application solution is characterised by three stadia in the so-called diagnostic-therapy cycle: observation, diagnosis, therapy. The patient sends data, the data are entered into his database and the decision is made as to the further therapy for the patient.

With the implementation of this data flow organization the following is achieved:

- entry of system users' data;
- data exchange between the system users;
- physician's insight into the consistency of data entry;
- entry of data on the patient's health status into the electronic medical records;
- statistical processing of relevant parametres that are observed.

The sequence of the activities in the application solution implementation is presented in Figure 2.

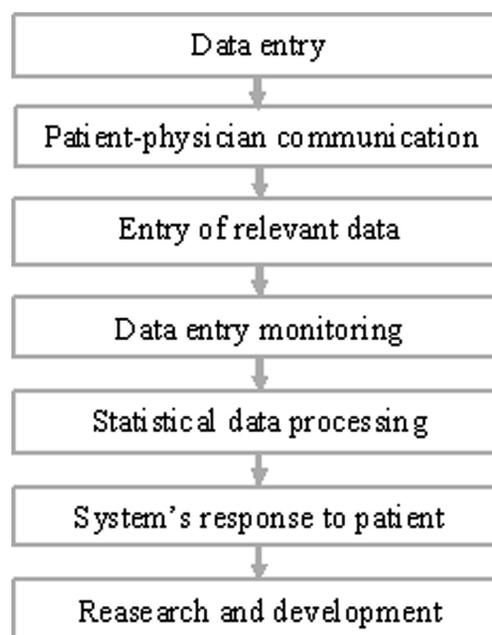


Figure 2. *The sequence of activities in application solution implementation*

4. Research findings and analysis

The research was conducted in accordance with the 1975 Declaration of Helsinki revised in 1983 with the approval of the Ethical Committee of the Blood Transfusion Institute of Serbia where the oral anticoagulant therapy is administered.

The sample included 116 male patients and 84 females 20 to 82 years of age (the median was 61 years of age). The criterion observed in including the respondents into the research process was that the patient receives a permanent anticoagulant therapy, that is, in the INR therapy span of the last three months. The research methodology is shown in Table 1.

Realization period	Research was conducted from September 2009 until September 2010
Sample size	200 patients
Target population	Patients receiving anticoagulant therapy
Research field	Beograd

Table 1. *Research methodology*

Over a period of one year, patients were asked to record the INR values on a fortnight basis. Several points in time period were observed within the study

analysis – after one month, after 4 months, after 6 months, after 10 months and after 12 months.

The respondents accessed the application via the web or the mobile phone. They entered the measured values of INR in blood. On access to application, each patient was asked if they would agree to receive electronic mail, i.e., an SMS to remind them to timely measure the INR values in blood. A too early or a delayed sample of blood may reduce the effects of the therapy and cause grave health problems. The mandatory frames on the screen format of the application are: patient identifier, the results of the laboratory analysis of blood, date and time.

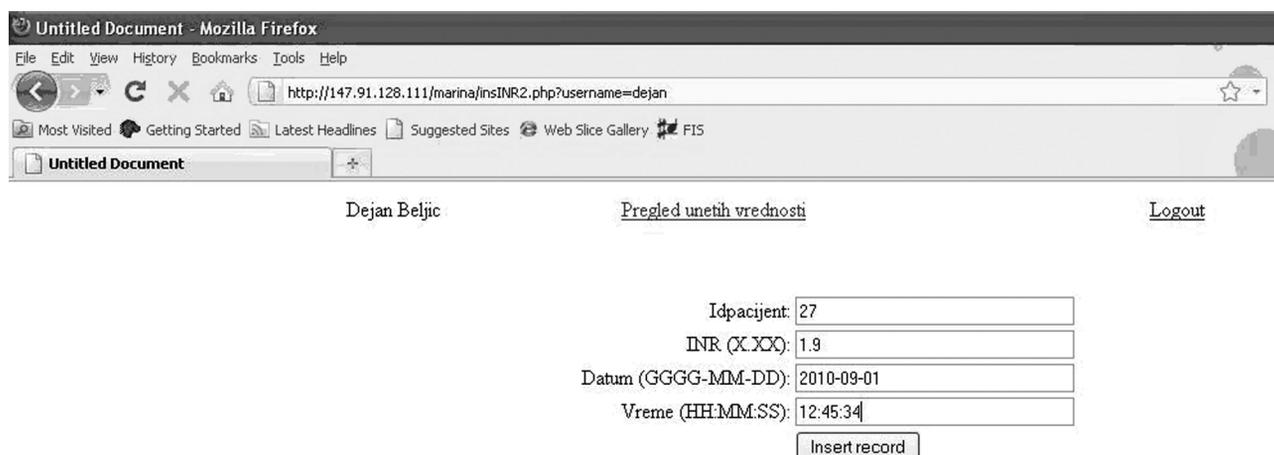


Figure 3. *The application site for recording the measured INR values*

This type of organization serves to avoid that the patients often add the analysis results, and the records of doctor's order and diagnoses reduced entering unidentified or doubled analyses to a considerable extent. If necessary, the laboratory findings can always be printed on a local printer.

The possible INR values are classified into 7 categories. Hence the recommendation to the patient as regards the therapy differs in accordance to the category. The possible values are the following [9]:

- when the INR value is lower than 1, it is necessary that the patient should see the physician.
- when the INR value is between 1 and 2, it is necessary that the weekly dose be increased by 5-20%.
- when the INR value is between 3 and 3.5, it is necessary that the weekly dose be reduced by 5-15%.
- when the INR value is between 3.6 and 4, it is necessary that one dose be skipped and the weekly dose be reduced by 10-15%.
- when the INR value is between 4 and 5, it is necessary that one dose be skipped and the weekly dose be reduced by 10-20%.

- when the INR value exceeds 5, it is necessary that the patient should see the physician.
- the referent INR value is between 2.0 and 3.0.

In case the INR values do not correspond to the above described values, the system automatically notifies the physician of the emergency of the case.

On the basis of the entered values a control card of numerical characteristics is obtained. The green zone shows that the INR values are within normal values, the yellow zone is the action zone, whereas the red zone is the alarm zone. The system displays a control card for each patient, showing whether the values vary in predicted or in unpredicted ranges, and also when the deviation is high enough to call for a corrective action.

The following graph presents the control card with INR values of blood, entered by the patient. The entered data are automatically transferred into the patient's electronic medical record.

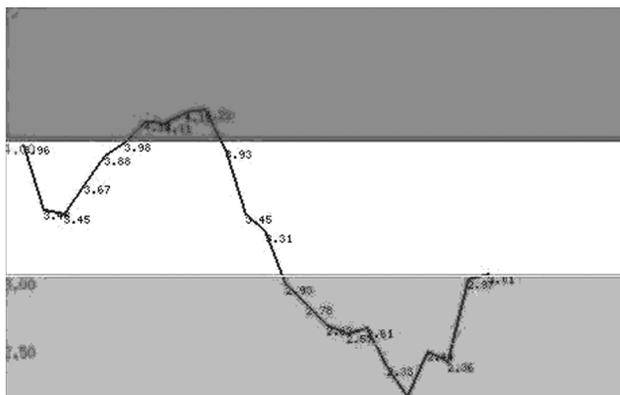


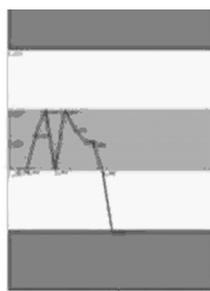
Figure 4. The chart of entered patient's INR values

The expert system compares the entered values and makes a decision as to the next step concerning the dosage of the medicine the patient is to be administered in order that his/her health should be stabilized.

Table 2 presents the number of entries of INR values for a given patient as regards five time points. It is clear from the table that throughout the research period (one year) the patient checked his health status via the electronic communication with the physician.

Table 2. The number of entered INR values as regards five points in time

Time period	Total entries made by the patient	%
After one month	2	100%
After four months	8	100%
After six months	12	100%
After ten months	20	100%
After one year	24	100%



Date	INR
10/1/2009	2
10/15/2009	2
11/1/2009	2.6
11/15/2009	3
12/1/2009	2
12/15/2009	3
1/1/2010	2.7
1/14/2010	2.5
2/1/2010	2.45
2/15/2010	1.98
3/1/2010	1

Not all patients, however, were active in entering the INR values into the system during the one year period. The following example illustrates that the patient discontinued recording the data into the application. Figure 5 indicates that the patient accessed the application 11 times and recorded the INR values.

Figure 5. A review of INR values and a graph for a patient that discontinued recording after 6 months.

In this case, the physician could see in the application that the patient does not access the system, therefore the physician contacted the patient in person. The treatment and the control continued in a traditional way, namely, the patient went to the health-care centre to see his doctor.

Generally, after a year of entering the iNR values into the application, the following conclusions could be drawn. At the beginning of the research, the patients included in the study adopted the new way of control of their health status. A number of patients, however, discontinued accessing the application over time (chart 1).

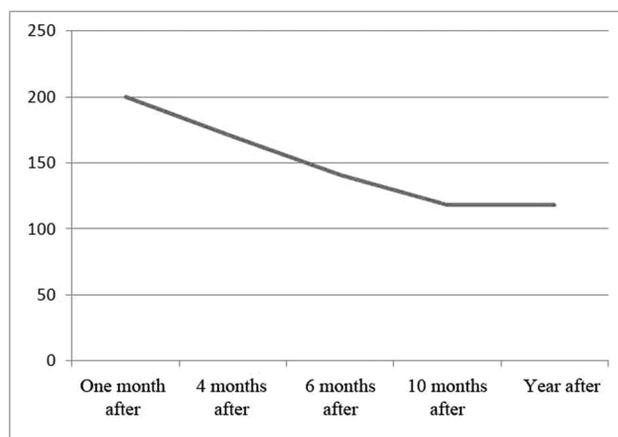


Chart 1. Number of patients who entered INR values as regards time

Table 3 illustrates the percentage of patients who entered the iNR values as regards the five time points.

Table 3. Number of patients who entered INR values

	Total number of patients who entered data monthly	%
	200	100%
	170	85%
	141	70,3%
	118	59,26%
	118	59,26%

Upon the completion of the research, the conclusion is drawn that 118 patients have continually controlled their INR values and regularly entered them into the application, which makes up 59.26% of respondents. The percentage is very high, from the aspect of the patients' age, since the age median is 61 years of age.

Given that the access to the application is possible from the computer or via the mobile phone, the research has shown that a majority of INR value entries was via the SMSs. This is evident from the fact that the use of the mobile phone to access the application is easier for several reasons:

- access to application is possible right in time;
- access to application is possible regardless of the patient's actual location;
- 82.7% of population use the mobile phone [10].

Table 4 presents the percentage of patients who used the computer, or mobile phone to enter the INR values as regards the five time points.

Table 4. *The percentage of patients who used the computer, or mobile phone to enter the INR values*

Time period	Number of patients who entered data monthly	Data entry via computer		Data entry via mobile phone	
		Number of patients	%	Number of patients	%
After one month	200	98	49%	102	51%
After four months	170	75	44%	95	56%
After six months	141	57	40%	84	60%
After ten months	118	49	41%	69	59%
After one year	118	49	41%	69	59%

The percentage of use of the computer and the mobile phone to enter the INR values is shown in chart 2.

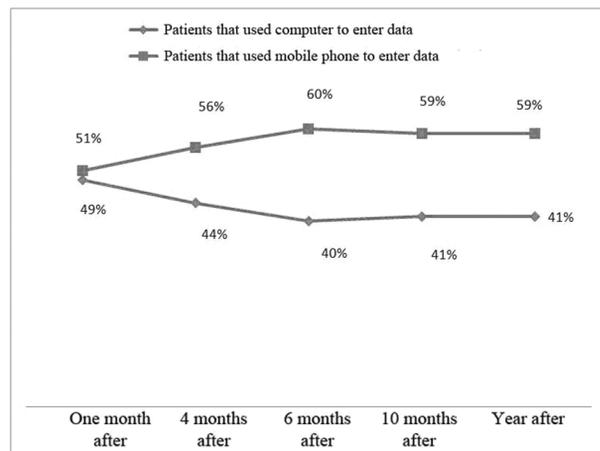


Chart 2. *The chart showing the percentage of use of the computer and the mobile phone to enter the INR values*

Conclusion

The research conducted shows that the population is interested and that their attitude to the introduction of the electronic health-care system is positive. This attitude results from the fact that the implementation of technology in everyday activities is increasing.

The findings of the research show that the majority of people are in favour of improving the quality of health-care services on the local level, using the information and communication technologies. These results demonstrate that it is necessary that a decision should be made on the level of the Republic of Serbia that lectures should be delivered in which the citizens would learn about the basics and the possibilities to use the ICT in health-care services. This would raise awareness about the need to improve the delivery of health-care services and create a positive general attitude on the establishment of an electronic health-care system.

The research gives basis to a conclusion that the citizens of the Republic of Serbia are willing to adopt the electronic health-care system which will ensure that the treatment process remains the same, however, the method of treatment will be easier and more efficient.

The pace in the development and expansion of the electronic health-care system worldwide shows that its implementation in this country is not the issue of necessity and profitability, but only a question of time.

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Small and Medium Enterprises – Economic Development Drivers

UDC: 330.34:334.012.63/64

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Considering the fact that many of the countries are going through a transitional period, the drivers of development should be small and medium enterprises. In this paper an analysis of the meaning of SME's will be performed in a way to show the huge contribution of SME's for overcoming the causes of transition and recovering the competition, entrepreneurship and increasing the economy efficiency. The elaboration of perspectives and advantages of small and medium enterprises is given at the end.

Introduction

Considering the fact that many of the countries are going through transitional period the drivers of development should be small and medium enterprises. The significant appearance in the period of the seventies of the 20th century was decreasing the rate of GDP, increasing the unemployment, decreasing the investment activities. The only way for enlarging the economic activities is bigger liberty on the market and decreasing the role of the state in the economy life. This is important for stimulating the competition, entrepreneurship and economy efficiency in the national economy. It helps for entrepreneurship's reconstitution, manifested by establishing the small and medium enterprises which lean on creativity, entrepreneurship spirit and individual innovation. On this way the economy structure has more flexibility and the probabilities for productivity –technically reconstructions. The number of SMEs is increasing permanently in developed countries but also in developing countries. The

growing of SMEs depends on character of the socio – economic development.

1. SMEs and economy development

SMEs are usually defined as independent firms which employ 250 people at the most. There are a lot of definitions and criteria for dividing the SME. For example, in France, German and Italy the criterion is 50 employees, in Great Britain – 200, Holland – 100 employees and in Belgium and Denmark- 70 employees. [1]

Beside this criteria other criteria are used with the same function such as volume of production, the assets of the company, the participation in capital property etc. In the most economies, smaller enterprises are much greater in number than the big enterprises. In Republic of Macedonia by the Trade Companies Law the enterprises are divided into small and medium enterprises by using three criteria [2]: number of employees, annual turnover and value of assets.

Criteria's	Dimension of enterprises		
	small	medium	big
average number of employees	to 50 employees	to 250 employees	more than 250 employees
average incomes	< of 8.000 wages	< of 40.000 wages	> of 40.000 wages
average of assets	< of 6.000 wages	< of 30.000 wages	> of 30.000 wages

Table 1: *SMEs definition [2]*

SMEs have a huge contribution for economics activities in the country and usually are appointing the question: What are the reasons and advantages of SMEs and why are they so important for country development?

SMEs are expected to boost efficiency and growth and they lead the economy development because:

- SMEs constitute the most dynamic segment of many transition and developing economies
- they are engine of job creation

- SMEs boost the innovations, entrepreneurship , competition and flexibility
- important role in promoting growth and development

The other advantages of SMEs establishment are:

- direct control of the costs;
- easier and cheaper function control;
- more liberal and free flows for entering a foreign capital;
- faster noticing of the direction for more successful investments, innovations and market participation;
- team work;
- bigger responsibilities in work organization, etc.

In most economies, SMEs are much greater in number than big enterprises. In the EU, SMEs comprise approximately 99% of all firms and employ about 65 million people. In many sectors, SMEs are also responsible for setting up innovation and competition. Globally SMEs account for 99% of business numbers and 40% to 50% of GDP.

The most important condition for SMEs development is the business environment.

There are many terms used to describe the conditions in which SMEs operate. The term “investment climate” is the broadest and most commonly used. It refers to the location – specific factors that shape the opportunities and incentives for firms to invest productively, create jobs and expand. There are three key elements of the investment climate. The first is costs, which are most commonly affected by the burden of regulation, taxes, corruption, infrastructure services and the cost of finance. The second is risks, which refers to policy predictability, property rights and contract enforcement affecting investment risks. The third is barriers to competition, which is affected by the regulations controlling business start-up and bankruptcy, competition low, and entry to finance and infrastructure markets. The other used term is business environment it gives attention to the role of business in creating investment and economic growth. [3]

The most important measures to improve the business climate and to increase the SMEs are:

- economic and political stability

- cheaper and faster start –ups
- better legislation and regulations
- availability of skills
- education and training for entrepreneurship
- getting more out of the single market
- tax relief
- financial support for SME
- strengthening the SME technological capacity
- developing stronger, more effective representation of SME interests
- one –stop shop system
- strengthening the infrastructure for SME support

2. Actuality with SMEs in Republic of Macedonia

Private sector development has started since 1990. In 1990 7234 enterprises were established and in 2009 there were 70 710 active enterprises.

The sectors with the highest share in the structure of business entities were: wholesale and retail sale; repair of vehicles, motorcycles and personal and household goods with 29 270 entities or 41.4% and manufacturing with 8 225 entities or 11.6%, whereas the least represented were the sectors fishing with 57 entities or 0.1% and mining and quarrying with 144 entities or 0.2%.

There were no registered business entities in 2009 in the sectors Private households employing domestic staff and undifferentiated production activities of households for own use and Extra-territorial organizations and bodies.

The data on the structure of active business entities according to the number of employed shows that the highest share of 84.0% belongs to business entities with 1-9 employed, followed by business entities without employed (or the entities did not provide information about employed) with 8.8%, and entities with 10-19 employed with 3.1%. The share of entities with 20-49 employed was 2.1%, those with 50-249 employed participated with 1.6%, while entities with 250 or more employed had a share of only 0.3%. [7]

Considering the fact than SMEs have the important role of economy development the number of SME has been steadily increasing.

	1991	1994	1997	1999	2000	2001	2002	2003	2004	2005	2009
SMEs	9,703	28,551	32,934	31,204	33,151	34,991	36,963	39,096	41,517	44,340	70,506
All-active	10,270	29,157	33,455	31,795	33,269	35,110	37,074	39,199	41,590	44,424	70,710

Table 2: Number of SMEs in Republic of Macedonia [6]

Sector	small	medium	Large
Agriculture, hunting and forestry	2778	32	5
Fishing	57	-	-
Mining and quarrying	133	7	4
Manufacturing	7787	364	74
Electricity, gas and water supply	93	22	9
Construction	3944	53	7
Wholesale and retail sale; repair of vehicles, motorcycles and personal and household goods	29165	96	9
Hotels and restaurants	3920	17	1
Transport, storage and communication	6459	26	11
Financial intermediation	308	17	9
Real estate, renting and business activities	6161	41	13
Public administration and defence; compulsory social security	146	47	26
Education	677	274	3
Health and social work	3106	119	21
Other community, social and personal service activities	4613	44	12
Private households employing domestic staff and undifferentiated production activities of households for own use	-	-	-
Extra-territorial organizations and bodies	-	-	-
Total	69347	1159	204

Table 3: *The table below indicates the number of active enterprises in Republic of Macedonia by sectors and number of employed [6]*

Financing of SMEs - The process of financing is important for enterprises existence. The financial situation is one of the key characteristics of every enterprise.

There are many resources for financing the SMEs in Republic of Macedonia but there is mainly need for:

- medium- and long term finance, especially for equipment purchase;
- working capital credit lines, including seasonal and sector specific;
- more complex products such as factoring, leasing and professional and affordable payment services;
- export financing, including reverse factoring, pre-order purchase finance;

And alternative financial instruments for small and medium sized companies are:

- real estate leasing
- long-term equipment purchase
- mortgages
- mezzanine finance
- private equity investment

SMEs and Employment - one of the important advantages of SMEs is creating new working places. In 2005 the number of employed in small, medium and large enterprises was 267.251 and 54,4% of them were employed by small enterprises and 21.3% by medium-sized enterprises. This illustrates the importance of SME sector for job creating (¾ or 75.7% of employ were employed in SME).[4]

Considering the advantages of establishing and functioning small and medium enterprises every national economy should make a reforms to develop them.

SMEs and Foreign Trade – Since independence trading with foreign countries has generated trade deficit, that is a big problem for the Macedonian economy and it is necessary to take measures for increasing the export and the main objective is to make Macedonian products more competitive on the foreign markets.

Country	export in thousand dollars January February 2010
German	86 807
Russia	1 737
Greece	32 705
Serbia	26 443
Bulgaria	43 900
Italy	27 003
Kosovo	51 606
China	11 196
Turkey	6 432
Croatia	18 039
Slovenia	5 253
Great Britain	6 350
Belgium	20 134
Romania	2 477
Switzerland	1 872
Netherlands	8 270
Spain	8 685
Bosnia-Herzegovina	9 852
Ukraine	243
Austria	3 391
Total	401 019

Table 4: *Countries in which Macedonia enterprises export in [5]*

Unfortunately the SME operate mainly in the domestic markets, and have a very small percentage in export.

3. Improving the business environment in Republic of Macedonia for SME development

The Business climate in Republic of Macedonia has the main role for economic activities and for boosting the economy.

According to the Doing business report 2009 Republic of Macedonia has done a lot of improvements in business climate. An analysis of business climate in R. Macedonia was performed according to the dates from

Doing business report for 2006 and 2009. That reports include the following criteria:

- starting a business;
- dealing with construction permits;
- employing workers;
- registering property;
- getting credit;
- protecting investors;
- paying taxes;
- trading across borders;
- enforcing contracts;
- closing a business.

Macedonia Easy of doing business (rank) 81				
Starting a business			Registering property	
Procedures (number)	13		Procedures (number)	6
Time (days)	48		Time (days)	74
Cost (% of income per capita)	11.3		Cost (% of property value)	3.6
Minimum capital (% of income per capita)	145.2		Getting credit	
Dealing with licenses			Strength of legal rights index (0-10)	
Procedures (number)	18		6	
Time (days)	241		Depth of credit information index (0-6)	
Cost (% of income per capita)	67.5		3	
Hiring and firing workers			Public registry coverage (% of adults)	
Difficulty of hiring index (0-100)	61		1.9	
Rigidity of hours index (0-100)	60		Private bureau coverage(% of adults)	
Difficulty of firing index(0-100)	40		0.0	
Rigidity of employment index(0-100)	54		Protecting investors	
Hiring cost (% of salary)	33		Extent of disclosure index (0-10)	
Firing cost(weeks of salary)	41		5	
			Extent of director liability index (0-10)	
			7	
			Ease of shareholder suits index (0-10)	
			6	
			Strength of investor protection index (0-10)	
			6.0	
			Paying taxes	
			Recovery rate (cents on the dollar)	
			15.4	
			Payments (number)	
			54	
			Time (hours per year)	
			96	
			Total tax payable (% of gross profit)	
			40.1	

Table 5: *Doing business ranking - Republic of Macedonia in 2006 [7]*

Source: Doing business report 2006

Macedonia Easy of doing business (rank) 71				
Starting a business		Registering property		Trading across borders
Procedures (number)	7	Procedures (number)	6	Documents for export (number) 6
Time (days)	9	Time (days)	66	Time to export (days) 17
Cost (% of income per capita)	3.8	Cost (% of property value)	3.4	Cost to export (US\$) 1.315
Minimum capital (% of income per capita)	0.0	Getting credit		Documents to import (number) 6
Dealing with licenses		Strength of legal rights index (0-10) 7		Time to import (days) 15
Procedures (number)	21	Depth of credit information index (0-6) 4		Cost to import (US\$) 1.325
Time (days)	198	Public registry coverage (% of adults) 6.5		Enforcing contracts
Cost (% of income per capita) 1.862.8		Private bureau coverage(% of adults) 0.0		Procedures (number) 38
Hiring and firing workers		Protecting investors		Time (days) 385
Difficulty of hiring index (0-100)	50	Extent of disclosure index (0-10) 5		Cost (% of debt) 33.1
Rigidity of hours index (0-100)	60	Extent of director liability index (0-10) 6		Closing a business
Difficulty of firing index(0-100)	30	Ease of shareholder suits index (0-10) 4		Time (year) 3.7
Rigidity of employment index(0-100)	47	Strength of investor protection index (0-10) 5.0		Cost (% of estate) 28
Firing cost(weeks of salary)	26	Paying taxes		Recovery rate (cents on the dollar) 16.7
		Payments (number) 40		
		Time (hours per year) 75		
		Total tax payable (% of gross profit) 18.4		

Table 6: *Doing business ranking - Republic of Macedonia [7]*

As we can see from the data Republic of Macedonia has huge progress in starting a business (today you can start a business for 7 days thanks to the introduction of the one stop shop system) and paying taxes thanks to the tax reliefs.

The most important condition for SMEs establishing is macroeconomic stability. The economics performance of the Macedonian economy is expressed through stable GDP growth of around 4%, a low rate inflation rate of 3% on average, fiscal discipline confirmed by the international financial institutions and a well- functioning coordination between fiscal and

monetary policy. In 2006, the Macedonia economy grew by 4%, which was both services and industry-driven. Inflation, as measured by the Consumer Price Index (CPI), was low and stable at 3.1%. The central government budget deficit in 2006 was only 0.5% of GDP, with surpluses on foreign accounts and the current account deficit around 1% of GDP. Furthermore, foreign exchange reserves increased to about 5 months of imports. These positive effects from a disciplined fiscal policy were reflected in monetary policy, causing a significant reduction in interest rates, which were 8% at the end of 2005 and 5.5% at the end of 2006. [4]

	2005	2006
GDP (real growth rates)	4,1	3,2%
GDP (USD Bn)	5,78	6,2
Inflation (December December)	1,2	2,9
Inflation (average)	0,5	3,2
Retail Price Index (December December)	3,2	2,9
Retail Price Index (average)	2,1	3,9
Unemployment Rate (in %)	37,3	35,9
Budget deficit	0,2	- 0,56
Money supply M1 (percentages changes, December December)	7,5	17,1
Money supply M2 (percentages changes, December December)	12,4	31,5
Money supply M4 (percentages changes, December December)	15,1	24,9
Weighted lending interest rates (in %,p.a)	12,1	11,3
Weighted lending interest rates (in %,p.a)	5,2	4,7
Average exchange rate MKD/EUR	61,3	61,2
Average exchange rate MKD/USD	49,3	48,8
Exports f.o.b (in million of USD)	2.039,6	2.396,3
Imports f.o.b (in million USD)	3.097,6	3.681,5
Trade balance f.o.b (in million USD)	- 1.057,5	-1.285,2
Current account balance (in million USD)	-81,5	-23,7
Current account balance (as % of GDP)	-1,4	-0,4
Gross foreign reserves (stock, end period)	1.324,7	1.865,8
Import coverage (gross foreign reserves/import f.o.b plus payments for services) in months	4,4	5,3
Total external debt (stock, end of period, in million of USD)	2.274,8	2.434,7
Total debt services (in million of USD)	234,4	481,5
Total external debt (as % from GDP)	39,1	39,2

Table 7: *Main economics indicators for Republic of Macedonia [8]*

Conclusion

The small and medium enterprises are the main factor for national economy development especially in developing countries where the processes of transitions are more and more frequent. The basic advantage of SMEs is the adaptation and the probability for transfer in the other sectors which is very important for realizing gain nowadays in terms of quick changes. The other advantage of SMEs is that the needed funding capital is smaller than the funding capital for the other enterprises, so many people can afford starting new business. SMEs participate in creating the GDP, they have an influence at the rate of employment, actually they engine job creation and they help improving the living standard of the people, so they can have a better life in the national economy. Considering in all these advantages of SMEs founding every national economy should take measures to improve the business climate for SMEs acting and to increase their number. In Republic of Macedonia a lot of measures are taken in order to provide SME development.

- improving the judicial system;
- declining the procedures and administrative burdens;
- adequate access to finances and high interest rates;
- increasing the productivity, quality and competitiveness of products;
- initiation of new technologies and transfer of know-how;
- entrepreneurial formal education (particularly in elementary and secondary schools);
- decreasing gap in the cooperation among education and business sector
- decreasing the corruption and strong political influence
- legal protection of creditors and enforcement of laws in general
- increasing the investments in SMEs sector
- creating a National strategy of the Government on development of SMEs

- SMEs support institutional infrastructure (Agency for Entrepreneurship promotion, Regional economics development centers, Entrepreneurship promotion agencies, Business incubators);
- cheaper and faster start – up (easier company registration with the establishment of one – stop shops now operational and a reduction in company registration numbers (only three required);
- relatively low –cost, skilled labor; etc.

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Manual for Authors

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

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Abstract - *These are instructions for preparing papers that will be included in the journal. 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)

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

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.

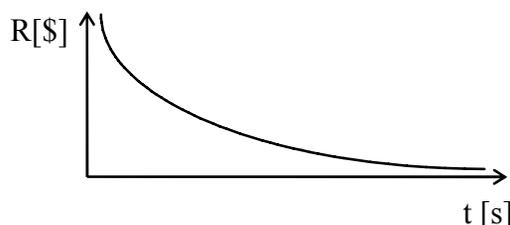


Figure 1. Graphic presentation of results

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.

- [1] Banks, J. and S.J. Carson., Discete - Event System Simulation Prentice - Hall, New - Jersey, 1984.
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