4th INTERNATIONAL SYMPOSIUM OF INDUSTRIAL ENGINEERING

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STEINBEIS ADVANCED RISK TECHNOLOGIES
STUTTGART, GERMANY

PROCEEDINGS

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Mirjana Misita

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PREFACE

The International Symposium of Industrial Engineering – SIE is the 4th event of series international forums for dissemination and exchange of scientific information in industrial engineering field. Up to now the symposium gathered together scientists and researchers from many countries: Serbia, Montenegro, Croatia, Slovenia, Bosnia and Herzegovina, Macedonia, UK, Germany, Romania, Portugal, Canada, USA…

The aim of the Symposium is to exchange views, opinions, experiences, current achievements and future trends in the field of industrial engineering. The Proceedings contain more than 50 papers. Most of the authors of contributed papers are experts in IE. The papers are grouped in four principal sessions:

Session A – Industrial Engineering Functions

Session B – Quality, Maintenance and Logistics Management

Session C – Decision Making and Control in IE and

Session D – Organizational Behavior and Human Factors.

Proceedings also contain four invited papers presented in Plenary Session that reflect the wide spectrum of important and new topics in IE.

We would like to express our thanks o all members of the Scientific and Organizing Committee, reviewers and participants for their valuable contributions.

Welcome to the 4th International Symposium of Industrial Engineering – SIE 2009!

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4th INTERNATIONAL SYMPOSIUM OF INDUSTRIAL ENGINEERING

SIE 2009

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CHALLENGES FACING ENGINEERING EDUCATION

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ABSTRACT

National Academy of Engineering in the United States of America has published several documents that outline requirements and challenges for engineering education in the next decade. The National Science Foundation is providing funding opportunities in innovative approaches to engineering education. In essence, these documents point out that universities should educate multifaceted engineers that can function in a rapidly changing world, and engineers that will have an ability to think creatively about complex issues. In order to do that, universities need to "re-engineer the engineering education". The paper reviews the requirements from the engineering educators, and provides several examples of innovative practices, ranging from the latest emphasis for funding from the National Science Foundation to several examples of implementation practiced by the author.

Keywords: engineering education challenges, Engineer 2020, sustainability, interdisciplinary, senior and freshman design

1. INTRODUCTION

In the recent years it has become apparent that the world is dynamic[1]. The old paradigms, such as "an engineer works for one company throughout his /her working life" or "types of technical work that he/she performs do not change", are beginning to fade in public's perception. Technology changes so rapidly that it enables companies to increase product quantity and quality. The communication barriers are largely disappearing to open pathways for global connectivity and production. The emerging situation will undoubtedly speed up the change even further in the very near future. Recognizing the challenges, the National Academy of Engineering in the United States of America has said that to prepare for this change "it is agreed that innovation is the key and engineering is essential to this task; but engineering will only contribute to success if it is able to continue to adapt to new trends and educate the next generation of students so as to arm them with the tools needed for the world as it will be, not as it is today."[2] In addition to assuming that the pace of technological innovation will continue to be rapid and most likely accelerate, and that world in which technology will be deployed will be intensely globally interconnected, the report goes even further to assume that the population of individuals who are involved with or affected by technology (e.g., designers, manufacturers, distributors, users) will be increasingly diverse and multidisciplinary; that the social, cultural, political, and economic forces will continue to shape and affect the success of technological innovation; and that the presence of technology in our everyday lives will be seamless, transparent, and more significant than ever. For engineers to rise to that challenge, they will have to have the following attributes[2]:

- Strong analytical skills and practical ingenuity – will now be applied to broader aspects, that include social, economic, legal and other constraints
- Creativity - creativity will grow in importance. The creativity requisite for engineering will change only in the sense that the problems to be solved may require synthesis of a broader range of interdisciplinary knowledge and a greater focus on systemic constructs and outcomes
- Communication - in the new century the parties that engineering ties together will increasingly involve interdisciplinary teams, globally diverse team members, public officials, and a global customer base. Communication is enabled by ability

to listen effectively as well as to communicate through oral, visual, and written mechanisms and use virtual communication tools

- Business and management - policy decisions in technological societies will demand the attention of leaders who understand the strengths and limitations of science and technology.
- Leadership, high ethical standards and professionalism - the choices will be gray in nature, balancing (for example) economic, social, environmental, and military factors. Leaders, and those who influence these choices, will benefit from a sense of purpose and clarity. Successful engineers in 2020 will, as they always have, recognize the broader contexts that are intertwined in technology and its application in society.
- Dynamism, agility, resilience, and flexibility – lifelong learners - not only will technology change quickly, the social-political-economic world in which engineers work will change continuously. In this context it will not be this or that particular knowledge that engineers will need but rather the ability to learn new things quickly and the ability to apply knowledge to new problems and new contexts. Career trajectories of engineers will take on many more directions—directions that include different parts of the world and different types of challenges and that engage different types of people and objectives.

It is the abovementioned attributes of Engineer 2020 that will be needed to resolve such urgent and essential problems as providing access to clean water for all humans, animals and plants, produce electric power sustainably, eliminate waste, etc. The grand challenges in which engineers play essential roles[3] will have to be resolved in the not-so distant future. So, is today's engineering education adequate for the challenge of educating Engineer 2020? The report [2] concludes that significant changes need to be made in the engineering education in order to produce successful graduates.

2. IMPLICATIONS FOR ENGINEERING EDUCATION

So, how do we educate the engineers who are able to solve the grand challenges and perform in the global environment? The National Academy of Engineering produced another report on educating the Engineer 2020, in which they state that the engineering educational system in the United States needs to be "reengineered." While many of their suggestions pertain to educational institutions in the US, I am including them here in their entirety:

1. The baccalaureate degree should be recognized as the "preengineering" degree or Bachelor of Arts in engineering degree, depending on the course content and reflecting the career aspirations of the student.

2. ABET should allow accreditation of engineering programs of the same name at the baccalaureate and graduate levels in the same department to recognize that education through a "professional" master's degree produces an AME, an accredited "master" engineer.

3. Engineering schools should more vigorously exploit the flexibility inherent in the outcomes-based accreditation approach to experiment with novel models for baccalaureate education. ABET should ensure that evaluators look for innovation and experimentation in the curriculum and not just hold institutions to a strict interpretation of the guidelines as they see them.

4. Whatever other creative approaches are taken in the four-year engineering curriculum, the essence of engineering—the iterative process of designing, predicting performance, building, and testing—should be taught from the earliest stages of the curriculum, including the first year.

5. The engineering education establishment, for example, the Engineering Deans Council, should endorse research in engineering education as a valued and rewarded activity for engineering faculty as a means to enhance and personalize the connection to undergraduate students, to understand how they learn, and to appreciate the pedagogical approaches that excite them.

6. Colleges and universities should develop new standards for faculty qualifications, appointments, and expectations, for example, to require experience as a practicing engineer, and should create or adapt development programs to support the professional growth of engineering faculty.

7. As well as delivering content, engineering schools must teach engineering students how to learn, and must play a continuing role along with professional organizations in facilitating lifelong learning, perhaps through offering "executive" technical degrees similar to executive MBAs.

8. Engineering schools introduce interdisciplinary learning in the undergraduate environment, rather than having it as an exclusive feature of the graduate programs.

9. Engineering educators should explore the development of case studies of engineering successes and failures and the appropriate use of a case-studies approach in undergraduate and graduate curricula.

10. Four-year engineering schools must accept it as their responsibility to work with their local community colleges to ensure effective articulation, as seamless as possible, with their two-year programs.

11. U.S. engineering schools must develop programs to encourage/reward domestic engineering students to aspire to the M.S. and/or Ph.D. degree.

12. Engineering schools should lend their energies to a national effort to improve math, science, and engineering education at the K-12 level.

13. The engineering education establishment should participate in a coordinated national effort to promote public understanding of engineering and technology literacy of the public.

14. National Science Foundation should collect and/or fund collection, perhaps through ASEE or the Engineering Workforce Commission, of comprehensive data by engineering department/school on program philosophy and student outcomes such as, but not exclusively, student retention rates by gender and ethnicity, common reasons why students leave, where they go, percent of entering freshman that graduate, time to degree, and information on jobs and admission to graduate school.

3. EXAMPLES OF INTEGRATING SUSTAINABILITY INTO ENGINEERING EDUCATION

Last May, I served on the review committee for a program entitled "The Innovations in Engineering Education, Curriculum, and Infrastructure (IEECI) – Integrating Sustainability into Engineering Education" [5] at The National Science Foundation (NSF) in Arlington, VA. IEECI asked for proposals which develop greater student understanding of and technical expertise in critical issues of sustainability. The program announcement stated the following: "Sustainable development marries two important themes: that environmental protection does not preclude economic development and that economic development must be ecologically viable now and in the long run. Dealing with sustainability requires the ability to think creatively about complex systems from an engineering, environmental, ethical and economic perspective simultaneously. At present our undergraduate and graduate students have too few opportunities to develop this important capability, and we seek proposals which will reverse this situation." Several hundred proposals were submitted and I had access to about 30. Those that were funded can be found on NSF's web site. During the proposal review process, I noticed several themes worth noting in this paper that pertain to the overarching goal of challenges facing engineering education, namely:

1. What are and how to measure the attributes of a student who is educated on the topic of sustainability?
2. Is there space in the curriculum? That is, how to incorporate principles of sustainability into already full engineering curriculum?
3. Faculty resistance for many reasons, namely resistance to change, fear there is no space in the curriculum, (that is, how to incorporate principles of sustainability into already full engineering curriculum?), incompetence, not understanding the need. Faculty must be educated on the importance of sustainability and how to implement it in the university.
4. Support from the Deans for broader applications and funding throughout the university, release time for developing new programs, etc.
5. Partnership with industry. Industry is the customer and the universities supply it with graduates.
6. Interdisciplinary collaborations between faculty and students.

The proposals addressed the abovementioned issues in the following ways:

1. Defining program educational outcomes and specific course outcomes is the first step in planning. Next is implementation, finding how students best learn the ideas, principles, and practices to become creative and innovative engineers, and how this learning is measured, using both objective and subjective measures.
2. The space in the curriculum problem has been solved in many creative ways in the proposals. For example, it was proposed to modify existing projects, in one or several courses spanning from freshman to senior year, to include sustainability-related technical expertise.
3. Faculty is motivated to change if they understand the benefits to the students and to their professional careers. This can be accomplished through seminars and

through professional mentoring within the university and professional community.

4. The support from the university has to be established, one that would allow faculty appropriate rewards for implementing new programs. And one that would incorporate sustainability, interdisciplinary problem solving, etc, as part of the program educational outcomes.
5. Industrial advisory board established by professionals in the field of sustainability is seen as one of the key components in formulating a meaningful program change both in how the program is run and in establishing the meaningful attributes of engineering graduates. Engineering internship programs and senior capstone projects are another example of how industry can be meaningfully involved.
6. Interdisciplinary collaborations are always very difficult due to different requirements in different disciplines, approaches to solving problems, etc. However, with careful planning, these difficulties could be overcome to the benefit of the students.

The abovementioned examples are just a few that engineering educational practitioners are beginning to embrace in order to develop programs that can successfully educate Engineer 2020.

4. DESIGN PROJECT EXAMPLES

These two examples will be explained in detail during the presentation. They are or have been practiced by the author at Seattle University, and have achieved some interest.

One of the most valuable learning experiences of Seattle University Mechanical Engineering students is the Senior Design team project that all are required to do in a year-long, industry-sponsored setting. An industrial sponsor sets project requirements and deliverables in the beginning, and students are usually tasked to provide a design solution in form of a device, and in written and oral formats. I will provide examples of two interdisciplinary projects related to fuel production from algae that my students have completed under the sponsorship of Bioalgene and Boeing. One involved a photobioreactor design and the other a design of an electroporation device that breaks the cell membrane and opens pores so lipids can ooze through for about $0.01/gallon of fuel.

Another innovative example is of a learning community developed to enhance the teamwork and communication components of a freshman design course[6]. The learning community was comprised of students from a freshman design course, a freshman graphics course, and a high school technology course. Design teams were formed by combining three to four students from each of these courses. These teams were required to research, design, build and test a specified product. The high school and university students communicated only using emails and Internet conferencing. This paper outlines how the learning community is implemented, describes three design projects, and presents the assessment methods. Assessment reveals that university students who participate in the learning community have a better understanding and confidence in the technical aspects of the design project than the students who do not participate in the learning community. It also reveals that high school participants display notable interest in the engineering design process.

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AUGMENTATIVE INTEGRATION OF STANDARDIZED MANAGEMENT SYSTEMS*

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Abstract:
In the design and use of management systems (MSs) based on international standards, "augmentation" can be taken to denote the application of specific MS standards (e.g., ISO 10001 on customer satisfaction codes of conduct) to strengthen and improve a single component of a minimal-requirement MS (e.g., a quality MS following ISO 9001). "Integration" can refer to the often-applied practice of the unification of minimal-requirement or augmented MSs in an organization. Thus, "augmentative integration" represents the process of combining two or more augmentative standard - based MSs. In this paper and the corresponding keynote address, a short theoretical and empirical discussion on the standardization of MSs is provided first. Some empirical results related to the integration of standardized management systems and a framework featured in the ISO integration handbook, which was published last year, are addressed next. An illustration of several augmentative standards follows, particularly focusing on their ability to foster both augmentative and traditional integration. Augmentative integration is then discussed in more detail and with examples.

Key Words:
Quality Management, Integrated Management Systems, ISO 9000, ISO 10000, ISO 14000

1. INTRODUCTION

Some nine months ago, at a plenary meeting in Tokyo, Technical Committee (TC) 176 of the International Organization for Standardization (ISO) established a Task Group (TG) on Portfolio Management and appointed me as the convenor of this TG. The portfolio of ISO/TC176 encompasses ISO 9000 and ISO 10000 standards on quality assurance and management, including probably the most widely known and applied ISO standard in the world, namely ISO 9001. Apart from ISO 9001, though, there are many other and largely new standards in the portfolio that are not nearly as recognized, yet can be as useful, to industrial engineers and organizations in general, as ISO 9001 was. This is especially true if the systems based on these standards are integrated, which can in turn build upon the related and clear strength of industrial engineers. It is therefore a pleasure for me, as an industrial engineer, to discuss the topic of augmentative integration of standardized management systems at this gathering, and particularly at my undergraduate alma mater.

Although the last couple of years have been full of various new developments in the world of standardized management systems (MSs), the notions of their augmentation and integration seem to have finally come to the fore. On the augmentation side, a number of new standards that can be applied to create stand-alone MSs or to enhance a particular subsystem of the overarching MS (see, e.g., Karapetrovic (2008A) for additional features of these standards), were either published or are being developed. For instance, exactly two years ago, ISO has completed the "complaint system for customer satisfaction" (CSCS) series of quality management system (QMS) standards, with the publication of ISO 10001 on codes and ISO 10003 on dispute resolution to complement the existing ISO 10002 on complaint handling (see, e.g., Dee et al. (2004) for more detail on the CSCS series). The systems based on these and other "Augmentative Standards" (AUGSs), e.g., ISO 19011 on MS auditing and ISO 10012 on measurement MSs, can be effectively integrated, both amongst themselves ("augmentative integration") and with other standardized MSs ("traditional integration"). This integration feature of AUGSs holds a particularly

promising future in the research and practice of standardized MSs (e.g., see Karapetrovic, 2008A).

Further increasing the potential scope for the integration of standardized MSs in organizations, ISO also announced the development of two brand-new management system standards (MSSs) in 2008, namely the ones for road safety and energy management. However, this "avalanche" of MSSs has been "channelled" with the July 2008 publication of the ISO book on their integrated use (ISO, 2008). Such a book was very much needed, especially since past research seemed to have largely focused on the models of integrated management systems (IMSs), rather than on the integration methodologies, which were particularly required in practice (see Karapetrovic and Jonker, 2003).

The following section discusses the design and use of MSSs, in other words the standardization of MSs. Subsequently, an overview of several AUGSs, emphasizing their augmenting features and integrative context, is provided. An illustration of some empirical results and the new ISO handbook on integration forms the analysis of integration methodology issues. The conclusion further addresses the importance of augmentation and integration in the research and practice of standardized MSs.

2. STANDARDIZATION

Apart from the AUGSs, two other groups of MSSs are being written by ISO and other standardization bodies, and subsequently implemented in various organizations (e.g., see Karapetrovic et al., 2006). "Assimilating Standards" (ASSIMSs) contain the minimal-requirement frameworks that organizations apply in order to establish general function-specific or stakeholder-focused MSs. Examples of ASSIMSs include ISO 14001 and CSA Z1000 for environmental and safety management, respectively, as well as ISO 27001 and ISO 28000 for information and supply chain security, respectively. In addition, new "Ascending Standards" (ASCSs), such as ISO/TS 16949 for the automotive industry and ISO 22000 for food safety, have joined the generic ISO 9004 and ISO 14004 and numerous Business Excellence Models (BEMs), to form the third group by providing additional criteria for all MS components in order to improve the overall performance level of an organization.

It is also interesting to illustrate some related empirical results, which point out the need for augmentation and integration in order to capitalize on the application of these MSSs and the respective MSs. The results come from a survey of 529 ISO 9001-registered companies in the Spanish region of Catalonia, with 353 of those having the ISO 9001 certificate only and exhibiting a 20% response rate, and the remaining 176 organizations having registered to at least ISO 9001 and ISO 14001 and responding with a 33% rate (see Karapetrovic et al. (2006) for full details on the survey). When asked to rank their preference for the future application of either AUGSs, ASSIMSs, BEMs or an alternative not to add any new standards or models, most companies from the ISO 9001-only group placed the first priority on AUGSs (31%), followed by ASSIMSs (27%) and BEMs (24%), with only 18% of the companies indicating the first preference for the "add nothing" option. Not surprisingly, companies with multiple registrations preferred ASSIMSs at 43%, BEMs at 22%, then AUGSs at 20%, and finally 15% ranked the "add nothing" option first. Looking at such preferences for the standards overall, as well as for AUGSs and ASSIMSs specifically, it is clear that augmentation and integration alike will be in demand. As mentioned previously, taking these two notions together leads to the practice of "augmentative" integration, which is focused on the integration of AUGSs-based systems and can be conceptualized as a type of integration in addition to the "traditional", i.e., ASSIMSs-focused, integration (e.g., see Karapetrovic (2008A) and (2008B) for a related discussion). The following sections therefore address "traditional" and "augmentative" integration, the latter type in a bit more detail, including some examples of conceptualization and application that will be presented in the keynote address.

3. TRADITIONAL INTEGRATION

Due to the long existence of the various ASSIMSs, such as ISO 9001 (22 years) and ISO 14001 (13 years), the integration of the corresponding minimal-requirement systems has been widely practiced. For instance, the available research, e.g., Douglas and Glen (2000), Karapetrovic et al., (2006) and Bernardo et al. (2009), shows that a significant majority of companies with two or more ASSIMSs certificates integrate their standardized MSs. The survey illustrated in Karapetrovic et al. (2006), specifically focused on the integration methodology issues in those organizations, such as the resources and techniques used in the integration, as well as the auditing of their IMSs. The results include the prevalence of the process mapping for MSs and the analysis of the "common elements" of MSSs as the integration methods applied by 93% and 92% of the respondents, respectively (Karapetrovic et al., 2006).

Also addressing a number of integration methodology issues is the new ISO handbook on the "Integrated Use of MSSs" (ISO, 2008). By

providing a flexible eleven-step framework for the integration of the requirements of both the generic ASSIMSs and the industry sector-focused ASCSs into the organizational MS, the handbook clearly differentiates the integration of standardized MSs from the integration of MSSs (see, e.g., Karapetrovic and Jonker (2003) for a further discussion on this issue). Guiding an organization through the integrative implementation of one or more MSSs, the handbook suggests the *understanding* and tailored *structuring* of both the *MS* (in Chapter 1 and Subsection 3.4.1, respectively) and the *MSS(s)* being implemented (in Chapter 2 and Subsection 3.4.2, respectively), followed by the *mapping* (3.4.3) and *incorporation* (Section 3.5) *of the MSS(s) requirements into the MS*. The subsequent steps of *maintenance and improvement* (3.6) and *applying the lessons learned* (3.7) can loop back to any one of the first three steps, namely *leading* (3.1), *determining the scope* (3.2) *and planning* (3.3) *the integration*. Some further details on the handbook and its underlying concepts will be provided in the keynote address.

4. AUGMENTATIVE INTEGRATION

Since the standards from the CSCS series and ISO 19011 provide a representative sample of both the established and upcoming AUGSs, these four documents will be briefly illustrated here. Another document that is just about to be added to the published ISO/TC176 portfolio, namely the Technical Specification (TS) on customer satisfaction monitoring and measurement ISO/TS 10004, will be discussed in the example of augmentative integration presented during the keynote address.

The AUGSs that have been in existence for a number of years now seem to have been used successfully worldwide. For instance, Clark (2007) reports that the Financial Ombudsman Service in the United Kingdom applies ISO 10002 as "*the framework for handling over 100,000 complaints per year*", while Karapetrovic et al. (2006) found that about a third of ISO 9001-registered companies in Catalonia conduct their internal audits according to ISO 19011. Karapetrovic et al. (2006) survey results indicate that a similar trend may continue for the recently-developed AUGSs, e.g., ISO 10001, ISO 10002 and 10003.

The shortest standard in the CSCS family, ISO 10001 covers the processes for creating and using product-related promises made to an organization's customers (Dee et al., 2004). Unlike ISO 10001, which facilitates the implementation of a simple framework for code establishment, ISO 10002, ISO 10003 and ISO 19011 provide guidance for the setup of a complete complaint-handling, dispute-resolution, and auditing MS, respectively, including all the necessary MS elements, such as MS performance evaluation and review. The CSCS standards are characterized by identical structures (Dee et al., 2004), which are fully compatible with ISO 19011.

Several of the AUGSs' characteristics make the related augmentative systems very flexible for different integration possibilities. Unlike the "traditional" integration, which is by definition cross-functional and must combine at least two overall MSs, integration of augmentative systems can be accomplished in both the horizontal and the vertical direction (Karapetrovic, 2008A). For example, an augmentative system established in accordance with any of the CSCS standards can be vertically integrated within an overall CSCS (e.g., see Dee et al., 2004), then at the next level up within, for instance, an ISO 9001-based or with an ISO 28000-compliant MS, and also within the overarching IMS. This integration can be done regardless of which underlying model is used to provide the framework for the higher-level function-specific MS or IMS (see, e.g., Karapetrovic and Jonker, 2003). Using the structure of ISO 10001 as an example, Karapetrovic (2008B) illustrates how the framework underlying the CSCS standards can be integrated into the "process model" of ISO 9001 and similar MSSs, the "PDCA approach" of ISO 28000 and analogously-structured MSSs, as well as any standardized IMS model.

However, the real advantage of AUGSs rests with the horizontal integration, where systems are used to augment each other and are combined more naturally (Karapetrovic, 2008A). For example, an ISO 10001-based system can be established by building on the MS components from other AUGSs, e.g., ISO 10002 and its sections on "*commitment*" (5.1), "*policy*" (5.2), "*responsibility and authority*" (5.3), and "*management review*" (8.6), as well as ISO 19011 to setup internal auditing. The same can be said for complaint-handling and dispute-resolution systems, which can be integrated themselves and use ISO 19011 for the auditing component of this integrated complaint-resolution system. In turn, the auditing system in an organization can use ISO 10001 for setting up codes related to its performance, as well as ISO 10002 and ISO 10003 for dealing with any complaints or feedback on auditing.

5. EXAMPLES

Some further examples of conceptualization and application of augmentative integration will be illustrated in the keynote address. In terms of the

conceptualization, these examples will focus on the flexibility of use of different AUGSs in forming the integrated management system. For instance, various combinations of two (e.g., ISO 10001 and ISO 19011), three (e.g., ISO 10001, ISO 10002 and ISO 19011), four (e.g., if ISO/TS 10004 is added to the preceding example), or even five or more systems based on AUGSs are possible, if needed.

On the application side, examples will be shown from the use of AUGSs in engineering education (e.g., see Karapetrovic (2009) and Karapetrovic and Doucette (2009) for further details). As the standards were applied in courses usually covered in industrial engineering curricula, this particular application should be additionally interesting to the seminar audience.

6. CONCLUSION

At least six standards originally or currently belonging to the ISO 10000 series represent examples of a new "species" of augmentative standards and have an outstanding potential for application and integration within organizational MSs (e.g., see Karapetrovic, 2008A). Although the benefits of the development of new MSSs are sometimes questioned, the integration of standardized MSs seems to be set for growth as an area of both practice and research. One important related development is the recent publication of the ISO book "The Integrated Use of Management System Standards" (ISO, 2008). Augmentative integration, as discussed here, is a particularly promising area of both research and practice for industrial engineers.

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CHAOS AND COMPLEXITY MANAGEMENT IN ORGANIZATIONS: BASIC DEFINITIONS AND SOME IMPLICATIONS FOR MODERN MANUFACTURING SYSTEMS (INVITED LECTURE)

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Keywords

Complexity, Chaordic System Thinking, Organization, Organizational Sustainability Manufacturing System

Extended Abstract

Chaos and complexity management in organizations is an emerging management discipline, and an emerging management paradigm, aiming to provide the organizations with capabilities such as capability for real novelty, "flow" organizational structures (instead of fixed ones), higher levels of coherence, learning, as well as for achieving the "traditional objectives as agility, permanent and "on-line" alignment with the market, i.e. environment, etc., in order to deal with the 21st century environment and intrinsic conditions characterized by growing complexity leading to the "traditional" organizations' inconsistencies, contradictory demands, dilemmas in decision making, malfunctioning of systems, and similar (Eijnatten, 2004).

Concerning the Manufacturing Systems (MS), "mainstream MS research and practice tend to consider complexity a negative phenomenon. Usually, it is regarded a problem to be reduced, controlled or – if possible – eliminated. MS research and practice are informed by the celebrated Occam's-Razor principle which states that "entities should not be multiplied beyond necessity" (Wikipedia, 2006). This so-called Lex Parsimoniae propagates simplicity in scientific theories. For instance, the two central propositions of Axiomatic Design theory can be regarded as a straightforward engineering interpretation of Occam's Razor. Suh (1997) states that all systems, machines and software should satisfy both the Independence Axiom: i.e. maintaining the independence of the functional requirements (FRs), and the Information Axiom: i.e. minimizing the information content of the design, at all times. Originally, Occam's Razor was construed as a decisionmaking procedure for choosing among or evaluating competing systems of hypotheses together with their definitions and logical consequences. As such, Occam's Razor has demonstrated validity in MS practice for both product and MS- solution evaluations. However, while this known parsimony principle could be assumed to be valid for evaluation or selection of better solutions, and of systems of FRs, its application in the process of generating or creating theories proves less obvious. Applying Occam's Razor for developing and designing new MS answers

may be detrimental, because it tends to result in creating more- of- the- same outcomes most of the time. A good example is product renovation applied to existing goods already available in a company, or in the market place." (Eijnatten, Putnik, Sluga, 2007)

However, the central thesis of the Chaos and Complexity management in organizations is that – in order to the "traditional" organizations' inconsistencies, contradictory demands, dilemmas in decision making, malfunctioning of systems, and similar – "complexity should not be eliminated but nurtured instead" (Eijnatten, Putnik, Sluga, 2007). This is the main paradigmatic "turn".

By the new paradigm the complexity is seen as a condition for creating the potential and emergence of the real novelty. The real novelty creation is seen as a critical issue, i.e. as a premise for the organizational sustainability, and (in the context of this lecture) for the organizational sustainability of modern Manufacturing Systems.

In other words, to create the potential and to provide the conditions for the organizational sustainability, and for the organizational sustainability of modern Manufacturing Systems, it is necessary to increase the complexity of the organization, or of the system. When we talk about the "Chaos and complexity management in organizations" we, actually, talk about the management of increasing the complexity and managing it towards "flow" ("chaordic") organizations, or enterprises and real novelty.

One of the approaches to chaos and complexity management in organizations is based on so-called Chaordic System Thinking (CST) as "a complexity-focused framework for seeing and interpreting organizational patterns that are often anchored in the meta-praxis of chaos" (van Eijnatten, 2004).

In the first part of the lecture the basic definitions, for the context of management in organizations, of Chaos, chaos, complexity, chaord, chaordic systems, Chaordic System Thinking (CST), Chaordic Enterprise, are presented. Especially, the CST/Chaordic Enterprise (CE) main properties Consciousness, Connectivity (the holonic feature of the CST/CE), Indeterminacy, Dissipation, and Emergence, and how these properties inform the organization management, are presented.

In the second part some implications Chaos and Complexity Management in Organizations for Modern Manufacturing Systems are presented. Namely, the concept of Chaordic Manufacturing System (CMS) is presented and how "traditional" MS concepts such as Axiomatic Design theory, Holonic Manufacturing Systems, Emergent Synthesis (ES), Collaborative Design, Interactive Manufacturing, Product Innovation, Work Teams, Collaborative Research Networks (CRN), are related to the Chaordic System Thinking.

Finally, the third part closes with the short conclusions and suggestions for further research, development and implementations.

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SUPPORTING ENGINEERING EDUCATION IN THE AREA OF INDUSTRIAL SAFETY AND EU NORMS IN SERBIA THROUGH INTERNATIONAL AND EU COLLABORATION PROJECTS

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Abstract: The paper presents the collaboration projects undertaken by Steinbeis Advanced Risk Technologies Group (www.risk-technologies.com) in Serbia in the last years in order to support and enhance engineering education in the area of industrial safety and application of EU norms in Serbia. Three main lines of projects are the projects undertaken directly with the industry (projects RiskNIS and others for the Petroleum Industry of Serbia, NIS), projects undertaken in the framework of German-Serbian collaboration (ESPRiT project) and in the framework of the EU-supported research (iNTeg-Risk project, FP7). The paper presents mainly the results of the ESPRiT project and the referrers to the results of RiskNIS project and plans for the iNTeg-Risk project as related to Serbia.

Keywords: engineering education, technology transfer, industrial safety

1 Introduction

Successful implementation of any new technology cannot be achieved if the people/persons indented to implement it do not receive the dedicated and appropriate training. Some technologies are less prone to problems of lacking of this education, but for some technologies the education accompanying the process of technology transfer is crucial. This is even more the case if the technology transfer relies on a series of norms and regulations, and the specific infrastructure needed for their implementation. The above is exactly the case in the area technologies relevant for industrial safety and application of EU norms, in this particular case in Serbia.

Since 2001, Steinbeis Advanced Risk Technologies Group (www.risk-technologies.com, Stuttgart, Germany) has undertaken a number of project and activities in the above are in Serbia. The technologies tackled are primarily RBM (Risk Based Management), RBI (Risk-based Inspection), RCM (Reliability Centered Maintenance), RCFA (Root Cause Failure Analysis) and HSE/HSSE (Health, Safety, Environment / Security). Generally speaking RBI, RCM, RCFA, HSE and HSSE allow to include safety, environmental, business and reliability considerations into the decision making process and, thus, provide better targeting of resources and improving the results of the run-replace-repair decisions in industry and governmental organizations dealing with industrial safety.

In all the above technologies, the above is accomplished by considering the risks of possible undesirable events, the risk itself being expressed as the likelihood of the event (in a given scenario) multiplied by its probable consequences. Properly developed, implemented and used, the RBI, RCM, RCFA and HSE/HSSE systems help to significantly optimize plant key performance indicators (KPIs) and assure safe, economical and, hence, competitive operation.

Steinbeis approach generally adopts EU practice (e.g. [1]) as the basis and uses the most appropriate EU and other documents (e.g. API, OECD, EPA or ASME) for single aspects.

2 Education in the area of industrial safety in Serbia

Successful integration of Serbia and its industry in the European and global economy is often slowed down by the issues related to the lack of reliable and comprehensive assessment of risks related to health, safety and environment in industrial systems. This lack prevents investments and lowers the value of these industries in the international competition, or disturbs the vitally needed regional col-

laboration between Serbia and its partners in the region.

The problem has been recognized by many, including the Serbian government and large industries, which have both undertaken important measures and set up projects aimed to improving the situation. Although the state-of-the-art methods and tools are generally available, the specially trained and certified "local" professionals needed for the successful application of the risk management approaches, methods and tools, are not available, neither at companies, nor at public bodies or industry. Especially possessing any kind of formal possibly "EU-conform" qualification/certification and this is a serious need for both Serbian economy and its foreign partners.

Steinbeis Advanced Risk Technologies Group has followed three main lines of projects: the projects undertaken directly with the industry (projects RiskNIS and others for the Petroleum Industry of Serbia, NIS, www.risknis.risk-technologies.com), the projects undertaken in the framework of German-Serbian collaboration (ESPRiT project, www.esprit.risk-technologies.com) and the project undertaken in the framework of the EU-supported research (iNTeg-Risk project, FP7).

3 Industrial projects

In the projects undertaken directly the Petroleum Industry of Serbia (NIS), e.g. in RiskNIS project), engineering education has been built into the concept from the very beginning. The project has started in the first half of 2005, and in the first phase, a pilot project was undertaken, aimed to provide the baseline needed for introduction of risk-based methods in inspection and maintenance, and risk management in NIS refineries and other operating units. The pilot project has clearly shown the advantages of the application of risk-based methods in inspection and maintenance system, and risk management as well and involved basic education of over 40 engineers from the very first phase (Figure 1).

The emphasis of the project and of the education has been on:

- Controlling the risk levels by means of optimization of inspection processes and justified maintenance tasks, what will contribute to the site safety management and operational reliability of asset and on
- Increasing the effectiveness of the inspection and maintenance activities.

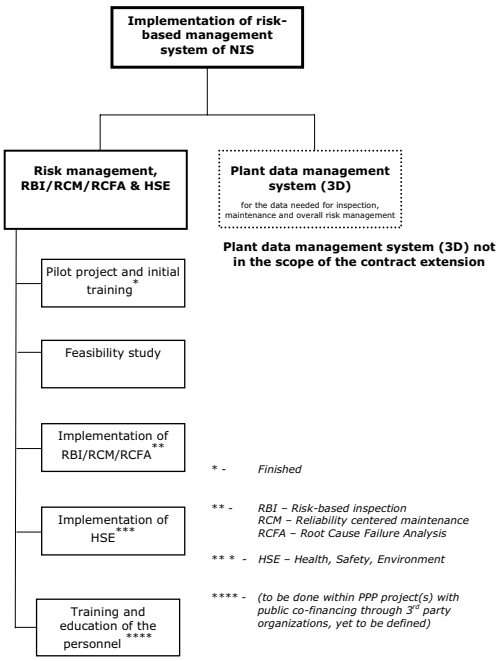

Figure 1: Training and education as a part of the industrial projects

The diagnostic and monitoring system of the equipment is assigned to provide advices for safety operation and minimize unscheduled shutdowns or losses in production, i. e. the used methodologies as tools should supply an updated knowledge of the equipment conditions allowing a forecast of the expected life and an extension to the maintenance cycles, complying with the national regulatory requirements and the EU legislation. The project has involved for all NIS refineries (Novi Sad, Pančevo and Elemir).

The result of the "Package A" of the project the comprehensive critical review of the state of NIS assets (Basic Resource Document) has been made and the integrated web-based system for Risk-based inspection (RBI), Reliability Centered Maintenance (RCM), Root Cause Failure Analysis (RCFA) and Health, Safety and Environment analysis installed and applied on over 2,000 sample cases (units, systems, pieces of equipment – approx. 6 times more than initially planned). Approx. 300 participants of the corresponding training, education and certification measures have gained the professional skills needed to apply the methods and use the system. Over 600 days of training took place and over 70 participants were certified, but it has also provided the full-scale on-the job training: approx about 1/3 of all analyses were done by NIS staff educated/trained in RiskNIS courses. The quality of the training was proven both by the satisfaction of the participants, and by in the qualified

discussions with the Serbian government and their consultants.

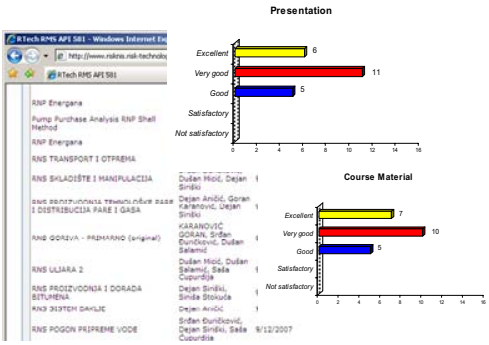

Figure 2: Satisfaction of participants of the courses in RiskNIS project

4 German-Serbian Cooperation

The DEG-Project ESPRiT („Enhancing Industrial Safety, Environmental Protection and Risk Management in Serbia by means of dedicated Training, Education and Technology Transfer“) is a project aimed at improving of industrial safety and environmental protection by means of enhanced Risk Management in the companies, especially in the small and medium enterprises (SMEs). The project started in June 2008 and will end in spring 2010.

ESPRIT project started with the support of DEG mbH is envisaged to primarily to providing the training and education in the area of risk management in Serbia. The main elements of this structure are:

(a) education and training in Serbian industries (professional education)
(b) extending the education curricula at Serbian universities
(c) on-the-job training of Serbian professionals in Germany (industry, academia, R&D)
(d) certification scheme according to German standards.

This PPP (private-public partnership) project addresses the above problems by involving the most relevant industries (oil & gas, insurance, electric utilities, chemical,…) both in Serbia and in Germany.

The project has duration of 20 months and involves costs of approx. 0.5 million €, out of which about 45% from public support from Germany, would result in training, educating and certification of professionals in Serbia in the area of risk management, according to the state-of-the-art EU practice. The levels involved ranges from the, e.g., “certified senior risk assessor - refineries” (professional qualification), up to “Master of Risk Engineering” including PhD (“Bologna”).

Steinbeis University Berlin in collaboration with universities in Serbia will assure sustainability of the solution for the time “after the project”, as well as the integration of the project results into the area of risk management and safety.

The “infrastructures” needed for the achievement of the project goals were developed in the project and these include the educational infrastructure, the IT-infrastructure, local offices and the modules of the special courses which have become part of the curricula at the Serbian Universities and industrial educational schemes. This overall infrastructure helps the Serbian government (e.g. the Ministries responsible for Labor, Environment, Technology and Education), as well as for the innovation centers at the Universities of Belgrade, Kragujevac and Novi Sad, to create a sustainable set of measures for improvement of industrial and occupational safety, and environmental protection in Serbia.

The key element of the concept is the implementation of an overall risk management system compatible with the EU-norms, and education of the HSE (Health, Safety, Environment) responsible professionals, according to the EU and German practices. The implementation has taken into account the specific factors and difficulties in Serbia such as, e.g., those in the area of education. In parallel to the above technical activities a comprehensive dissemination and PR network have been created.

Main results of the project include education of trainers and several hundred course participants, (800 course participations are planned, current results are shown in Figure 3), as well as the certification of 200 participants The education and certification follow the EU-criteria and Steinbeis University Berlin is in charge of the certification process. As a measurable parameter of the successful project implementation, the KPIs (key performance indicators, at least 2 of them in 2 Serbian plants) should be improved by at least 5 % as the result of the project. On the overall economic plan, the project leads to increased attractiveness of Serbia for foreign investors, due to the improved possibilities to meet the requirements resulting from the use of the EU legislation.

Indicator	Target	Done so far	Comment	Target vs Achieved
Survey of needs conducted (Results available at http://www.esprit.risk-technologies.com/ma/Survey_Statistics.aspx?ID=185)	1	1	(48 responses)	100%
Partnership agreements with Serbian companies from power and oil industry	2	3	Partnership agreements signed covering both industries	150%
Partnership agreements with Serbian universities	2	3	1. Univ. of Belgrade, 2. Univ. of Novi Sad, 3. Univ. of Kragujevac	150%
Partnership agreements with other Serbian beneficiaries	-	4	industry and government bodies	100%
Contracts for "on-the-job-training"	4	4		100%
Registered candidates for course participation	800	914	Formal online registration	114%
Application for trainers	10	53	Formal online registration	530%
Training of the trainers	10	31	Training has started (two training courses for trainers done, one more in plan)	310%
Registered trainers	10	1	process continues	10%
Registered candidates MSc / PHd studies	5	7		140%
ESPRiT courses incorporated in education program of two university	2	2	application started September 2009.	
On-the-job training - short stay	40	31+22	Training done, September 13 - 20, 2009	135%
Prepared courses	12	12+2	Courses on insurance and RBI-Power added	116%
Organized courses	min 12	14	Second round started in October 2009, courses # 1, # 5 and # 11 done	116%
Course attendees	800	725	(only those with 80%+ presence rate were counted in)	88%
Course evaluated by % of course attendees	75%	87%		109%
Course evaluated as "Successful" by % of evaluating participants	75%	89%	NOTE: 1 course, so far, has not met the criterion	116%
Average number of attendees per course	15-20	46	interest was under-estimated	306% (230%)
Certificates for individual courses	200 (min 150)	517	Certificates, except for the Course # 1 in second round, handed out October 27, 2009	258% (344%)
Certified risk examiners (for specific areas)	160	0	starts in November 2009	
Certified senior risk assessors	40	0	starts in November 2009	
ESPRiT Back-office in Stuttgart	1	2	Offices in HDW Stuttgart and SIMT Stuttgart	200%
ESPRiT Front-offices in Novi Sad+ Belgrade	1+1	1+2	Additional office at University of Kragujevac	150%

Figure 3: Status of ESPRiT project in Nov. 2009

5 EU Projects

iNTeg-Risk (www.integrisk.eu-vri.eu, Early Recognition, Monitoring, and Integrated Management of Emerging, New Technology related, Risks) is a project that responds to the call of offer from the FP7 (Seventh Framework Programme for Research and Technological Development) in the area of "Nano-sciences, Nano-technologies, Materials and new Production Technologies". iNTeg-Risk coordinates research and development sub-projects related to new materials and technologies for establishing a common EU approach to face the challenge of emerging risks within the next 15 years. Serbian industry (NIS) and one university (FTN) are involved as partners in iNTeg-Risk. Education is recognized as an essential aspect of the project (Figure 4) and it is included in all 4 dimensions of iNTeg-Risk, namely in the following ones:

This is being done by concentrating efforts in four fundamental dimensions:

[T] Technical, technological: Technical knowledge and technologies supporting the knowledge.

[H] Human, management: Skills of personnel and organization of the human resources

[C] Governance, communication: A process with clear definition of role and responsibilities of the management of a decision making process involving several stakeholders, and the associated communication organization

[R] Policies regulation, standardization: Clear and complete regulatory framework, standards and norms

Figure 4: Education in Subproject 4 (SP4) of iNTeg-Risk

6 Conclusions

A comprehensive portfolio of educational activities of Steinbeis Advanced Risk Technologies Group has ensured that education is firmly embedded into the overall technology transfer and European integration of Serbia. Close link to industry has ensured the sustainability both of the educational infrastructure developed and of the project results.

Acknowledgments: Support of DEG mbH, EU-FP7 and NIS is gladly acknowledged here.

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SESSION A – INDUSTRIAL ENGINEERING FUNCTIONS

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INFORMATION SUPPORT SYSTEMS FOR COMPLEX PROBLEM SOLVING IN INDUSTRIAL ENGINEERING

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Abstract
The paper is concerned with complex problem solving in industrial engineering. Specifics characteristic of the complex problem solving process are presented. Complex, unstructured and semi-structured problems are possible to solve by simultaneous quantitative and qualitative analysis with the support of contemporary information systems. Alternative modeling and ranking within decision support systems greatly facilitates the complex problem solving process in industrial engineering.
Key words: industrial engineering, complex problem, information systems, decision support systems.

1. INTRODUCTION

Complex problems in manufacturing business system involve those problems that are complex in terms of formulation and/or solving procedure and as such they are the subject of research in industrial engineering. A large number of variables in the complex problem solving process do not condition the complex character of the problem. If for a certain problem there are clearly defined quantified quantities and also the defined algorithm for solving the observed problem, it cannot be considered complex. It is only necessary to perform a few mathematical operations for such problem, but there is no dilemma regarding the definition of the problem or dilemma in terms of establishing the procedure for its solution.

On the other hand, there are problems where the formulation phase is complex, most commonly due to stochastic nature of quantities involved in the problem. Stochastic quantities have different values from one case to another therefore manipulation of such quantities implies probability involvement in calculations.

In manufacturing business systems, the quantities of stochastic nature emerge for the most part. The presence of stochastic quantities in problem solving reduces the determination level of the problem, which classifies the problem into the category of complex problems. In addition to stochastic nature of quantities existing in the manufacturing business system, the relations between those quantities are to be mentioned too. Establishing the relations between those stochastic quantities and determining the intensity of their impact are the steps to be performed within the framework of concrete problem solving in industrial engineering.

In contemporary circumstances of business operations the implementation risk of the decision made in the process of complex problem solving in manufacturing business systems is indispensible information for final decision making in the choice of alternative solution. Since risk is calculated as the product of probability of a certain cause and effect, in a concrete case of complex problem solving the effects refer to financial aspect as well as to business image, competitor's advantages and the like.

Horgan J. (2000) defines complexity as "the edge of the chaos". He claims that on one side there is a completely certain situation and the other extreme is the state of the chaos. Between the two there is complexity. Horgan reports the research by Seth Lloyd who systematized the definitions of complexity and his systematization established the link of complexity to entropy, arbitrariness (coincidence, stochastic process) and pieces of information. However, all definitions of complexity are not used now because, as the author claims, what was once considered to be complex can be presented by a short computer program today.

So, there are no strict boundaries between simple and complex problems in the manufacturing business system. Complex problems in the

manufacturing business system will be considered as problems where there is a certain complexity in terms of formulation and within the problem solving process. Such problems are mainly unstructured or weakly structured, even though the unstructured (or weakly structured) problem cannot be automatically considered complex.

2.SURVEY OF CURRENT MODELS FOR COMPLEX PROBLEM SOLVING IN INDUSTRIAL ENGINEERING

The problem of modeling the company's organization successfully dealt with by so called "complex analytical method" (Dešić, 1969) can be taken as an example of a complex problem that emerges in the manufacturing business system. By applying the complex analytical method in the early 1970s, through a series of 160 influential elements coupled in a matrix with 11 organizational departments, there started solving of one of the most complex problems that can occur in the manufacturing business system: the assessment of organizational level in several respects, interpretation of results and identification of crucial aspects and measures to elevate the company's overall organizational level. At that time the Dešić complex analytical method had seen great success in the scientific world, but despite successful application in several hundred companies the complexity of both the problem and the method for problem solving itself were a limiting factor in its further implementation. It is assumed that the application of computerized information systems to a complex problem of the company's organizational modeling would considerably simplify the problem solving process, thereby also opening the door for a broader use of a very significant complex analytical method. Considerable simplifications in the application of complex analytical method supported by computerized information systems would reflect in easy use of the model because a user need not go into details of calculations to obtain the score for organizational level, reduced time for problem analysis, lesser possibility for error occurrence in calculations and the like. Throughout 1970s the software development level could not support complex problem solving (generating criteria hierarchy, assessment of criteria relative weight, sensitive analysis application and the like), but today it is possible to choose an adequate information decision support system according to the nature of the problem.

A combined problem solving method in the manufacturing business system (Bulat, 1999) is an original model specifying the phases of the complex problem solving process.

In current literature there are works dealing with the complex problem solving process. As the area of complex problem studies is relatively novel those works mainly originate from the second half of 1990s (Funke, French, 1995), (Moursund, 1996). Also, it is noted that the earliest works in the area have come from investigations performed by psychologists trying to explain the complex problem solving process.

In their book, Funke & French (1995) report that the complex problem solving process occurs in the case of overcoming the barriers between a given initial state and desirable goal. The notion of "overcoming the barriers" is understood to be the complexity regarding behavior, understanding or more activities to be performed in order to solve the problem.

The authors consider that each problem consists of initial state, barriers, desirable state as well as tools we are using throughout the problem solving process. In cases when those barriers become overwhelming (become too complex) the problem sets in the domain of complexity. Complex problem solving conditions efficient interaction between the decision maker and the developed situation demanding from the decision maker to involve cognitive, personal, intellectual and social abilities in the process of problem solving, Fig. 1.

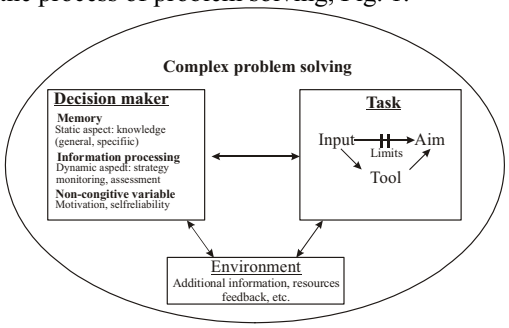

Fig. 1 The situation of complex problem solving (Funke, French, 1995)

There is evidence of research works concerned with complex problem solving in the domains of computer technology, ecology (Tainer, 1996) but in the sphere of manufacturing business system management the results are rather modest.

Yet, a majority of authors agree that in the process of complex problem solving computerized information systems should be implemented. They can provide adequate support for decision maker in some phases of the complex problem solving process and assist in reducing the time, analysis, calculations, result synthesis and the like.

Turban and Aronson (1998, with modifications from the source – Sprague, 1980) analyzed computerized information systems for problem solving support, integrating the implementation of available tools for decision making support and adequate problem solving phases – Fig. 2. In the formulation phase the decision support information systems can be of considerable assistance. Control information systems, by constant monitoring of internal and external data resources, can show early that the problem is occurring. That process involves so called "data mining" which is a new technology for

special data browsing in databases and considerably reduces the time of problem identification. Another technology, so called OLAP (Online Analytical Processing) is based largely on work via the internet where a user can set query and analyze data to reduce the browsing and data analyzing time.

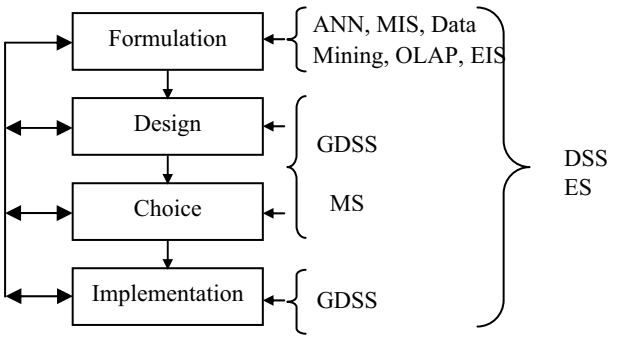

Fig. 2 Problem solving process and computerized information support systems for some problem solving phases (Turban, Aronson, 1998 – after Sprague, 1980)

Expert systems can advise decision maker in the problem formulation phase and thus (in accordance with the phase of the problem) assist in understanding the nature of the problem, problem diagnosis, problem classification and the like.
Luccas (1995) reports that in all phases of complex problem solving the decision support systems should be implemented, whereby better communication, acceptability, understanding among employees is achieved.

3.AN EXAMPLE OF COMPLEX PROBLEM SOLVING

A model of decision making in assessing the spare parts' supplier is presented as an example of complex problem solving in industrial engineering. When the supplier is assessed it is necessary to define the criteria to be used for analysis and ranking of four alternative solutions (suppliers).
Based on the criteria defined, the model hierarchy structure was generated, Fig. 3. Furthermore, problem solving involves the assessment of influential criteria according to their structure in the overall structure of criteria and assessment of alternative solutions against the defined criteria and sub-criteria respectively.

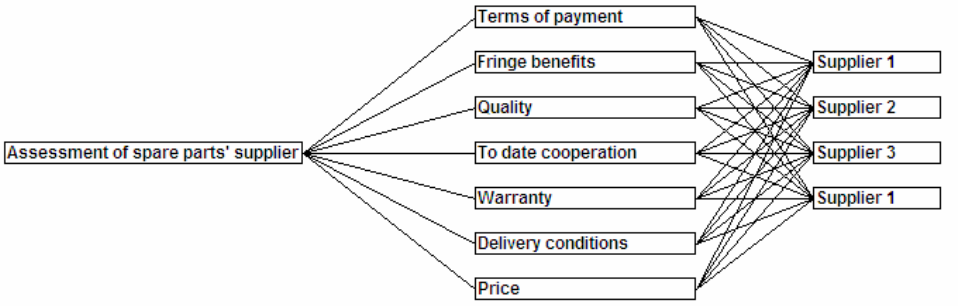

Fig. 3 Decision making model

Tab. 1 shows scores for impact of criteria relative weights, alternative solutions scores against the defined criteria. For the price criterion a numerical scale was used to enter a real purchase price of spare parts per supplier. For other criteria, a five-level verbal scale was deployed.

Goal	Weights	Rating Set	Attributes	Supplier 1	Supplier 2	Supplier 3	Supplier 1
Assessment of spare parts' supplier	75,00	Terms of payment	Terms of payment	100,00	100,00	75,00	75,00
	75,00	Fringe benefits	Fringe benefits	75,00	100,00	100,00	100,00
	100,00	Quality	Quality	75,00	100,00	100,00	75,00
	75,00	To date cooperation	To date cooperation	75,00	100,00	100,00	75,00
	75,00	Warranty	Warranty	75,00	75,00	75,00	100,00
	75,00	Delivery conditions	Delivery conditions	75,00	75,00	100,00	75,00
	75,00	Price	Price	81,70	78,51	80,64	71,06

Tab. 1 Weights of criteria and alternatives

Alternative ranking was performed according to entered scores for relative weights of influential criteria and scores for alternative solutions based on defined criteria, as shown in Fig. 4. The analysis of results indicates that the most suitable supplier in the existing circumstances is supplier 3 (0.905), then supplier 2 (0.903), supplier 1 (0.793), supplier 4 (0.816).

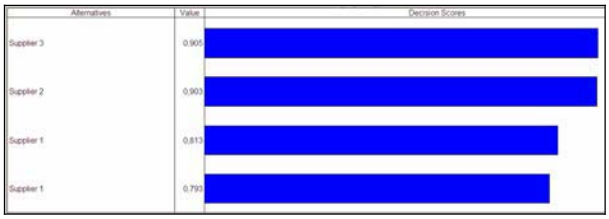

Fig. 4 Decision scores

That is, supplier 3 is the most suitable solution for the defined relative weight scores of established criteria on the first level of the decision making model. Assessment of supplier by implementing decision support system makes possible for decision maker to perceive advantages and disadvantages of each alternative solution in the situations when the selection is affected by a few criteria, to make decision in a shorter time interval along with increased quality of the decision made.

4.CONCLUSION

The paper analyzes the approach and process of complex problem solving in manufacturing business companies, and also methods that could be implemented in some phases of the complex problem solving process. Using the example of decision model for the assessment of spare parts' supplier, the description was given of the defined steps in complex problem solving as well as the implementation of the decision support system as one the contemporary information systems deployed in semi-structured and unstructured problem solving. Complex problems in industrial engineering can be successfully solved by multidisciplinary and interdisciplinary approach in methodological sense with a considerable support of contemporary information systems.

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INNOVATION, ENTREPRENEURSHIP AND GLOBAL ECONOMIC CRISIS

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Abstract

The purpose of this paper is to highlight the question of the relationship between innovation, growth and entrepreneurship as possible path to solve actual global economic recession. Under the influence of global economy changes, the position of the innovation and entrepreneurship have been drastically altered – they are increasingly seen as a generators of the economic recovery and growth. Having understood the importance of innovation and entrepreneurship for the economic growth, many countries have recognized these processes as a vital elements of their development.

In short, entrepreneurship and firm creation have long been recognized as a vital force driving innovation. In our opinion innovation and entrepreneurship are the only weapon that would enable a company and national economy to survive a crisis. Also, we deeply believe that economic crises are historically times of industrial renewal and creative destruction.

Key words*:* innovation, economic crisis, creative destruction, entrepreneurial economy, innovative entrepreneurship

1. INTRODUCTION: INCREASING IMPORTANCE OF INNOVATION IN SOCIETY

Innovation can be defined as the application of knowledge to create additional value and wealth. Innovation involves using knowledge to find new ways to create and bring about change for the better. This definition of innovation has implications for the types of activities within businesses that can be considered innovative. Innovation is not just about new products to the market, it is also about a focus on understanding our customers' needs and collaborating with them to deliver customer focused solutions that are simple to use and help make life easier.

Increasing global competition, particularly from low-cost emerging economies, and the steadily increasing rate of global technological change means that competing through efficiencies delivered by structural reform and competition is no longer enough for many developed economies. More than ever before, developed economies are competing on the basis of unique value delivered through the application of knowledge in the production process. In short, innovation involves the commercial application of old or new knowledge to create additional value and wealth.
There are sound economic reasons why collaborations are growing in importance, including the rising cost of technology development, shortening product lifecycles, and the difficulty in sustaining closed research and development (R&D) models. An increased focus on core competencies at many businesses has provided an opportunity for interdependencies to a much greater degree than at any time previously.[1]

Innovation always implies newness. To define and measure innovation better, we investigated three dimensions of newness: what is new, how new, and new to whom? Drawing on prior research by Schumpeter and Kirzner, in literature (16) is developed a scale that addresses six areas of innovative activity: new products, new services, new methods of production, opening new markets, new sources of supply, and new ways of organizing. We can say that innovation as newness represents a undimensional construct, distinguished only by the degree of radicalness.

One popular perception of innovation, that one meets in media every day, is that has to do with developing brand new, advanced solutions for

[1] Casimer DeCusatis, (2008), Creating, Growing and Sustaining Efficient Innovation Teams, ***Creativity and Innovation Management,*** Volume 17, Number 2, p. 155-156

sophisticated, well-off customers, through exploitation of the most recent advances in knowledge. Such innovation is normally seen as carried out by highly educated labour in R&D intensive companies, being large or small, with strong ties to leading centers of excellence in the scientific world. Hence innovation in this sense is a typical "first world" activity.[2]

Indeed, innovation is one of the essential factors of enterprise performance as well as national economic growth. Either on the micro or the macro economic level, the relationships between innovation and performance have been (and are still being) studied in several important works (Schumpeterian and neo-Schumpeterian analyses, endogenous growth theories, etc.). Although Schumpeter emphasized a multiplicity of innovation forms, the accent in most of these analyses is essentially upon technological innovation (based on Research and Development). Schumpeter explains the nature of entrepreneurship by the recognition and assertion of opportunities through innovation, which includes "the introduction of new commodities" as well as "technological change in the production of commodities already in use, the opening up of new markets or of new sources of supply, Taylorisation of work, improved handling of material, the setting up of new business organizations such as department stores – in short, any 'doing things differently' in the realm of economic life" (Schumpeter, 1939, p.84).[3]

The study of innovation is of interest to engineering, business, social and behavioral sciences, and spans sociology, history, philosophy, economics, psychology, and political science. Innovations transform economies into the knowledge-based economy and alter global relations and produce new structures of social control. Innovations change the day-to-day lives of individuals. Also, innovations in any domain can be enhanced by principles and insights from other disciplines. However, the process of identifying the linkages between different domains and the need for innovation science is apparent.

Moreover, innovation can be developed in order to activate demand, by finding new ways of marketing products or services, but also through new applications of technology which will facilitate fast and efficient operation of the distribution network and conduction of transactions. Innovations and ideas that may arise from new research and data in the field of marketing could serve as an outlet to the current economic crisis. In other words, the range of innovation goes from new ideas and concepts, through new products and services, new processes, new structures and new organization, new business models up to corporate ventures. Therefore, we need both individual and corporate entrepreneurship, innovation and operational excellence at the same time.

Successful innovation requires contributions from managers, salespeople and customers just as much, if not more than, researchers and scientists. Therefore, without *entrepreneurial people* there can be no future, yet without people able to work in an efficient, consistent manner there can be no present. In short, the promise of an innovative, entrepreneurial and competitive economy is being held out as the so-called panacea for economic ills. Innovation has become an increasingly complex process with an increasing number of interacting actors involved.

Investments in innovation can be of strategic importance for long-term growth. Most growth comes from improvements in efficiency, new technologies, new types of innovation, and doing things better. The crisis causes some of these types of investments to fade away, but governments are trying to cushion the fall in private research and development (R&D) spending through support for private R&D. Many countries are investing in research infrastructure because it can be a double-dividend improvement. Many countries are also trying to connect spending in research, development and innovation to the market. Government policies are trying to connect innovation policies to new social and economic needs because this is where future markets will be located.

Innovation can also contribute to resolving environmental challenges, such as climate change. Last but not least, a catalyst for globalization and innovation, new technology (notably, the Internet) have become a fundamental component of the global economic infrastructure. (OECD, 2007; p. 29) Lastly, we also can say that innovation is a necessary condition of entrepreneurship, just like the existence of entrepreneurial opportunities and heterogeneous risk taking individuals that organize the exploitation of these opportunities.

2. ECONOMIC CRISIS AS IMPULSE FOR INNOVATION AND ENTREPRENEURSHIP

The current economic and financial crisis is the first of this severity to hit developed countries since they have shifted to knowledge-based service economies. We think that the problem of the current economic crisis is not, inherently and mainly, a problem of

[2] Jan Fagerberg, Martin Srholec and Bart Verspagen, (2009), Innovation and Economic Development, UNU-MERIT, p. 14

[3] Schumpeter, J.A. (1939), Business Cycles. A Theoretical, Historical, and Statistical Analysis of the Capitalist Process, 2 Volumes, New York: McGraw Hill.

supply, but a problem of active demand for goods and services. Although the global, hypercompetitive nature of the current business environment makes any competitive advantage short-lived, it would be a mistake to view these turbulent times as anything other than an unparalleled era of opportunity. Therefore, we accept opinion of many authors that current economic crisis can provide a perfect backdrop for disruptive or radical innovation. Moreover, we believe that economic crises are also historically times of industrial renewal and creative destruction. Innovation, especially development of new ideas in areas such as technology and the green economy, is considered as the primary way of exit from the economic crisis. In fact, the current financial and economic crisis is providing the impetus for new entrepreneurs to take the step into self-determination and to build the employment base for the future. Furthermore, we think there is nothing like a good economic crisis to fuel the growth of new innovative energetic businesses.

Therefore, we can say that disruptive, or radical innovation should be one of the organizational ethos to be successful in this hyper competitive globalized environment. Thus, disruptive research is absolutely critical, especially in the technology space. Furthermore, it is not enough to simply have brilliant engineers. Without competent management on the business side, the most advanced technology can wind up on the scrap heap of business history, or even worse, usurped by a competitor. Moreover, some authors suggests that, for some companies, the economic crisis can actually provide an innovation platform. While many organizations are focused on being solvent in this current economic crisis, companies with strong balance sheet, in our opinion, should continue to focus their R&D effort on radical, or disruptive innovation. Also, we believe that in a current economic crisis an entrepreneurial culture will be a new "modus operandi" that will drive individuals, organizations, and societies towards an expanding set of new possibilities, ensuring not only business survival, but also self-renewal and the long-term health and well-being of the economy and society. ''The crisis can, however, magnify the competitive advantage of research-intense firms who seize the opportunity to reinforce market leadership through increased spending on innovation and R&D. Many of today's leading firms such as Microsoft or Nokia were born or transformed in the "creative destruction" of economic downturns. And several of today's leading technology firms such as Samsung Electronics, or Google strongly increased their R&D expenditures during and after the "new economy" bust of 2001.'' (OECD, p.6)

Therefore, the current economic and social crisis invites us to discuss "sustainable innovation" or "environmental innovation" as a basis for a new techno-economic (and social) paradigm founded on new technologies, and savings of energy and resources and on the development of renewable energies. In this context public policies to support innovation are henceforth at the root of all scientific and technological initiatives.

Indeed, the crisis is providing multiple opportunities for governments to take decisive action on innovation, and policy-makers should champion those possibilities as they hammer out stimulus packages.

3. FOSTERING ENTREPRENEURSHIP IN CRISIS

Fostering entrepreneurship means channeling entrepreneurial drive into a dynamic process that takes advantage of all the opportunities the economy can provide. To flourish, entrepreneurship requires efficient financial markets, a flexible labor market, a simpler and more transparent corporate taxation system, and business rules better adapted to the realities of the business world.
The innovation process requires active orchestration of both intangible and tangible assets by entrepreneurs and managers. This is true whether the context is the small or the large enterprise.[4] Moreover, we have remember that the high-growth companies have been built by entrepreneurs with: 1) an innovative idea, 2) great ambitions and 3) significant market and business related skills. In short, entrepreneurship is a great magnet to deliver new ideas, unique approaches and innovative technologies. When conducted in a proper way, turning people into entrepreneurs improves a country's economic situation and aids sustainable progress. However, transition to become an entrepreneur is not that aspiring to all. Risks and uncertainties involved in starting a new business coupled with stagnant economy discourage people to step up the plate and take a swing.

The teaching of entrepreneurial skills at all education levels, from elementary school through university, has a significant impact on levels of entrepreneurship throughout the world. Much is made these days of which countries produce the highest numbers of scientist and engineers.

Fostering Entrepreneurship is commonly viewed in the light of economic growth, competitiveness and job-creation. But this perception falls short on the social relevance entrepreneurship has for society. In

[4] David J. Teece, ''The role of managers, entrepreneurs and the literati in enterprise performance and economic growth'', *Int. J. Technological Learning, Innovation and Development, Vol. 1, No. 1, 2007*

fact, ever faster structural and competitive economic changes are leading to significant changes in society. This affects the individual life plans of particularly the youth and requires an increasing degree of self-reliance. In this context, fostering entrepreneurship and self-employment also provides the population with a career option parts of society might be better suited with to meet the changing demands of postindustrial economies. In this respect fostering entrepreneurship is not only an economic but a socioeconomic task for most economies. Their economic, social and cultural differences however require a tailor made approach that responds to the socioeconomic realities within the single countries.

Entrepreneurship can consist of innovation or the introduction of creative change and change is generally considered as part of the entrepreneurial expectation. In that sense, the entrepreneur is a *change agent.* Therefore, more innovators need to be entrepreneurial, and more entrepreneurs need to be innovative.

4. CONCLUSION

Entrepreneurship and innovation provide a way for many people and professionals to overcome the global challenges of today, building sustainable development, creating jobs, generating renewed economic growth and advancing human welfare.
In sum, creativity, innovation and entrepreneurship are an essential elements for economic progress as it manifests its fundamental importance in different ways:
1) by identifying, assessing and exploiting business opportunities;
2) by creating new firms and/or renewing existing ones by making them more dynamic;
3) by driving the economy forward – through innovation, competence, job creation and by generally improving the wellbeing of society.

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ECONOMIC ANALYSIS OF HYDRO-GEOTHERMAL TWO CASCADE HEAT PUMP - SERBIAN CASE

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Summary:
The aim of the paper is evaluation of economic justification and technical feasibility of the system of exploitation of subgeothermal waters in Serbia. Results of the technical analysis show that utilisation of two-cascade heat pump represent an optimum method of using renewable subgeothermal potentials. Calculated economic parameters of the pilot project of two-cascade heat pump indicate that this form of energy exploitation is commercially justified, even in the cases when calculation does not include positive environmental effects.

Key Words: Heat pump, Subgeothermal water, Energy efficiency, Economic analysis, Investment justification

INTRODUCTION AND TECHNICAL DESCRIPTION OF THE PROJECT

Total investment in the period 2000-2005 for direct use of geothermal waters in the world was about US$ 1725 million. Exploitation of subgeothermal resources can be accomlished using heat pump systems. Use of renewable subgeothermal energy may bring, in addition to ecological effects, significant reduction in consumption of energy from conventional sources [1]. It is estimated that in Serbia over 1000000 users can use this type of resources .
Significance of using these resources lies in the fact that, according to our estimates, they may allow release of minimum 1200 MW_e from the current total power of all power plants in Serbia, which is about 8200 MW_e. In other words, consumption of electricity would be reduced by approximately $3{,}5*10^9$ kWh, accompanied by saving of minimum 500000 t of liquid gas, $2{,}2*10^6$ t of coal and $600*10^6$ m^3 of gas.
In Serbia almost 50% of energy consumption is used in residential premises [1]. The prevailing method of heating in Serbia is by individual heating systems with typically low energy efficiency. About half of households use solid fuels (coal and wood) for heating, while another half of households is connected to the remote heating systems. Medium energy efficiency of the existing households is as a rule unsatisfactory and even 65% of energy is used on heating residential and office premises [1, 2, 3]. Therefore, nearly one-third of Serbia's total energy needs are related to heating of homes and offices. For heating of the premises and preparation of hot water supply, households mostly use electric power, then solid fuels, heat from central heating systems, remote and local sources, and other forms of heating. The rest is the consumption of energy generated from natural gas. Even 33% of households are using electric power for heating, which is from the aspect of general energy efficiency extremely unacceptable. In the future period, substantial investment in building modern thermal-energy capacities is expected, as well as adoption of the binding legal regulations in compliance with the EU Directives, which will result in more significant participation of renewable energy sources in the total energy balance and implementation of stricter standards regarding environmental protection. In that respect, exploitation of energy potentials of geothermal and subgeothermal underground waters, plenty of which can be found in some regions of Serbia, will gain massive importance [3, 4].
In spite of indisputable energy potential, subgeothermal underground waters cannot be used, due to their low temperature levels (10-30 ^oC), directly for heating. However, this energy source can be efficiently used for heating if adequate heat pump systems are utilized. There is a wide range of

possibilities how such heating systems with heat pump can be used. Particularly significant is the case when subgeothermal heat pump is used as a substitution for the central heating systems. The heating system with the heat pump would be installed directly into the existing central heating system substations (Fig. 1) and would not require any further interventions on heating bodies and distribution system [3]. If the building has not been connected to the remote heating systems, awarded energy effect is supplemented by the environmental effects arising from closing of crude oil and coal-fired power plants.

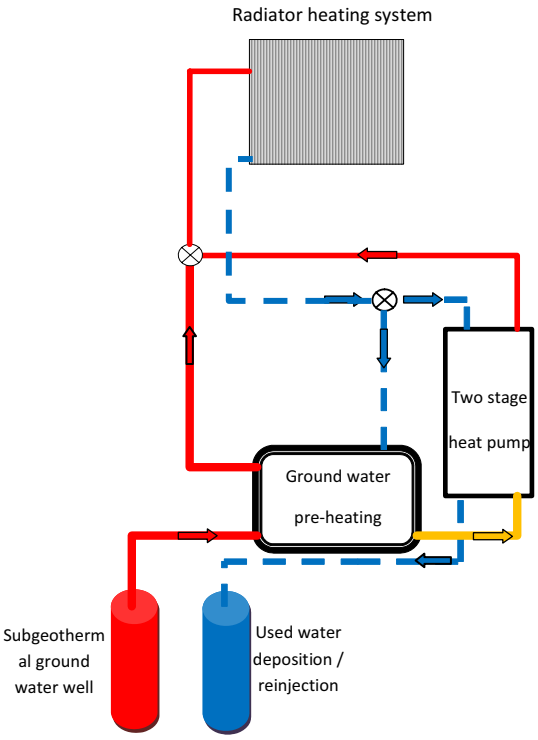

Figure 1. Connecting of subgeothermal heat pump in the system of central heating

Considering the required temperatures of heating water in central heating systems as well as the temperature levels and abundance of the available subgeothermal underground waters in Serbia, severel heat pump heating systems have been analyzed [3]. It has been concluded that the optimum technical solution for the given conditions is a heat pump, consisting of two coupled heat pumps – the cascade heat pump (Fig. 2).

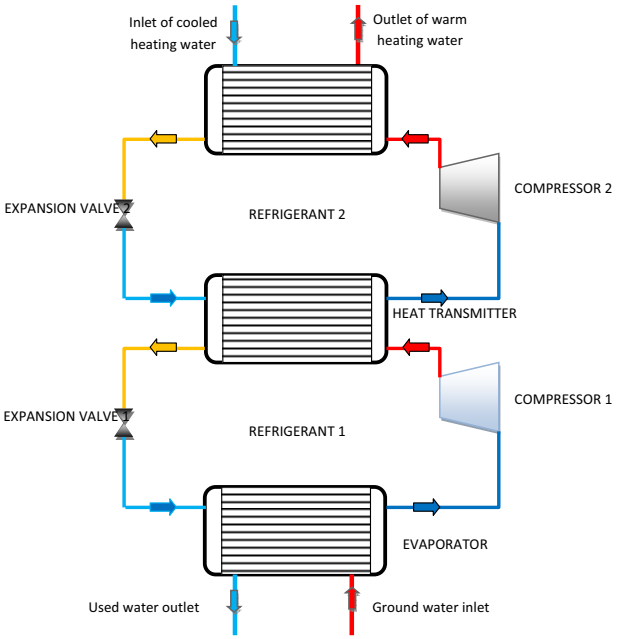

Figure 2: Cascade (two stage) heat pump scheme

This technical concept allows efficient bridging of the big differences in temperatures of the heat source (subgeothermal water) and outlet water towards heating bodies.

ASSUMPTIONS

Economic analysis was made for the pilot project of cascade heat pump with capacity of 218 MWh/year with assumed intake well depth of 30 m and water temperature of 16ºC. This well is chosen as optimal from two aspects: 1. relatively shallow dip of water bottom horizon, and 2. slightly higher water temperature than average air temperature in the moderate-continental climate belt where most of the territory of Serbia lies. This latter condition implies that there is slight temperature abnormality or that there is heat island effect, frequent in urban areas, which are largest potential consumers of thus generated energy. All economic calculations are made in euros and at fixed prices. Produced quantity of heat should, with appropriate installations, heat the area of 2000 m². Period of exploitation of installations is estimated to 15 years. It is assumed that it is the period in which the installed equipment can operate at full capacity, without massive repair costs. It is estimated that these parameters would correspond to the relatively frequent optimistic scenario of subthermal waters use in Serbia.

METHODOLOGY

For economic optimisation of the cascade heat pump pilot project, two approaches for evaluation

of projects in the area of energy efficiency were applied [5]:
a) Least-cost approach
b) Cost-benefit approach.
Least-cost approach was applied for calculation of price of heat from geothermal source. Based on the present value of costs and present value of quantity of the generated heat energy, two tariffs are calculated: a) tariff based on travel cost method and b) tariff based on current exploitation costs. Tariff based on travel costs includes investment costs and operational costs per kWh of energy produced, whereas tariff based on exploitation costs includes current costs per kWh of heat energy produced.
Cost-benefit approach was applied for evaluation of the overall economic justification of the investment into the pilot project of cascade heat pump. Based on this approach, standard criteria for evaluation of acceptability were calculated – economic net present value (ENPV) as a measure of absolute value of economic gain in the overall period of exploitation of plants and internal rate of return (EIRR) as a relative measure of economic profitability of the pilot project.

PILOT PROJECT COSTS

a) Investment costs

Investment costs of the pilot project are divided into two groups: a) costs of works on absorptive well and b) costs of equipment purchase and installation. Table 1 gives the overview of the estimated investment costs.

Table 1. Investment costs

Investment	EUR
Works on the well	6000
Equipment:	93000
Compressor LT	20000
Compressor HT	30000
Evaporator LT	12000
Evaporator HT –condenser LT	11000
Condenser HT	10000
Automatics	8000
Other equipment costs	2000
Total investment	99000

Cost estimates of components of the initial investment were made in a pessimistic scenario. Calculation was made on the basis of the highest prices of compressors, evaporators and condensers. Initial refrigerant charge is contained in the item "Other equipment costs". Cost estimates on the sugeothermal water intake well are determined on the basis of gross price of EUR 200 per metre of the well depth.

b) Depreciation costs

For calculation of equipment depreciation, linear method was used. For the period of exploitation of 15 years, linear depreciation rate of 5,33% was applied. This rate assumes that at the end of the exploitation period, the residual value will be 20% of the purchase price. The equipment's residual value was increased by the value of works on the absorptive well. The obtained amount represents total capital increase on the basis of non-write-off values of the heat pump pilot project.

c) Current and operational costs

Costs of exploitation of cascade pump include current maintenance costs and electricity costs. Current maintenance costs are specified on yearly basis and are calculated at the fixed prices with annual real growth of 1%. Costs of electricity, used for running the system (55897 kWh/per year) are defined according to the average price of electricity for industrial users of 0,07 EUR/kWh. These costs, calculated at the fixed prices and on yearly basis, should come to EUR 3913. The exploitation costs also include costs of occasional reparation of the cool liquid in compressors.

DETERMINATION OF ECONOMIC PRICE OF GEOTHERMAL HEAT ENERGY

Economic price of geothermal heat energy is determined on the basis of total discounted costs and exploitation discounted costs at the outlet of the heat source as *Tariff 1* and *Tariff 2*. *Tariff 1* is defined as relative ratio between the sum of discounted investment and operational costs and discounted quantity of heat energy in the entire period of exploitation of the plants. *Tariff 2* is calculated as relative ratio between discounted exploitation costs and discounted quantity of the heat energy produced throughout the expected exploitation period.

$$Tariff_1 = \frac{PV(UT)}{PV(Q)} \qquad (1)$$

$$Tariff_2 = \frac{PV(OT)}{PV(Q)} \qquad (2)$$

where *PV(UT)* and *PV(OT)* represent present values of total and operational costs, while *PV(Q)* represents present value of the produced heat energy.

Economic price based on travel costs is 0,0835 EUR/kWh, while economic price based on the exploitation costs is 0,0448 EUR/kWh. For calculation of present values of costs, discount rate of 5% was applied. It is a lower discount rate level, typical for renewable energy projects with positive

environmental implications. The current price of the heat energy at the outlet of the heat plant, delivered by the Public Utility Company "Beogradske elektrane" is 0,0365 EUR/KWh. If this price is compared to the price based on the *Tariff 2* (marginal costs) from geothermal source, the difference is approximately 23% in favour of the energy delivered from the remote heating plant. Calculation of the commercial tariff in our case does not include potential savings of gas due to switching to the geothermal source or monetary equivalent of the positive environmental effect. If these effects were also included into the calculation and/or if exploitation costs were reduced by these amounts, prices at the outlet of the heat plant and the price of geothermal energy would level off. It is clear that this conclusion applies only to this pilot project.

Pilot project revenues and profit

Revenues of the pilot project are calculated on the basis of the assumed area heated by a geothermal source (2000m²) and projected price of the heat energy (0,7 EUR/m²). Revenues from sales of heat energy are calculated at the fixed prices p.a. for the entire period of exploitation of the geothermal plant. Profit from the pilot project represents differences between revenues achieved from sales of heat and current costs and current exploitation costs. Throughout the exploitation period, the planned heat pump pilot project achieves profit. Net present value of the total net profit is EUR 68677.

Economic justification of the investment

Total economic justification of the pilot project of cascade heat pump is determined on the basis of the projected economic flow. The economic flow of the Project includes investment and annual exploitation costs, excluding depreciation and tax on the one hand, and revenues from heat energy sale, on the other.
Total positive economic effect of the pilot project is determined through net present value, which is at the discount rate of 5% equal to EUR 26597. Present value of the difference between the pilot project's revenues and costs is positive and shows economic justification of investment into cascade heat pump. Positive economic net present value means that the planned pilot project is also justified from the aspect of total economy, that is, represents contribution to the growth of total added value of the economy as a whole by EUR 26597. Economic internal rate of return (average profit rate) of the pilot project is 8,67% and is higher than the average productivity rate in the energy sector. Accordingly, the heat pump pilot project is economically acceptable from the aspect of this criterion as well. Pay-back period of the investment is 7 years, which is in the area of acceptable pay-back period for energy sector projects.

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CVP EQUATION vs NPV EQUATION

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Abstract

Cost-Volume-Profit (CVP) equation and Net-Present-Value (NPV) equation are equations showing the relation between net profit and variables that it depends on (revenues, costs, production volume). Both equations are used for the same purpose i.e. they measure the profitability of some business. When both equations are applied, the net profit of some business is calculated for some period of time. The aim of this paper is to mathematically arrive at "the point of separation" between these two equations i.e. to demonstrate what makes them basically different. The essential difference is that CVP equation does not take into account time value of money, while NVP equation does it. Hence, there are differences in calculations of net profit by using both equations.

Key Words: *CVP equation, NPV equation, cost of capital, discount rate.*

1. INTRODUCTION

Cost-Volume-Profit (CVP) analysis has been the subject matter of investigations by many authors over a long period of time. This analysis is used by a large number of companies, especially small and middle businesses, and it has been applied for several decades.

CVP analysis is considered by many authors a suitable business decision-making tool on the part of the company's management. Hirsch (2006), analyzing relevance of CVP analysis, emphasizes that it still provides us with a basic decision-making tool. CVP analysis allows managers to investigate a wide range of scenarios and examine a wide variety of dimensions as they analyze business problems.

Webster (2004) states, the usefulness of CVP analysis may be greater in less complex smaller firms, while for larger firms, CVP analysis can be valuable as a decision tool for the planning stages of new projects.

Chan and Yuan (1990) consider cost-volume-profit analysis is frequently used by management as a basis for choosing among alternatives. The managers have to determine (1) what is the sales volume required to achieve a target level of profits, and (2) what is the most profitable combination of products to produce and sell.

Finch and Gavirneni (2006) identify breakeven analysis with CVP analysis and say that breakeven (also known as CVP) analysis has long been used as a decision-making tool for making choices among alternatives with different fixed and variable costs.

According to McIntyre (1977), CVP analysis is a well-known managerial tool that attempts to specify a firm's cost and revenue functions and the relations between the two. It is used by managers, accountants, investment analysts, and other interested persons to examine the impact on profit of changes in costs, volume, selling price, product mix and related factors.

On the other hand, the Net Present Value method is well-known and commonly used in business decision making, because it is an absolute measure for profitability of some investment endeavor (project) that a company intends to undertake (Dubonjic, Milanovic 1997).

Gannon (2001) reports that the net present value is the most useful discounted cash flow methods. NPV analysis yields a result, expressed in after-tax dollars (important for profit-based operations), that takes into consideration the difference in the value of future cash flows and the cost of raising the capital required for the investment. NPV helps make sound decisions about whether to accept or reject potential investment projects based on an objective financial criterion.

2. CVP and NPV EQUATION

It is widely known that CVP analysis interprets the relations between profit and costs, sales volume and sales price, and examines the impact of changes in costs, sales volume and price on the profit (Gopal 2009).
Conventional CVP analysis rests on the assumptions that all organization costs are either purely variable or fixed, that units made equal units sold, and that revenue per unit does not change as volume changes. With these assumptions, an organization making a single product can write its profit equation as follows (Atkinson, Kaplan 2007):

Profit = Revenue – Costs
Profit = Revenue – Variable Costs – Fixed Costs
Profit = (Units sold x Revenue per unit) – (Units sold x Variable cost per unit) – Fixed costs
Profit = [Units sold x (Revenue per unit – Variable cost per unit)] – Fixed costs.

The following symbols can be used to represent the various items in the above equation:

p – profit
x – sales volume (units sold)
r – revenue per unit (sales price)
v - variable cost per unit
f - fixed costs

The equation can now be expressed in mathematical terms as:

$$p = (r - v) \cdot x - f \quad (1)$$

This formula is called the Basic Profit Equation (Caplan 2006), or CVP equation.

One of the drawbacks of this equation, as pointed out by Kee (2007), is that CVP is a one-period model of a product's profitability, although the product may have an economic life of several years. However, the equation (1) can be also written for some observed period n (n – number of years), assuming that production volume will not change. If p is observed as after-tax profit (t_s - tax rate), then the above equation can be presented as:

$$p = \sum_{i=0}^{n} [(r_i - v_i) \cdot x - f_i] \cdot (1 - t_s) \quad (2)$$

Prior to presenting NPV equation, some other symbols will be introduced:

s – net present value
d – depreciation charges
f' - fixed costs without depreciation ($f = f' + d$)
i_s - capital investments
l_s - salvage value
i_b - investments in working capital
l_b - working capital recovery
k – discount rate (MARR)

Using the above and these symbols, NPV equation can be written in the following form:

$$s = \sum_{i=0}^{n} \frac{[(r_i - v_i) \cdot x - f_i'] \cdot (1 - t_s)}{(1+k)^i} + \sum_{i=0}^{n} \frac{d_i \cdot t_s - i_{s_i} - i_{b_i} + l_{s_i} + l_{b_i}}{(1+k)^i} \quad (3)$$

Adding and subtracting the expression $d \cdot (1 - t_s)$ and separating some of the sums, equation (3) becomes:

$$s = \sum_{i=0}^{n} \frac{[(r_i - v_i) \cdot x - f_i' - d_i] \cdot (1 - t_s) + d_i}{(1+k)^i} - \sum_{i=0}^{n} \frac{i_{s_i}}{(1+k)^i} - \sum_{i=0}^{n} \frac{i_{b_i}}{(1+k)^i} + \sum_{i=0}^{n} \frac{l_{s_i}}{(1+k)^i} + \sum_{i=0}^{n} \frac{l_{b_i}}{(1+k)^i}$$

As investment most commonly takes place in year zero (present time), then $\sum_{i=0}^{n} \frac{i_{s_i}}{(1+k)^i} = i_{s_o}$ and $\sum_{i=0}^{n} \frac{i_{b_i}}{(1+k)^i} = i_{b_o}$. Likewise, salvage value and working capital recovery take place in the n-th year (final year of analysis), consequently $\sum_{i=0}^{n} \frac{l_{s_i}}{(1+k)^i} = \frac{l_{s_n}}{(1+k)^n}$ and $\sum_{i=0}^{n} \frac{l_{b_i}}{(1+k)^i} = \frac{l_{b_n}}{(1+k)^n}$.

Now equation (3) assumes the form:

$$s = \sum_{i=0}^{n} \frac{[(r_i - v_i) \cdot x - f_i] \cdot (1 - t_s)}{(1+k)^i} + \sum_{i=0}^{n} \frac{d_i}{(1+k)^i} - i_{s_o} + \frac{l_{s_n}}{(1+k)^n} - i_{b_o} + \frac{l_{b_n}}{(1+k)^n} \quad (4)$$

If time value of money were not taken into account ($k = 0$), then equation (4) becomes:

$$s = \sum_{i=0}^{n} [(r_i - v_i) \cdot x - f_i] \cdot (1 - t_s) + \sum_{i=0}^{n} d_i - i_{s_o} + l_{s_n} - i_{b_o} + l_{b_n}$$

As working capital recovery (in the n-th year) most commonly equals investments in working capital (in year zero), i.e. $i_{b_o} = l_{b_n}$, and $\sum_{i=0}^{n} d_i = i_{s_o} - l_{s_n}$, it is obtained $s = p$ i.e. NPV equation becomes equal to CVP equation.
Consequently, the difference between these two equations is a discount rate *k*. It can be claimed that NPV equation is actually CVP equation that takes into account cost of capital (Kee 2007) expressed through the discount rate.

3. EXAMPLE

A can factory should make a decision whether to extend the production program by introducing a new type of a drawn can on the basis of novel technology. The following relevant data are available to the firm's management for decision making:

- equipment investments: 852,000 €
- investments in existing workshop adaptation: 10,000 €
- workshop value prior to adaptation: 20,000€
- planned annual production volume: 61,000,000 units
- production costs: 0.042 € / unit
- tool sharpening costs: 1,000 € * 4 times annually = 4,000 €
- purchase of a new tool set: 24,000 €
- product unit price: 0.05 € / unit
- number of cans obtained from a single white tin plate: 48
- a single white tin plate weight: 0.8 kg
- white tin price: 950 € / t
- average total amount of all lacquers moist painting per a single white tin plate: 30 g
- average lacquer price: 4 €
- investments in working capital: 280,000 € (white tin and lacquers investments needed for 1st quarter of a year)
- working capital recovery: 280,000 €
- equipment salvage value after a 5-year depreciation period is zero, and likewise tool salvage value after a 3-year depreciation period is zero, as well as workshop salvage value after 20 years (depreciation is performed by a linear method)
- tax rate is 10%, and discount rate is identical; the analysis period is 3 years.

Based on available data and using the symbols given in this paper, the following can be presented:

1. Capital investments:
   $i_s = 852{,}000 + 30{,}000 + 24{,}000 = 906{,}000$ €
2. Investments in working capital: $i_b = 280{,}000$ €
3. Working capital recovery: $l_b = 280{,}000$ €
4. Revenue per unit: $r = 0.05$ € / unit
5. Variable cost per unit: $v = 0.042$ € / unit
6. Fixed costs without depreciation: $f' = 4{,}000$ €
7. Sales volume: $x = 61{,}000{,}000$ units
8. Depreciation and salvage value:

- equipment:

$$d_e = \frac{i_{s_e} - l_{s_{e5}}}{n_e} = \frac{852{,}000 - 0}{5} = 170{,}400\ €$$

$$l_{s_{e3}} = i_{s_e} - 3 \cdot 170{,}400 = 340{,}800\ €$$

- workshop:

$$d_h = \frac{i_{s_h} - l_{s_{h20}}}{n_h} = \frac{30{,}000 - 0}{20} = 1{,}500\ €$$

$$l_{s_{h3}} = i_{s_h} - 3 \cdot 1{,}500 = 25{,}500\ €$$

- tools:

$$d_t = \frac{i_{s_t} - l_{s_{t3}}}{n_t} = \frac{24{,}000 - 0}{3} = 8{,}000\ €;\ \ l_{s_{t3}} = 0$$

$$d = d_e + d_h + d_t = 179{,}000\ €\ .$$

Integrating all these values into equations (1) and (3) for profit and net present value, it is obtained:

$$p = 821{,}070\ €$$
$$s = 427{,}586\ €.$$

Graphic presentation of the functions $p = f(x)$ and $s = g(x)$ will show the best similarities and dissimilarities between CVP equation and NPV equation:

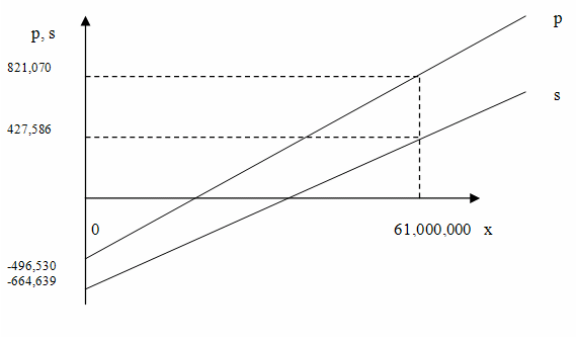

Figure 1. CVP and NPV Chart

It is possible to determine from Fig. 1, among other things, break-even point – BEP of production volume. Certainly, due to different approach to net profit determination, BEP is different for CVP equation and NVP equation respectively. Value *s* is commonly termed as economic value, whereas value *p* is referred to as accounting profit (Kee 2007).

4. CONCLUSION

CVP equation and NPV equation are used for the same purpose i.e. to measure profitability of some business. Using both equations the net profit of some business is calculated for some period of time. The essential difference is that CVP equation does not take into account the time value of money, while NVP equation does it. Hence, there are differences in the obtained result when calculating net profit by using both equations. Those differences are certainly lesser and lesser if the period of analysis is shorter and discount rate lower. In practice both equations are often used, depending on the goals of presenting the results.

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INFORMATIONAL DIMENSIONS OF STRUCTURING

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Abstract: This paper analyze the most important aspects of information impact on the organization structuring.

Key words: Information, structuring, organization

1. INTRADUCTION

This short description of the way leading from the list of all activities (existing or future, depending on whether we are talking about the reorganization or projection of the macroorganizational structure of a new company), via business operations and/or assignments, past the initially small and later larger and larger macroorganizational subsystems until finally reaching the company as a whole, demands a great deal of time and resources, and should not be the permanent activity of those who are responsible for the organization of a company. We believe that Lewin was right in seeing changes in structural organization as falling into three stages (each to be as brief as possible): the process of unfreezing, of structural changes, and of freezing them again.

One part of these (business) activities represents activities to do with harmonisation (i.e. management), and activities related to direct staffpersonnel unit and technical support provided to managers during the process of harmonisation. The number of such implementors is difficult to define ahead of time, which is why it is difficult to come to a total number of implementors by using only the accepted span of control. Thus, the real value of the hirerachical angle of refraction (defined as the quotient of the total number of employees and the average management span) can be established only ex post.

A good organizational structure must contain the germ (i.e. the action code and structural algorithm)for providing fast and efficient functional solutions (procedural, managerial, production-related, and business-related), as well as appropriate transformations (material, energetic, and informational) related to all internally or externally generated challenges (demands), which may threaten parts of the business or the business as a whole, while maintaining the macroorganizational structure throughtout.

2. ORGANIZATIONAL STRUCTURING

Formal organizational structure is a combination of various principles and regulations dealing with the decomposition of work integration. It is important to note that there is a very clear and strong link between division of labour and coordination: the more detailed the division of labour, the more necessary intensive coordination becomes. Coordination is the result of the interactive process of individual initiative (by implementors and managers) which always implies general rules to do with division of labour an coordination, established by the macroorganigram. We would also like to emphasize that the macroorganizational structure is the foundation and support for the behaviour of implementors and managers in the process of their

meeting the objectives defined by (and built into the structure of) the company.

In that sense, macroorganizational structure is to business what grammar is to language. Business operations, broken down into business and work assignments are integrated and effected through a framework and through regulations established by the macroorganizational structure – in the same way that language, broken down into words, becomes integrated into a complete verbal communication with the help of rules imposed by grammar. We repeat that the condensed interpretation is not simplified because the process of condensation introduces concepts which are more abstract, rather than more simplified. Of course, as the element of abstraction increases, meaning becomes less and less precise, but this does not reduce the scope. The wealth of activity is transformed – via the introduction of various criteria, categories, samples, and models ("Jobs and work assignments"). This block is transformed into the following interpretative block through the use of similar or identical principles, but typically through the application of other criteria and categories.

3. INFORMATION RELATIONSHIPS IN MAKROORGANIZATIONAL STRUCTURING

The interpretative possibilities of macroorganizational structure (in both directions – i.e. towards decomposition, and towards integration) have their numerous and various limitations, of which we will mention the three that are infrastructural, i.e. informative (and partly of the linguistic provenance): 1) incompatibility, 2) minimum amount of variety required, and 3) the Bremermann Limit.

Ad (1): As business operations become more complex, so the macroorganizational structure becomes more general, its meaning can be interpreted in more ways, and it becomes more imprecise. In short, the perception of the company becomes more and more unclear.

Ad (2): Despite this, the macroorganizational structure must provide a minimal, adequately clear framework for the expected varieties of future states and actions in the business operations of the company.

Ad (3): And finally, there is a limit beyond which information cannot be processed by existing material means. As a rule, the potential variety of even the simplest sociotechnical systems easily and quickly crosses this line (known as the Bremermann Limit). The answer lies in organization (more precisely, in the organizational structure), which reduces the possible states and behaviours to pre-assigned and pre-arranged situations (known to the business coordinators), which contain certain prescribed (defined) problem-solving procedures. At the same time, a risk is consciously accepted – the risk of knowing that pre-assigned situations are not fully adequate to the variety of all possible real situations. However, the result is certainly better than suffering the consequences of overstepping the Bremermann Limit, and thus risking complete decision paralysis.

The organizational structuring of the information system is mostly governed by the general rules relating to organizational structuring, coupled with the adjustments which usually accompany the organizational structuring of business functions. However, in the process of organizational structuring of the enterprise's information function, one encounters latent inherent difficulties arising from the infrastructural nature of the information system. Therefore, the macroorganizational structuring of the business information system is actually the structuring of infrastructure, which may cause semantic as well as organizational and technical difficulties and ambiguities. That is a great problem, which will not be dealt with in greater detail on this occasion. In any case, it is necessary to design, introduce and adjust the macroorganizational articulation of the parts of information infrastructure with special attention.

The organizational structuring of business functions results in the organizational model which is usually a combination of two organizational forms: a line (hard, hierarchical) form and team (soft) form (see /3/). The organizational structure of the system is the result of breaking up (fragmenting, factoring) the overall business operations into hierarchically arranged and less complex business units. This fragmentation continues until such units, that is, subsystems are obtained as will be surmountable without any further fragmentation. The fractiles so obtained are surmountable both in terms of job performance and in terms of job coordination, i.e. they are surmountable both in terms of the division of work (since we now have a group of identical or very similar jobs for whose performance one or more employees of the same or very similar profile

are needed) and in terms of work coordination (since coordination can be unambiguously defined for that task).

The fractiles at the end of the business decomposition chain, that is, the decomposition of the global task of the enterprise are the elementary tasks and – from the viewpoint of macroorganizational structuring – they are the "black boxes" in the interior of which it is not entered, regardless of the scope of activities and the number of relevant employees. The essential quality of the elementary tasks is that they have all major qualities of the overall aim of the enterprise, regardless of the method used to divide the overall aims into the elementary tasks. The introduction of this assumption is useful because, if the elementary task is organizationally arrticulated into the smallest (or indivisible) organizational unit, then such a quality enables the freedom of combining organizational entities in the process of macroorganizing the enterprise as a whole or, to be more exact, in the process of building macroorganizational entities at higher hierarchical levels of the enterprise.

The clusters of the elementary tasks, that is, the clusters of the elementary organizational entities, combine freely on the basis of the arbitrary (or some other) criteria adopted by the designer of the organizational structure, whose main task remains to be defining the hierarchical relationships among the elementary organizational entities. For the designing purposes, the designer may regard the organizational entities so combined as the elementary entities and combine them in the same way up to the level of the superstructure, that is, the enterprise level. In that way, for the same number of elementary tasks, we obtain macroorganizational hierarchical structures having a different height and ramification. For example (see /1/), three different elementary tasks (that is, three elementary organizational entities) can be combined into four different hierarchical macroorganizational structures. For ten elementary tasks, the number of possible combinations of the hierarchical organizational structure is 282 million, and for fifteen elementary tasks the figure has more than eighty digits.

The choice of alternatives is radically reduced, primarily through the multi-level process in which the division at each level reduces the number of the remaining alternatives. With the hierarchical fragmentation of the organizational system, all horizontal interactions and some vertical ones disappear. There remain only the limited vertical interactions between the elementary tasks, or elementary macroorganizational entities making up the same organizational form. The barriers imposed by hierarchy are called line (horizontal) and functional (vertical) gaps. These barriers simplify vertical and horizontal coordination to a significant extent, but this simplification is paid for by the conscious suboptimization of business coordination due to the isolation of organizational entities by gaps. The response of the organizational structure (see /2/) is the horizontal business harmonization based on additional soft or hard, occasional and/or constant, structural modalities.

The fragmentation of the aim into two or more subaims continues at the next level in the created fragments, where the non-elementary aims or tasks are further divided into the subaims, until the elementary tasks are created. Fragmentation creates some kind of structure tree and the measure of fragmentation (ramification) is the number of non-elementary tasks, that is, ramification nodes. The number of branches in each node is actually the span of control and it is an inverse function of fragmentation.

$$\mathbf{f = (n - 1) / (s - 1)}$$

where **f** = fragmentation, **n** = number of elementary tasks and **s** = span of control. It is evident that, for a given **n**, maximum fragmentation for a minimum span control is 2.

The marginal case **s = n** is a completely flat hierarchical structure, where the span of control is equal to the number of elementary tasks with one node (non-elementary task), which coordinates the activities within **n** elementary tasks. The other extreme, **n** elementary tasks and **s = 0**, is a substantive anarchy. In any case, the total number of potential relations (and relation is, by definition, information) is very sensitive to **s** (in short, an increase in the span of control by one doubles the number of potential relations), so that (in view of the fact that fragmentation and the span of management are in inverse proportion to each other) it is attempted, in practice, to achieve an optimal balance between the fragmentation and

interaction of the tasks. A great number of organization theoreticians and practicians have devoted considerable time and efforts to the search for an optimal span of control, but this issue has not been satisfactorily resolved to the present day.

To coordinate the functioning of an organizational system it is necessary to ensure communications among its parts, primarily within each organizational form and then also in the model – the macroorganigram of the enterprise. In a hierarchically arranged system, communication is carried out (by the nature of things, unless ordered otherwise) through communication channels, which follow the hierarhical structure tree.

In a non-hierarchical system (**s = 0**) with **n** elementary tasks, the number of pairs of potential direct information relationships is **(n-1)n/2**. If we retain all these free relationships and add the relationships imposed by the system hierarchy, the number of relations will increase **s /(s-1)** times. Both cases are quadratic functions **n**, which means that the number of relations in both cases rapidly overcame the Bremmerman limit and practically blocked the functioning of the system. The purely hierarchical communication channels radically reduce the total number of information relationships to the number of fragmentations (**f**) multiplied by a uniform span of control (**s**), and that number of information relationships amounts to **s(n-1)/(s-1),** which is the linear function of the number of elementary tasks and increases at a much slower pace than the first two. A comparison of the number of information relationships in non-hierarhical and hierarchical systems is reduced (on the assumption that max s=n) to a comparison between **n/2** and **n/(n-1),** and that means that hierarchical structuring is »profitable« if there are 3 (or more) elementary tasks. That is the hierarchy with 4 members, which is (see /1/) a very resistant hierarchical structure, since small-sized enterprises with 4 or more members have demonstrated the same virulence and resistance as those with 20 or more employees. It can be assumed that, in part, this power is derived from the adjustment of the organizational and informational structures of the enterprise.

The price of reducing the number of communications by introducing hierarchy is, above all, the distortion and delay of messages when passing through the nodes. Every decision-maker must be aware of the fact that all received information underwent significant changes in all nodes through which it had passed. The number of intervening nodes is equal to the number of hierarchical levels through which the information had passed, and that is $\log_s n - 1$, where **n** is the number of elementary tasks which are, directly or indirectly coordinated by that decision-maker, while **s** is the constant span of control. If **s** is not constant, the number of intervening nodes can be approximated, or counted on the organigram. In part, the information distortion problems can be alleviated by introducing the information pool or, in other words, by forming the database that will be accessible to all nodes of the business information system under the specified conditions and according to the estabkusged rules.

4. CONCLUSION

Plans are the main tool of coordination. The factoring of the global aims into the subaims is communicated to lower levels by means of plans and subplans, whereby each node generates plans for the subordinated level. The resources required for their realization are also allocated by means of plans. In addition to the information received from the formal information system of the enterprise, the dominant source of information for the development and realization of plans and other means of coordination (orders, instructions, control, etc.) is not objective reality, but its descriptions, which are contained in the so-called primitive (original, basic, firsthand) data. They are mostly beyond the decision-maker's control and are susceptible to errors, delays, bias, filtration and other kinds of distortion, whether deliberate or accidental. The reliance on the information received from the formal information system, or on primitive information depends on the size of the enterprise; the larger the enterprise, the more the decision-makers (managers) will rely on secondhand information.

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AN APPROACH FOR DOCUMENTING THE DESTRUCTION PROCESS OF A PRODUCT WITH AN EXPIRED PRODUCT LIFE

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Abstract: *The destruction of products with an expired product life is currently attracting a lot of intrest. These sorts of products can be, due to inadequate (illegal or unsafe) handling, very dangerous. The products that fit this description are: Electronics (heavy metals), batteries (heavy metals, acids), weapons and military equipment (explosives etc.), medical, industrial and other kinds of waste, drugs etc.*

This paper demonstrates the documentation of the destruction process of one of the products, done by HK "KRUŠIK", based on the recording of all phases of the destruction process. The photographs taken during the process were organized into a database which can be searched using anything visible in the photograph as a search parameter (letters, numbers etc.) and which assured the client that everything was done legally, safely and according to standards and procedures the client demanded.

Key words: *Destruction, documentation, photographs database, waste, drugs, weapons and military equipement.*

1. INTRODUCTION

HK "KRUŠIK" has recently, under contract with the foreign client, destroyed a certain number of products from their area of expertise whose product life has expired.

Through the realization of this contract HK"KRUŠIK" has developed the technology for destruction and the documentation of the destruction process of said products in a way and with quality still unsurpassed in the world[1]. The foreign client was completely assured that the whole contract was fulfilled according to their expectations and that all units designated for destruction were destroyed.

The purpose of documenting the destruction process is to prevent that any of the units designated for destruction end up in the wrong hands (black market, unsafe disposal resulting in environmental pollution etc.) which could have unforeseeable consequences for the environment, society and country.

At the moment when we are facing the consequences of global warming we are becoming more aware of problems caused by disregarding regulations and the importance of methods, such as this one described in this paper, which could verify whether procedures prescribed by law or contracts are being followed.

During the carrying out of the task named "Missile System Destruction", the HK ″KRUŠIK″ formed two types of documents (printed form and digital-electronic form) in order to confirm the quality and quantity of the activities done.

The digital-electronic form of documents is saved on many disks (photos resolution function).

2. CD AND DVD-s CONTENT

CD content:

- Documents User Manual (file **User Manual. PDF**).
- List of the Missiles Destroyed (file **GRAIL List. PDF**).

DVD-**s** contains photos of the missile and its subparts (for each of the 1000 missiles), in accordance with the phases of disassembling and destruction process. The photos are stored in the database readable by **ACDSee** software Ver. 5.0.

[1] This positive assessment was given by the representative of the foreign client and it will be the basis for the bid to name HK"KRUŠIK" as the regional center for disposal of this kind of products.

The database review can be done by the serial numbers as well as by the identification numbers.

DVD-**s** Dissaembly organization.

Root folder contains: folder **C:\Disassembly**[2] and file **C:\ACDDatabase.xml**.

The folder **C:\Disassembly** contains photos of the missile and its subparts (for each of the 1000 missiles), before and after disassembling process[3].

File **C:\ACDDatabase.xml** enables database review by **ACDSee** software Ver. 5.0.

DVD-**s** Destruction organization.

Root folder contains folder **C:\Destruction**, with photos of the missile and its subparts (for each of the 1000 missiles), before and after destruction. Folder **C:\Destruction** contains 4 subfolders: **C:\Destruction\IRHH Destruction**, **C:\Destruction\LT Destruction**, **C:\Destruction\PU Destruction** and **C:\Destruction\WH-FS Destruction**[4].

The videos of Warhead Destruction (explosion), are on special DVD named Movies.

3. CD DOCUMENTS USER GUIDE

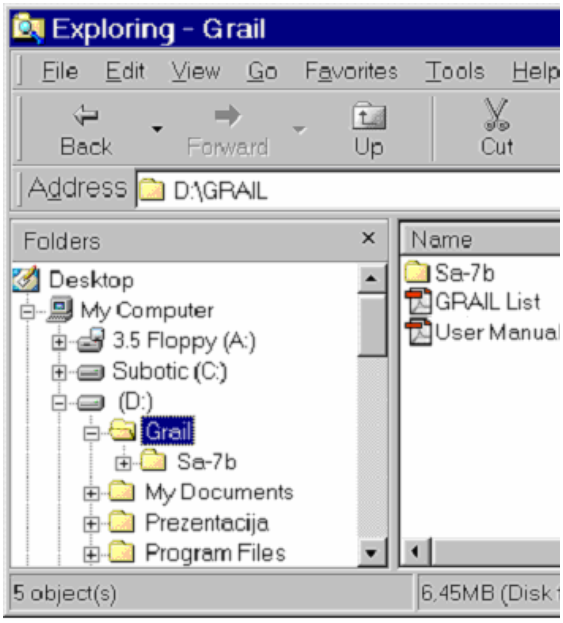
To review documents contained on the disks, the following steps are needed:

- On the PC[5] with **Microsoft Windows** OS (Windows XP or later), create the folder **C:\GRAIL** (for example C:\GRAIL).

- Copy the contents of all disks into the folder **C:\GRAIL (picture database)**.

- Install the **Adobe Acrobat Reader** software in order to read: User Manual (file **User Manual.pdf**) and List of the missiles Destroyed (file **GRAIL List.pdf**).

- Install the **ACDSee** software (Ver 5.0), for the database (photos) review.



3.1 Software ACDSee (Overview)

The photos overview (database search), needs the **ACDSee** software (Ver 5.0).

The database search options are:

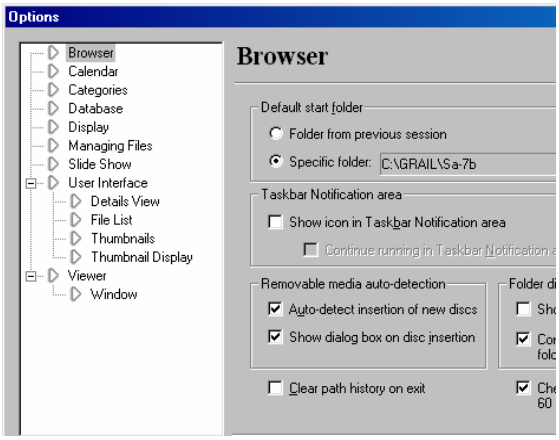
- serial number[6] (on the missile and its subparts, bold colored by the manufacturer) and

- HK ″KRUŠIK″ hand written identification number[7] (No. 0001-1000).

The following steps are needed.

Start **ACDSee** software.

From the **Tools\Options\Browser** menu, choose for Default start folder (Specific folder) **C:\GRAIL\Sa7b** (for example **C:\GRAIL\Sa-7b**).



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[2] **C:** The disk logical name, for example **c:**.

[3] The photos are located in the specified subfolders (Missile photos grouped in sections of 100 photos). Each subfolder is divided into 100 subfolders, for example 0001, 0567 or 957 (HK "KRUSIK" identification number for each missile).

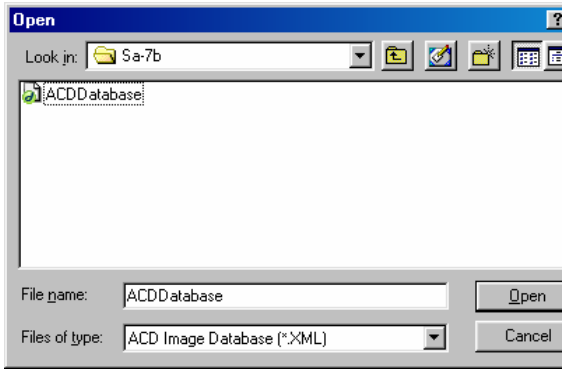
[4] Due to the different technologies used for the destruction of the missile subsystems and the fact that many of them were destroyed simultaneously (Infrared homing head, Launching tube, Propulsion unit and War head with fin section), the photos are separated into the different subfolders (for example C:\SA-7B\Destruction\IRHH Destruction), that are also divided into the new subfolder levels referred to the every single missile, for example 0001, 0189, 0496, 0497, 0499.

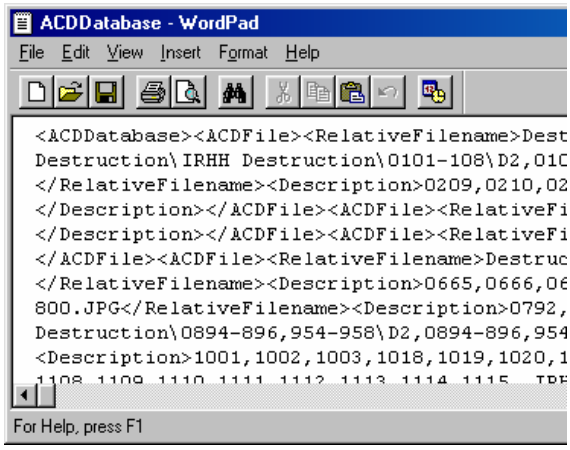
[5] The PC is recommended to be equipped with a microprocessor as powerful as possible (for example Intel P4) to shorten the base searching time.

[6] For the serial number P09208, search engine will find photo of the missile part with the same number. Definitely it is IRHH disassembled from the missile with identification number 0005.

[7] For the identification number 0005, search engine will find 12 photos related to the missile number 0005.

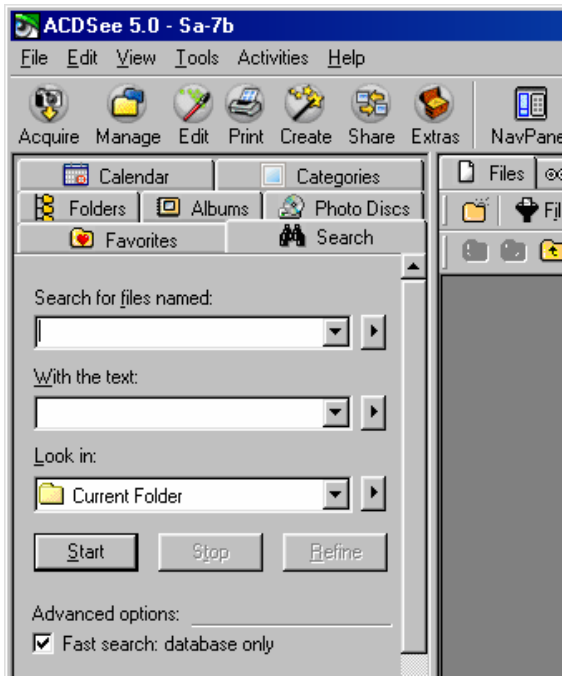
From the **Tools\Database\Import Database Info …**, menu import database from the file C**:\GRAIL\ Sa-7b\ACDDatabase.xml**. The database is ready for use.





The database part listed by the Word Pad

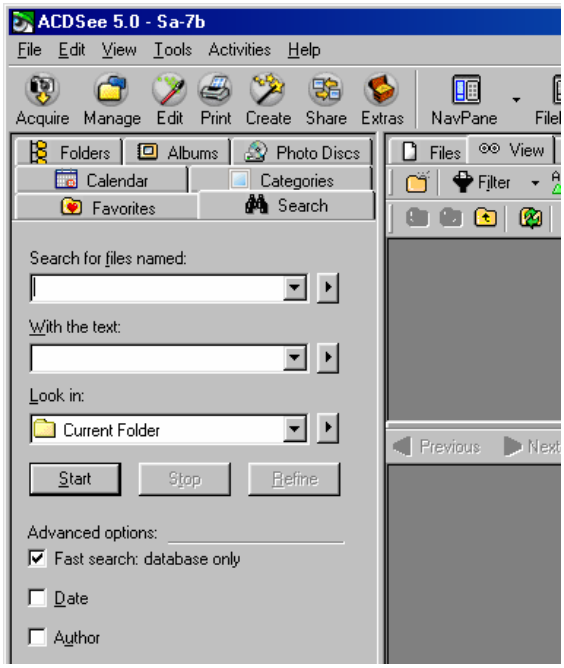
Click on the **Search** option, than select Fast search: database only.



In the field **With the text:** (arrow to the right) select only: Appearing in description.

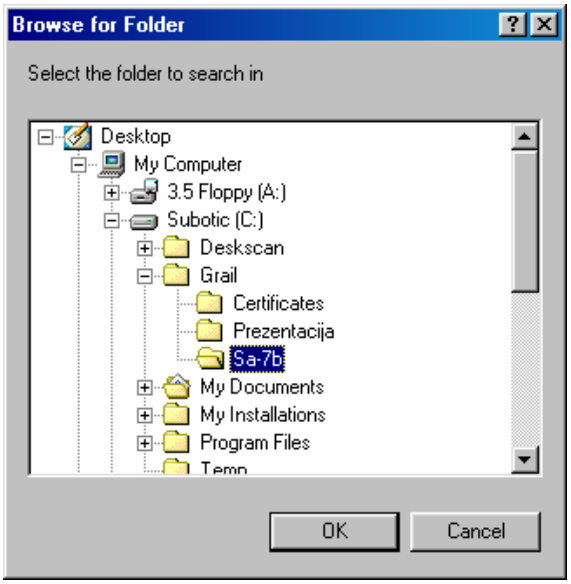
In the field **Look in:** (arrow to the right) select only: Include Subfolders.

Click on the View tab, to put **ACDSee** into the mode appropriate for the photos review.



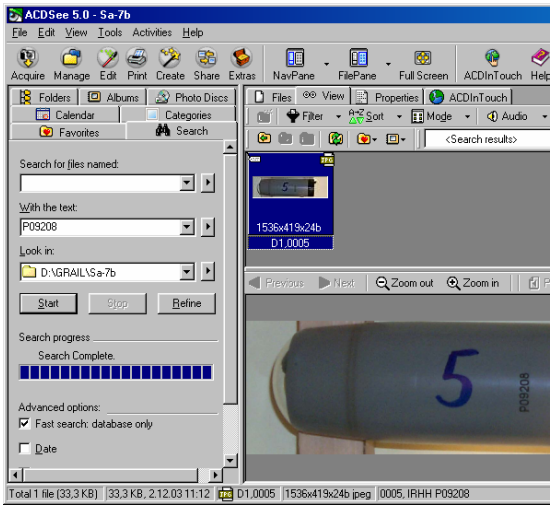
Restart the ACDSee, to apply the new settings.

In the **Look in:** chose (arrow to the down) folder containing database, Browse path C**:\GRAIL\Sa-7b** (for example **C:\GRAIL-\Sa-7b**).



In the field **With the text:** write a needed missile or subpart serial number for example P09208, and click on the start button. Software will search database only through the field Appearing in Description, folder C**:\GRAIL\Sa-7b** and all its subfolders.

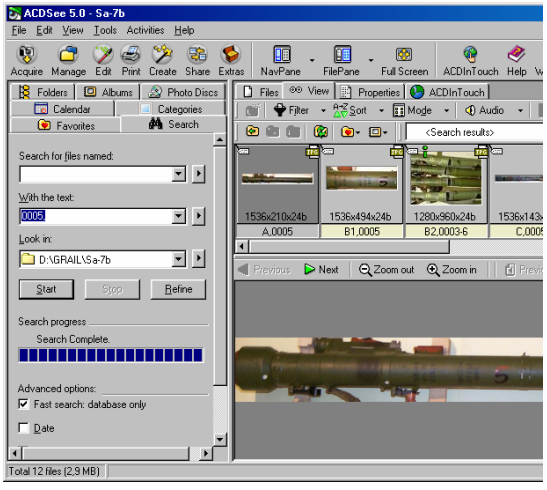
If there is a part or subpart in the database with the needed serial number, it will be found.



In this example, the search engine has found the required serial number on the part IRHH (Infrared Homing Head) with the HK ″KRUŠIK″ identification number 0005. To see more about the part, click on the smaller photo, followed by **Ctrl** + **D.** The window with more detailed data will appear, in our case **0005, IRHH P09208**.

This means that the found part is Infrared Homing Head, disassembled from the SA-7B GRAIL missile No. 0005 (HK ″KRUŠIK″ identification number).

Set of data (photos) for SA-7B GRAIL missile No. 0005, can be found in the same manner as the already mentioned serial number P09208, searching the database for the identification number SA-7B GRAIL missile No. 0005, typing "**0005,**", in the field **"With the text"**.



During the previous search it is necessary to type a comma behind the identification number ("**0005,**"), to avoid getting subpart photos which have notation 0005 in their serial numbers as search results.

The search results are displayed in following order: SA-7B GRAIL missile, Launching tube, Daestroyed launching tube, Missile, Infrared homing head, Destroyed infrared homing head, Warhead, Warhead prepared for destruction, Destroyed warhead, Propulsion unit, Propulsion unit prepared for destruction and Destroyed propulsion unit.

4. CONCLUSION

1. We successfully modeled a method for destruction process documentation for an unusual, special product.
2. We successfully designed a photograph database which can be used with ACDSee search engine.
3. We used ACDSee as a picture search engine.
4. Foreign client of HK KRUSIK was very satisfied with documentation of the destruction process.

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ECONOMIC ANALYSIS OF THE PASSIVE AND INTELLIGENT MULTIFAMILY RESIDENTIAL BUILDING IN BELGRADE

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Abstract: *This paper presents some technological and economic aspects of the project inspired by numerous initiatives in extremely low energy consumption energy efficient building in modern architecture. Project main aim was to present a new model of the integral application of science, education, enterprise and the public sector in the future transformation of cityscape, thus forming guidelines for urban residential development in Serbia.*
Key Words: *economic analysis, passive building, innovation.*

1. INTRODUCTION

Global economic and energy crisis have reinforced changes in European legislative and regulative in the field of energy efficiency. This resulted with the European Parliament resolution on the 31. January 2008. (2007/2106(INI)) which promoted and even reinforced passive house construction standards starting from 2011 onwards.
Building of the ultra energy efficient objects, as passive objects are, increases investment costs in the EU countries comparing to the standard buildings, on the level of 12% in Germany and about 30% in Poland.
Strict application of the accepted standard in the Republic of Serbia from 1987. would result in average installed power for residential buildings of 95 W/m^2. This is much less than the republic average level of 160 W/m^2 valid for district heating systems and central heating systems based on boiler [5]. This is also confirmed in the case of Belgrade [6]. It is notified that renewable energy sources usage is very small. It is concluded that strict application of existing standards for design and building would result in much better energy efficiency in residential sector. Passive house standards go further.

2. PROJECT INITIATIVES

Nineteen scientists form faculties of Architecture, Mechanical, Electrical and Civil Engineering University of Belgrade started the „Project of the Passive Building with Active Occupants“. Project of the first multifamily residential passive building in Serbia was promoted in September 2008. Project team members earned numerous official letter supports as this project was accepted as necessity. Feasibility Study [2], discusses technical and economic possibilities for implementation of one prototype, passive-intelligent object, in Belgrade area. Realization of numerous passive building projects in EU countries was accomplished through state and local institutions and their support [4].

3. PASSIVE AND INTELLIGENT BUILDING FOR THE CITY OF BELGRADE

Expression “passive building“ originates from the “passive“ elements which together with a building, make pleasant inner temperature. Expression “passive“ means no electrical energy use, as the functioning is based on the spontaneous natural processes. Passive technology is totally ecological. Passive building, quantitatively expressed, is the object with extreme low energy consumption of which maximum energy consumption for heating is only 15kWh/m² per annum.
Basic elements of the passive solar architecture are correct building orientation (south in the northern hemisphere), windows, radiant barriers, wall and furniture colors, Trombe’s wall, verandas, underground energy accumulation, etc. In this project some additional system which are based on the primary energy are incorporated. Photovoltaic systems would be active parallel to the electro distributive network, with possibility to deliver electrical energy extras to the network.
Project incorporates two architecturally different concepts. Basic concept presents conventional object solution with orthogonal constructive system, and realization which is in wide use at the Serbian market.
Improved concept represents solution which is presented as a synthesis of the functional form inside the object and envelope innovative solution made of prefabricated elements outside.
Windows areas can function as solar panels. In this sense movable panels as well as outer barriers are necessary. Building envelope should satisfy criteria ≤0,6ACH (Air change per hour) at relative pressure 50Pa.

It is planned to employ floor and wall heating and cooling without radiators. For multilevel building, with total surface of 2500m^2, four heat pumps will be installed, type ground/water, energy very efficient [1].
As wall and furniture colors influence the solar radiation gain, it was planned to use materials with defined absorption coefficient values.
Philosophy of the passive buildings demands use of waste heat from the air and water and all other sources like, body heat from the people and pets, low-energy lighting, high-efficiency electrical appliances, etc.

4. ECONOMIC ANALYSIS

4.1. Investment

The study [2] gave a structure and dynamics of the total investments in the passive house of the total surface of 2500m^2 and heating surface of 2000m^2, with presumed location Zvezdarsko brdo. Beginning of the building was planned to be in March 2010. Building period would be 16 months. All previous calculation expenses are based on the constant prices, for the course of 95 RSD for 1€. In estimation of the material and workers costs a pessimistic scenario was used, with prices equal to those before the economic crisis.
Structure and dynamics of investments is divided in four parts, as preparatory activities (26000 €), construction works (914100 €), various vocational works (918000 €) and final works (180000 €), what makes building investment in total, without city taxes, of 2038100 €, i.e. 193619500 RSD. Construction average price is then 1019,05 €/m^2, i.e. 96809,75 RSD/m^2.
City taxes, expenses of the connection to the electrical, water and sewage systems increase total investment to the amount of 2488942 €, i.e. 236449500 RSD. District heating system is not included as the heat pump is planned.

4.2. Preliminary calculations of the possible income

Estimation of the residential square meter price in this part of the town is based on the econometric model with data base with 6160 units of flats and houses for Belgrade:

$$Y = \alpha_0 + \sum_{i=1}^{12} \alpha_i X_i ,$$

where Y presents flat average price in Belgrade, X_i are influencing factors (location, size, heating system,...) and coefficients α_i are characteristic model parameters [3]. Solving this model by OLS the relevant tests of the statistical significance have shown that only five of these twelve variables are statisticaly significant (X_2 - location, X_3 - size of the living space, X_4 - size of the non-living space, X_5 - heating system and X_7 – usage, living or business space). Average market price of 1575,08 €/m^2 for the residential flat on the location Zvezdarsko brdo is obtained by introducing relevant values in the previous model. Diffence between the average selling price per square meter and average investment cost is 330,61 €/m^2. It represents average nondiscounted benefit for the investors.

4.3. Project feasibility study

Standard procedure of the discounted cash flow was used for the project feasibility study. Planned deadline for the building construction is 480 days: March 2010.-June 2011. It was planned to realize all the location expenses, participations and earthworks in the first two months. Main construction activities, except some insulation works and gray water systems, should be realized in the period of March-October 2010. Vocational works are planned for the period September 2010-June 2011.
It is assumed that investor does not charge flats in advance. All money incomes are dated to the end of the construction period, in June 2011. Investor should then count on the precisely dated financial outcomes what is the worst case.
Planned cash flow is precisely elaborated in the Feasibility study [2]. Average interest rate on the international credit market was adapted as the credit sources and conditions (payback period and possible grace period) were mostly unknown. Monthly discount rate of 1% was used in the calculation of the discounted cash flows. Net present value calculated by discount rate of 1%, is 25936 € in constant prices. Internal rate of return is 2,08%. It means that invested capital in the building in the period March 2010 – June 2011 would have average monthly profit rate of 2,08 %. Net present value of the total expenses is 2427160 €, i.e. 1213,58 €/m^2. With sale price of 1423 €/m^2 net present value equals zero, and internal rate of return is equal to the relevant discount rate of 1%. This price is considered as critical sale price of the passive building. This conclusion stands only in the case if other project parameters, like workers payments, material prices, construction deadlines, capital price, remain unchanged.
Economic effects of savings in natural gas, electricity and drinking water for the period of exploitation of the geothermal, photovoltaic and gray water systems are projected on the present value and located in the month of June 2011. Annual discount rate for the exploitation period of these facilities is 12%. Time location of these effects on the construction deadline ensures calculation consistency of the determination of the net present project value and economic internal rate of return.
Economic net present value of the building for adopted selling price of 1575 €/m^2 is 436707 €, and economical internal rate of return is 2,87% monthly. Passive building project with all these systems is then economically approved. Economic internal rate of return is above the average capital productivity in the construction sector, what estimates passive building project as approved and acceptable.

4.4. Sensitivity and risk analysis

Sensitivity analysis is the first phase in estimation of the risk investment analysis. It is started with the most possible input values. Selling price per m^2 and construction expenses are the changeable values throughout the period of project realization. These fluctuations surely influence on relevant parameters for feasibility study. Sensitivity study is made in the way that one input value is changed for a certain per cent, while the rest inputs remain constant. It is, therefore, static approach without simultaneous change of input values. Choice of the critical parameters is based on the try and effect approach. It means that after the variation of one input for a certain per cent, variation of the level of the estimation

parameter is observed. Selling price and construction expenses were located as the critical parameters. Risk analysis have shown relatively significant changes of the estimation parameters for risk investment analysis. Decreasing selling price for 10% would decrease profit for around 60% and average month profit rate for around 40%. Decrease of 20% would result in losses and makes it economically unacceptable. Decrement of 16%, i.e. price of 1319 €/m^2, is the lowest limit of the passive building feasibility. Construction of the passive building is less sensitive on the construction expenses. Increment of the construction expenses of 20% results in profit decrement of 50%, i.e. average month profit rate for 37%. In this case, besides significant decreasing of the estimation parameters, project acceptability is still satisfying.
It could be concluded that this project has moderate acceptable risk investment intervals.

5. CONCLUSIONS

Implementation of the Project of the first multifamily passive building in the Republic of Serbia incorporates numerous technical, technological, social and other ecologically oriented innovations of importance for domestic energy efficiency standards and industry. Benefits of the project are numerous and listed below.
Experimental – building and realization of the object for exploitation in defined working regimes.
Expert – application of the results for forming legislative, regulations, standards and recommendations.
Scientific – application of the results and methodology from Belgrade and other parts of Serbia in international exchange of experiences and development of the scientific institutions and researchers with the main idea to improve energy efficiency.
Educational – application of the experiences and results in student education and even younger generations, what would widely implement rules and energy saving psychology in our society.
Economic – total constructing cost is 2038100 €. Average construction price is 1019,05 €/m^2, i.e. 96809,75 RSD/m^2 what is almost a double price the conventional building in the Republic of Serbia. It should have in mind that project includes, besides passive building highly demanded construction concept, also innovative intelligent and ecofoot print technologies. Net present value of the project is 436707 €, and internal rate of return is 2,9 % monthly. Covering sale price is 1319 €/m^2. On the basis of the aims, applied technical solutions, financial and economic estimation of the investment, as well as acceptability of the investor, it is possible to conclude that this project is technically possible and economically proved.
In addition, success of the passive house projects in the world show that there will be no conflict between ecology and economy, as all participants will profit from it [4].

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IMPACT OF RELIABILITY ON SELECTION OF TECHNICAL SOLUTIONS IN MANUFACTURING ORGANIZATIONS ENTREPRENEUR

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Abstract: *For young entrepreneurial manufacturing organizations, not only for them, the reliability of technical systems can have a key role in achieving and maintaining competitiveness in the market. Besides that, one should bear in mind that the technical aspects of reliability in its realization stumble upon limitations of an economic nature. It is known that a constructional solution, whatever successful it was, from a technical standpoint and in terms of feasibility must be considered from economic aspect too. This paper discusses the optimization of the cost of reliability, since in practice this aspect usually has a dominant role in the selection of constructing solutions.*

Keywords: *Technical system, reliability, level of trust, resigns, products, costs.*

INTRODUCTION

The reliability of the technical system is the structural characteristics of the system, its components and parts. The basic concept of reliability theory is being fired, in other words, loss of working ability of technical systems. Reliability has a key role in achieving competitiveness in the market manufacturing organizations. Methods of reliability allow most economical expenditure of material, time and financial resources to achieve the appropriate technical effects. Unreliability, not only reflects the cost of new or repaired product, lost time due to delays and cancellations, but it has a strong psychological effect on both producers and users of the market. In production, exposed to constant competitive pressure from the market, the psychological effects of uncertainty are reflected in the level of consumer confidence and preserve the prestigious position of producers. The level of confidence of the estimated reliability depends on the degree of accuracy determined by the distribution of random variables: load, tension, time, flow, pressure. During constructing a large set of requirements emerges before the constructors who are by nature and merits completely different. Requests in terms of cost optimization in the implementation of the technical aspects of reliability usually limited domain solutions in the construction phase. This type of restriction is justified economic reasons, and the products are different views of buyers and sellers on the cost of reliability. Before the constructors are the requirements to determine the level of reliability that would be an appropriate solution that meets the expectations of producer and consumer in terms of production, use and maintenance of technical systems. Four groups of claims, as part of the overall requirements of the applicable constructors during the choice of technical solutions are given in Figure 1.

The distribution may be given as the function of distribution $F(T)$ related to the probability that the failure will appear until time instant t, i.e. the probability that the time of work without failures does not exceed a value t [1-4, 9]:

$$F(T) = P\{T \le t\} \quad (1)$$

It is evident that at $t=0$, the value $F(0)=0$, and that at $t\to\infty$ the value $F(T)$ tends to be unity, i.e. $F(\infty)=1$.

The probability of work without failures or the reliability function is a complement to the unreliability function and may be represented by the following equation [1-4, 9]:

$$R(T) = 1 - F(T) = P\{T \ge t\} \quad (2)$$

It is evident that at $t=0$, the value $R(0)=1$, and that at $t\to\infty$ the value $R(T)$ tends to be zero, i.e. $R(\infty)=0$.

In this regard, the theoretical model of reliability of components in technical systems can be defined in one of the three following ways, as proposed by Dasic [1-3]:

- on the basis of a previously defined theoretical distribution,
- via choice of a theoretical distribution, which fits better the experimental data and
- using distribution and complex [10] networks.

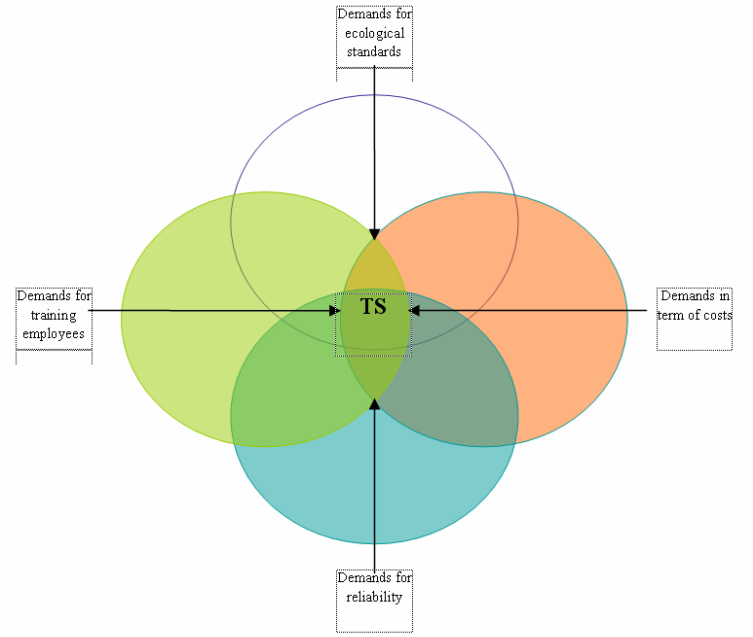


Figure 1: Four groups of demands during the choice of technical solutions of the system

The development of technical systems, one of the important questions that should be answered in the planning phase is how many organization resources (financial, material, human resources etc.) should ensure that technical solutions to implement and achieve the required reliability of technical systems. Product development planning should include the planning of reliability growth including problems related to the implementation of the planned growth of production for many shortcomings in the work of the system may be manifested later. For planners, it is important to properly arrange funds within the program of development and determine the turning points in development. Tracking achieved reliability in crucial points allows the defects in one spot, where the level of reliability is less than specified, be corrected until the next phase of control - turning point. It is undoubted that the monitor phases of the product development are followed by uncertainty and that the organization must strategically and well devise business plans so as not to jeopardize the process of product development and its market prospects for growth and development. Realization of a satisfactory level-planned product development, including planned and reliability enables the organization to continue its activity directed towards the active search for new market opportunities, rather than fix problems with existing products and an effort to minimize harmful effects of unreliability in operation.

2. Functional ability of the organization and reliability

Ability that the organization may at any time accept the demands of the market includes built-up organizational, technical and technological, financial, personnel and any other necessary ability to, without delay and cancellation within the deadline, with the planned costs and recognized quality respond to requests from the market. The ability of the organization is characterized by the functionality of the processes that transform inputs (resources, actions) to outputs (results, products). Processes (especially operational) are dependent on the functional abilities of an organization that includes the maximum reliability of the available technical systems and fulfillment-related support, the human factor, environmental protection, worker safety, maintenance costs and production while all of these requirements affect the evaluation of system capabilities and production process.

There are different approaches of theorists in the development strategy of a new company, but basically they all agree that growth is highly needed, and that the development potential is largely based on his own power and ability of companies to respond to requests coming from users. Reliability is not only a technical system, but organization to meet demands and realize contractual obligations is a key variable in evaluation of eligibility of producers and

evaluation capacity to implement obligations. Strategic decisions, especially in young entrepreneurial manufacturing organizations are not usually in the hands managers with experience that sufficiently understand the processes and requirements from the market on which the research occurred [7, pp. 674] and is put before the organization. Reliability is often the direct damage the organization's efforts to achieve the desired growth and profit that is achieved in accordance with the planned functional characteristics of products. The launch of the product before the examination and testing, testing the reliability of its components and systems in general in all the crucial points of reliability, can bring manufacturer an increase in costs in the period after delivery, reduced profit, the trust of customers and cause incalculable harm to business reputation in the market.

Theorists who deal with strategic management point to the danger of catastrophic creating of strategy of domination of the entrepreneur needs for early growth and success is not based on long-term business strategy in the market. Therefore, the Minzberg [5] approach to creating a development strategy for entrepreneurs is seen through four main characteristics:

- Dominance of the active search for new opportunities,
- Centralization of power in the hands of the chief manager, who manages the fate by relying on his own power, charisma and his final assessment of the feasibility,
- Dramatic jumps forward and backward in terms of business achievements, which is done in terms of organization with challenged business uncertainty,
- Growth is the dominant objective of entrepreneurial organizations motivated by the need for success more than anything.

There is no doubt that the jumps forward and backward in business organizations do not make the realization of a stable growth, motivated primarily by profit could jeopardize the competitive ability of organizations to the market. Business failure due to, lack of strategic policies designed productive young entrepreneurial organizations, in many cases caused by unachieved and planned (required) reliability from the buyer.

3. Cost and reliability from the standpoint of producers and users

In the era of great economic crisis with both the large and small manufacturers the limitations of economic nature are dominant. With this in mind, the designers and economists seek to answer the question of which level of reliability should be implemented in the construction of the (product) to the cost of production and exploitation were minimal, and that the product had a stable market. The minimum cost corresponds to the optimal level of reliability (Ro). In the process of creating new products the costs of production (Tp) increases with increasing levels of reliability (Figure 2a), because the increased level of reliability requires more economic resources for research, testing and control products, but also requires less economic resources to maintain product warranty (compulsory) period. Therefore, the cost after the launch of the product (Tl) decreases with increasing levels of reliability (Figure 2a). Optimal reliability of the process of creating construction products (Rop) follows on the basis of minimum cost producers, bearing in mind the cost in the production process and costs after the launch of the product (Figure 2b).

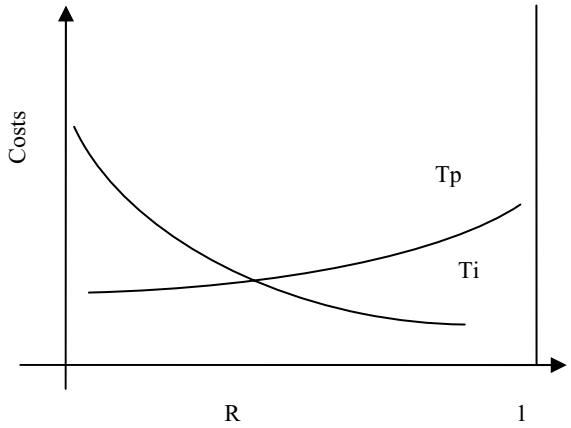
Product user has two types of costs: costs of acquisition (purchase) of new products and maintenance costs (To). Acquisition costs respond to overall costs of products' producer (Utp) (Figure 2b). The second part of the costs related to maintenance costs (To) of the product after the warranty period (Figure 2b). These costs decline with increasing levels of product reliability. In the area of low reliability maintenance costs are close to cost price of a product (Figure 2b). This area is typical of today time of the high economic crisis when the market is full of "cheap" products. Optimal reliability from the aspect of user products (Rok) is obtained based on the minimum user cost, given the costs of maintenance and procurement costs of new product. Which optimal level of reliability (Rop or Rok) the producer will incorporate into their product depends on the competitiveness of the market and the economic status of consumers where the product is intended. Increase above the optimum increases the reliability and costs. The maintenance costs can significantly affect the phase of the process of constructing (creating intellectual products) by selecting construction solution that enables repair of products, extending its technical and economic century, while ensuring the planned level of reliability. The possibility of reparations increases customer confidence in product [8, pp. 356].

4. Conclusion

Determining the optimum level of reliability and designing proper required minimum cost is not an easy task. Key activities to gather data on time to failure if it is an innovated system or a technical failure and prediction of weather data collection phase of testing and testing of all manifestations of resigns. Development of products with the requirements of reliability is most often irrational to do outside of research institutions. The assumption that the organization's business success can be achieved in the increasingly challenging market, derives from the practice, but confirmed that the necessary preconditions organization must have the potential to create: the production volume required

the innovative and has the ability to create synergies as a prerequisite for successful business. Linking production with research organizations and scientific institutions would contribute to the selection of technical solutions using the experience and pod casts from other research, and in order to obtain such reliable information about the distribution of random variables, it is necessary to devise an organized collection of data, as the economy where there is exploitation conditions, and from academic institutions where they are present laboratory conditions. This information would float and be processed in a single center, and would be available to all its activities, which are based on reliability. Today, this job is much easier, given the large representation of the computational techniques.

In the development of these ideas, that is, in its first iteration, the principle should be applied to provide their own data and withdrawing the right to use the data of other participants. This process would come to the real distribution of random variables. The end result of these activities given to mechanical design and technical systems much more economical and reliable. At the same time, production organization would have more secure performance on the market, and consumers would have more reliable and economically acceptable product.



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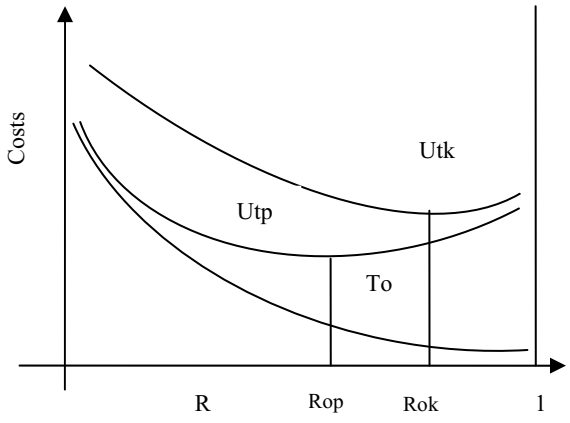

Tp - Costs in the production process *To - maintenance costs,* *Utk - total buyer's costs*
Tl - Costs of launching a product *Utp - total costs of producers*

Figure 2a and 2b: The costs of producers and users, depending on the reliability

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BUSINESS MANAGEMENT SYSTEM

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ABSTRACT

Today, business systems are the core of the functioning of specific organizations. Savrmeni development of society, which is characterized by turbulent change, globalization, new economy, internet, is based precisely on the management of business systems themselves. Under the direction of the mean effect of continuous control action to achieve specific goals the organization. Management as a scientific discipline is directed towards finding such measures and actions which improve the implementation of various activities and the enterprise and makes more efficient functioning and development of business and social systems. Management of business systems is one of the primary goals for any organization that wants to improve their operations and to focus on customer requirements, which is shown in this paper. Control approach to solving various problems, the main characteristics of modern management, modern scientific discipline, without which it is impossible to effectively function, operation and development. Management becomes increasingly important in organizations that work is becoming more and more complex more specialized.

Keywords: management, business systems, development, organization

1. INTRODUCTION

In terms of increased complexity of operations is necessary to find approaches that meet these emerging changes, which can be implemented in such a simple manner while providing good results. One of the main causes of increased komplesksnosti business and the concurrent realization of a very large number of business systems, which be adequately managed. Managing the phenomenon today vemena, a necessity of modern life and work and its general complexity that is all the more stronger. Management is necessary for the effective functioning and development of every company, every single social system and society in general, for each složenijeg efficiently conducting business and enterprise. Depending on the current state and complexity of the business system is one of the main goals is finding a systematic framework in which companies that can quickly respond, where it must provide sufficiently flexible way of doing business flexible market changes while securing innovation and improving the existing system work, products and services.

2. CONCEPT BUSINESS MANAGEMENT SYSTEM

Every business system is recognizable entity in the business world. Investigation of the management process has a fundamental meaning for global and partial operation of research and development of business systems, enterprise and individual subprocesses are implemented within the system so every company wants to achieve optimal performance of business, but how do you measure all the necessary parameters for achieving that, when the modern business environment more complex than ever before?

Therefore, in early 1990 that established a new approach to organizational design and organizational changes, and started to draw attention to the academic community and the business world, and developed a concept of business systems and orientation on business systems and processes. Based on the idea, or looking organization with respect to orientation

towards consumers and a set of activities that create value - business systems, new process paradigm provides easier understanding of the business. Business bands represent the core of the functioning of a particular organization because the organization is primarily composed of različizih systems, not products or services. In other words, manage the company means to manage its business systems.
Despite their importance, commercial systems have long been disregarded in managerial studies mainly due to the fact that the organizational units in organizations generally structured according to functions or products. Basically, the goals represent the future state of the system wants to achieve. To reach the set goals, ie. in order to realize the defined development system, ie, the functioning of the system must be directed and lead to goals and as a management.

In striving towards success, organizations should accept the principles of the systemic paradigm. Focus on systems can mean many things, such as system views, system access, system orientation, system management, process management and improvement process.

3. BUSINESS MANAGEMENT SYSTEMS

Business management system includes a set of methods that provide understanding, control and improvement of business processes in one system, which enables the realization of the ultimate goal of the system. Management in the broadest sense should be regarded as separate scientific discipline dedicated to research problems of management and various social and business systems management business systems based on continuous optimization pistupu through solving the problems in order to ensure competitive advantage. The main task of business management systems to ensure the improvement of business processes and monitoring their output size.

Modern organizations, economic and NON PROFIT, require constant control actions to be developed and operated in a complex dynamic environment in which it works. Management of business process solves many problems of traditional, hierarchical organizational structure, primarily because it allows understanding of the process in the company, as well as easy detection of problems and shortcomings. In addition, application management, business systems connect organizational units of the company and gives employees the opportunity to understand the ultimate goals of the company, and to examine their role in it.

Every business system is recognizable entity in the real world, and consists of:
• goals
• business resources
• business process
• business environment.
As is shown in the following picture.

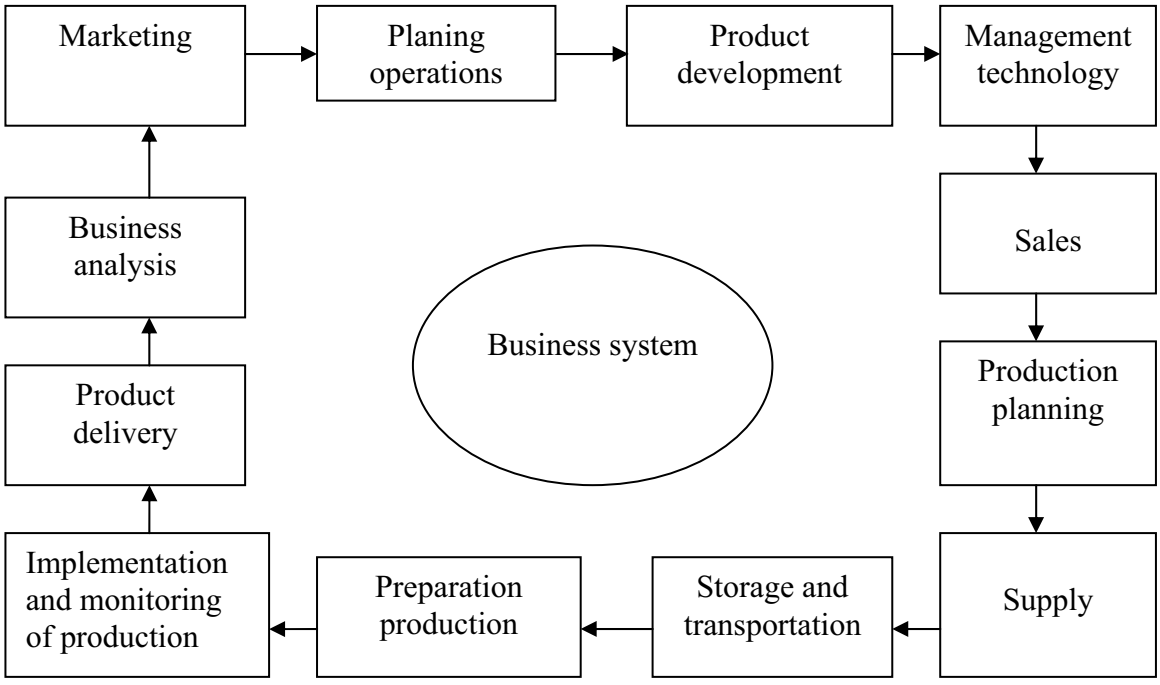

Figure 1 Business system with its components

Business management system includes:
• The introduction of procedures that reduce management time and provide optimum use of resources
• Measuring the cost and quality of business processes
• Manage systems and their improvement
• Introduction of monitoring and documenting the results of business processes.

The biggest advantage of applying business management system that enables the understanding of all systems that exist in business systems while pointing to the problems and disadvantages.
The mere application of business management system helps to:
• reduce the time needed to manage business processes
• increase quality of business processes
• employee satisfaction
• improving efficiency of business processes
• Reduction of costs

Management is linked to achieving the goals of the system, and in that sense is defined as a continuous process that is directed towards the realization of the goals of the system. It is a process (set of actions) that act on the system that he reached the defined goals.

4. IMPROVING BUSINESS SYSTEMS

Fast technological development emphasizes the need to use management methods and approaches, and use of management as a scientific discipline that deals with business management systems and processes and management of all organized systems to improve their efficiency and their constant improvement. Management is a universal means necessary tools of the modern industrial world. Every company, every possibly more complex or serious business activity requires management to lead to the selected target, that would be effectively ended the activity itself. Therefore, it is necessary to adequately manage them and improve them continuously.
Manage business systems rely on a business approach to managing change for improvement of business processes with the ultimate aim of realizing business objectives.
Manage business systems enabling business improvement through a series of elements, among which are:
• consulting services
• Implementation of solutions that support business strategy
• fuller utilization of existing resources in the performance of business processes
• Automating existing resources in the performance of business processes.
To methodologies for improving business systems be effective it must meet certain requirements. First of all it has to integrate all existing initiatives in the company and at the same time that is easy to use. Also, it is necessary to achieve it essential improvements.

A model for improving business process consists of four stages:
1. Identify critical business processes to improve the
2. Analysis of existing business processes
3. Improving business processes
4. Implementation of improved processes in the company

5. CONCLUSION

Modern market game creates intense pressure on businesses and requires them to continuously improve business performance. Management of business systems is one of the primary goals for any organization that wants to improve their operations and to focus on customer requirements. Besides the management of business systems is one of the prerequisites for increasing both efficiency and satisfaction of employees. The concept of business management system is one of the main ways in which the challenges and dangers of modern and unpredictable business environment, convert the chances of successful modern business organizations and foundations to build on these competitive advantages. Although, it must be recognized that the unique and always appropriate solution certainly exists. Finding the right solution is a great challenge and a difficult task for any company and its management structure in today's harsh world.

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IMPLEMENTATION OF MARKETING CONCEPT IN ESTABLISHMENT OF TOURIST DEVELOPMENT POLICY NAUTICAL SYSTEM OF MONTENEGRO

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Abstract

The development of nautical tourism is one of trends in global tourist development. The desire of man-tourist to spend a part of his holiday on tourist vessel is more widespread, and it contributes significantly to the growth of international fleet of nautical tourist boats. Montenegro as a tourist destination that comes out to Adriatic Sea, which is one of the most beautiful bays in the Mediterranean - globally the most popular tourist region, thanks to its position and natural beauty has excellent prerequisites for development of nautical tourism. However, the material basis for development of this form of tourism is very low and needs to be improved significantly in order to answer adequately this destination demand of modern nautical tourists. Just because of the above, this is a moment for application of marketing concepts in development of Montenegrin nautical-tourist system as a subsystem of overall tourism and economic system of this country. The definition and implementation of marketing strategies in development of Montenegrin nautical tourism provides its sustainable development both in economic as well as in environmental and organizational terms. Application of marketing segmentation strategy of nautical tourism market, makers of nautical tourism product in Montenegro can choose just those parts that can be maximally satisfied at this destination, ensuring contemporary the sustainability to this product-offer both in economic and in other views. Strategy of product differentiation will provide diversity of its competitors, based on anticipating of properties of previously selected segments and customizing of product attributes to these qualities with these elements necessary to preserve the autochthony-originality, and thus to the international recognition. The result of this development is adapted to possibilities of destination, since it takes care of all elements of sustainability, with realization of profits. Finally, only such development contributes to ambition of total tourist offer holder in Montenegro to position this destination as a high quality one in international tourist market.

Key words: Development Policy, Nautical Tourism, Yachting, Marketing Concept, Montenegro

INTRODUCTION

Nautical tourism is one of mega trends in contemporary tourism. Nowadays, sea and different manifestations of tourism, being associated with it, attract the largest number of tourists. Modern tourist is showing increasing interest to spend the whole or part of his vacation on own or rented - chartered boat, or on cruiser. Although originally the word nautics comes from Greek word *naus* meaning *sailing skills*, ability to manage the vessel has ceased long ago to be *conditio sine qua non* (requisite or indispensable

condition) to spend a part of the holiday on a boat intended to sport and entertainment. Scientific interpretation of this manifestation form of tourism is scarcer than in the case of other manifestations, such as swimming, health, congress and others. Many years of research of the author in this field led to the formulation of definitions of nautical tourism as a specific form of tourism, which is based on the desire of man / tourists to spend his free time on the vessel intended for sport and leisure and aspiration of the holder of various forms of offers to meet as better as possible needs of man / nautical tourist with the realization of profits. Basic characteristics of this form of tourism are that they are solely related to water (whether on sea or inland waters), with the existence of boats at waters, whether on vessels that are privately owned or owned by charter company besides water and vessels for development of this kind of tourism it is necessary the existence of appropriate infrastructure such as marinas, services, petrol stations etc. With infrastructure, the existence of organized supply intended for these tourists (tourist accommodation facilities, entertainment facilities, shops with nautical equipment and food and restaurants) is a condition without which today they could not be attracted in serious numbers to some destination. Divisions that exist in a contemporary nautical tourism are based on several criteria such as water in which they sail (sea, lake, river), the country of origin of tourists (domestic and foreign), flag of vessels (domestic and foreign), the purpose of travel (trip , cruising, sport and leisure and round trips). Definition of vessels in the wider sense is: "Vessel intended to navigation, i.e. any object that is suitable for movement on water surface"[7]. In serious researches, related to nautical tourism, vessels' lengths less than 3 meters, which are used for navigation in narrow coastal zone, with vessels that are not used for tourist purposes, are excluded from these studies. Other vessels are mainly divided into three categories: up to 5 m long (small vessels suitable mostly for short rides), from 5 to 15 m in length (mean vessels in which it was developed nowadays modern nautical tourism suitable for several days sojourn) and longer than 15 m so called mega yachts (these vessels are getting more popular, but due to growing length of luxury tourist boats as mega yachts are often counted vessels longer than 24 m). Number of vessels intended for recreation and leisure in the second half of the twentieth century has significantly increased. This increase became so that the number of official statistics began to exhibit the ratio of people and boats in some states. In the U.S. the number of vessels in coastal maritime traffic increased from 8 million in 1945 to 19 million as it was in 1965. Out of that number in 1967 in yacht tourism about 8 million boats have taken part. In that period in the U.S there was in average one vessel motor driven per seven inhabitants. Besides America a significant increase in number of boats took also place in Europe. So in England in 1964 it was a production of tourist boats in the value of 41.5 million pounds, in France in 1971 it was registered about 230 thousand boats, while in Italy it was about 120 thousand. Growth and development of production of these types of vessels in EU was continued in the XXI century, so that within the Union during 2003 it was produced over 3,000 vessels in the value of 1.3 billion EUR. After Italy, which is now the most important European manufacturer, the United Kingdom (760 million EUR per year) has retained significant participation, while countries like Netherlands, Germany and France in 2003 achieved production of boats intended for sport and leisure, worth around 400 million EUR. At the level of entire EU, at that year there were produced 13,000 boats intended for sport and leisure, worth around 3.3 billion EUR. Of that, 1.5 billion EUR relates to production of 8400 boats while 4500 of manufactured motor yachts worth 1.7 billion EUR[4]. Implementation of new technologies in production of boats was of great importance. Thanks to serial production using glass – plastic materials in making of vessels' hulls. The number of vessels has significantly increased. Some indicators show that growth in the number of vessels in U.S since the sixties of the twentieth century was about 4% annually. In Western Europe the number increased from 4.5 million of vessels as it was in 1980 to 5.5 million vessels in the late nineties. At the end of the twentieth century, citizens of North America spent yearly about 18 billion dollars on purchase of new vessels. Regarding the structure of vessels in nautical tourism, the most important role in number and revenue, which they exercise, has medium-sized vessels. However, growth of production and sale of mega-yachts is extreme trend that has marked the last decade in nautical tourism. Journal "Triton" (9, p.24) writes about the current production of these vessels of approximately 500 pieces per year. According to the magazine, growth of vessels length every year is higher and it begins to talk about introducing a new category of vessels, so called "*Giga - yachts"* of seventy and more meters long. Luxury, which is represented in construction of these vessels, raises their prices on several dozen million dollars.

In the last thirty years, nautical tourism recorded a huge expansion in all worlds' seas and becomes a very important segment in the global tourist offer. In the seventies of XX century, the largest flows of nautical tourism turnover were moving in the areas of North America, Mediterranean and between them.

Because of natural benefits of the Caribbean region it has become one of the most significant region for sailing in America, while the Mediterranean Sea during the past thirty years, offers were gradually spreading to eastward. Mediterranean countries such as Turkey, Croatia and Tunisia in recent years become important globally speaking, not only within the framework of Mediterranean. Development of nautical tourism in Turkey in the last twenty years was mostly helped by foreign charter companies, especially French and Greek ones. Post war Yugoslavia - SFRY had excellent conditions for development of nautical tourism: 6116 km coastline, which is 23.8% of the total length of Mediterranean coastline, great jagging in the form of 1233shore islands and reefs in and a number of ports and harbors suitable to be in accordance with that time needs of re-assignment for tourist purposes. However, only at 1965 it was seriously approached to production of projects for development of tourism in the Adriatic whereby the construction of material basis for development of nautical tourism, occupied a prominent place. The two most important projects of that time are "Project South Adriatic" which has begun in 1965 and within the same in two years till 1968 there were adopted basic concepts of general urban plans for the given area of Adriatic coast from Ulcinj to Hvar, and the "Upper Adriatic Project " which began in 1972 and within the same were specified four types of nautical tourism bases: *ports, marinas, recreational bases and vessels' marinas*. These projects represented the most important basis for planned constructions of marinas on the eastern coast of the Adriatic. Till 1978 in SFRY was completed a construction of five marinas: Dubrovnik, Split, Zadar, Punat and Mali Losinj, and in addition to the above it was planned a construction of marinas in Baošići in the Bay of Kotor, Trogir, Zadar, Sibenik, Umag, Izola, Portoroz and Piran. Some of these marinas have been already built (Croatian and Slovenian) and some other remained only in the form of plans (Montenegro) (1, p. 46). In Montenegro, were made adjustments of wharfage parts in ports of Bar, Kotor and Budva, in order to make them able for reception of yachts and other tourist boats. In 1978 on the Yugoslav coast there were offered 742 berths on 2375 meters on up-to-date built coast for nautical tourist boats. On the eastern Adriatic nautical tourism is experiencing a real economic boom after the establishment of ACY in 1983 (the abbreviation of English title Adriatic Club Yugoslavia). Former ACY, and nowadays ACI (Adriatic Croatia International) is meritorious for 90% of revenues generated in nautical tourism in Croatia. Montenegrin marine tourist offer is not significantly changed for the last twenty years. Previously mentioned customizations that are made in ports of Bar, Zelenika, Budva and Kotor are now the only serious offer in nautical tourism in Montenegro. This offer is somewhat improved in recent years as the installation of some more sophisticated technology for serving and servicing of vessels in these four ports and as well in the city port of Herceg Novi. By signing the contract on changing the purpose of military shipyard in Tivat in marina for luxury (mega yachts) yachts, and implementation of the first phase of this project a few months ago, it creates a real basis for making the historical review on development of contemporary nautical tourism in Montenegro to be counted in the future from that day.

1. IMPLEMENTATION OF MARKETING IN PLANNING OF DEVELOPMENT OF MONTENEGRIN NAUTICAL OFFER

Unlike natural resources (air, land benefits, the depth-transparency-color-sea temperature, etc.) that in Montenegro are extremely favorable for development of nautical tourism, the material basis for its development so far is mainly in the form of plans. Building of material basis includes new accommodation capacities (berths) for vessels, both in sea and on land (classic and dry marina), reconstruction of existing utility ports and harbors (locally called "mandrać"), new infrastructure facilities (gas stations on the sea, access roads, water supply and sewerage infrastructure), service centers, hotels, accommodation for boaters, specialized trade shops, increase nautical tourism especially in the charter fleet etc. Therefore, the application of principles of modern marketing in this phase of development of Montenegrin tourist nautical product has the crucial importance for its future.

Nautical tourist products as well as many other products, either in service or production activities, have been coming out long time on the market without prior examination of the same. However, by increased supply and appearance of the first difficulties in product placement it came to the situation that it is necessary to take some measures to facilitate easy placement or to be produced in advance for determined customers, which automatically would make the sale of this product easier. The first attempts to overcome the problem of placement primarily represented investment in promotional activities that initially have given results, until the moment when competitors applied the same tactics. Such a situation has led to the application of modern marketing principles in business organization of nautical tourism system.

Chart1. CONCEPTUAL FRAMEWORK FOR MARKETING MANAGEMENT OF NAUTICAL TOURIST DESTINATION (2, P.31)

Situation analysis includes analysis of macro environment, market competition and also analysis of micro-environment and internal strengths and weaknesses. According to Kotler and Fox (1985) in practice there is often the case of appearance of so called „reverse thinking" i.e. the appearance that existing strategy and structure (organization) selects objectives, strategies and tactics that manages, and thereafter scans the environment and seek opportunities that would best fit to already set goals and strategies (2, p.35). Brief analysis of macro and micro environment of nautical tourist offer of Montenegro was carried out in the introduction to this work.

Formulation of the mission, goals and guidelines is another step in marketing management of nautical tourist destination. Without mission, i.e. purpose or role that destination would like to achieve by tourist development at particular area, as the main factor that destination points in its long-term purpose of tourism development, and guidelines (such as roads to set goals) there is no real decisions regarding strategic management and design of responsibilities on destination. The mission must be real, must motivate and it must be different from competitors (3, p.71). The mission of nautical tourism in Montenegro is to be in line with modern trends in the global nautical tourism, to build such offer which will satisfy needs of carefully selected segments of boaters and to provide sustainable valorization of limited natural resources with overall improvement of tourist offer of Montenegro.

The aim of the development of nautical tourism in Montenegro stemming from previously defined mission and can never be only one and final. Time hierarchy of goals that are set with regard to future development of nautical tourism in Montenegro should be such that log-term goals are resulting from medium-term targets and from them short-term ones. Long-term goal - development of modern nautical tourism based on principle of sustainability, which, to a great extent improve the competitive position of Montenegrin tourist product on the international market, includes: construction of the planned marinas with introduction of additional contents for mega yachts, forming required service contents, formation of high-quality fleet of charter boats, sufficient number of specialized personnel for normal functioning of nautical tourism systems on destination, image of Montenegro as a quality nautical tourist destination. Medium term goal - the construction of marinas Njivice, Bigovo, Sveti Nikola (Budva) and Ulcinj, so that it can safely cruise the entire Montenegrin coast, promoting cooperation in the region of Eastern Adriatic, introduction of nautical subjects and conceptions in education system of tourist personnel, while short-term goals - construction of marina Porto Montenego Tivat, privatization of Shipyard Bijela and the introduction of necessary service programs in business activities of this company, improvement of offer of existing capacities in marinas in Zelenika, Bar and communal urban ports, providing favorable credit arrangements to local stakeholders in this activity, organizing of

accelerated specialized courses for additional training and retraining of personnel needed for normal functioning of newly formed offer, organized presentation of specialized nautical fairs in the region and Europe, improving working conditions for all services that provide safe navigation and application of the new Law on Yachts.

Guidelines for development of nautical tourism in Montenegro are quantifying of previously set goals - they are for example for short-term goals improving of offer quality with extra content in marina Herceg Novi, Bar and Zelenika till June 2010, introduction of additional training and retraining of personnel for development of nautical tourism in the center for training of seamen Azalea-Bijela untill September 2010, acquisition of new fast vessels with special equipment, services that ensure safety of navigation in Montenegrin territorial waters until May 2010, construction of second phase of nautical tourist port in Tivat to May 2010, introduction of program for service of yachts and mega-yachts in the shipyard Bijela till September 2010. Guidelines for medium-term objectives (period from 2009 to 2013) are the motivation of investors for investment in marina Njivice and Bigovo, while "eco-marinas" Buljarica and Ada Bojana should be financed from public funds, in order that they would not be exclusively intended for creating higher profit (which is the main objective of private investors), but for improvement of quality of tourist offer in the entire destination.

Marketing strategy is the mean to achieve marketing goals (*stratigiki* - Greek – art of general). Formulation of one or more possible strategies on the basis of which it is possible to achieve set forth mission and goal of Montenegro as a tourist destination represents the next step in application of marketing concepts in management of nautical offer of this destination. Marketing strategy of segmentation of nautical tourism and differentiation of nautical tourism product of Montenegro with the strategy of image profiling, aims to final, after its full implementation, positioning of this destination as a high quality one on nautical and total international tourist market. Montenegrin nautical tourist product should be positioned at exactly defined segments (not between segments). It should see what are potential segments and in which part they are not satisfied with the service of our competitors, so that application of differentiation strategies could make a product that will satisfy them better than the competition one. Thus, for example, boaters in Croatia are less than satisfied with the hospitality than in Spain and Turkey, received value for money according to boaters is higher in Turkey than in Slovenia and Croatia, and the spatial arrangement of marinas is better in France and Spain than in Croatia, Slovenia and Turkey, Boaters expressed greater satisfaction with outfitting of marinas in Turkey than in Croatia and Slovenia. However, the security of the country by evaluating of boaters is much higher in Croatia and Slovenia than in Turkey (5).

Marketing mix realizes operational objectives by reducing the four types of transaction barriers (time, place, ownership and barrier of utilization). There are several levels of decision making when it comes to marketing mix instruments. For example, it is decided which instruments in the company (destination) are available in a given situation - universal aspect; which one from available ones should be employed - selective aspect, how to manage instruments involved - qualitative aspect, what should be a time sequence of engagement of certain instruments - time aspect; how to combine individual marketing instruments in order to be effective - combining aspect (7, p.118)[7]. Main instruments of the marketing mix are promotion, sales channels, product, and price. According to McIntosh and Goldner finding of five real elements in formulation of market image of products helps their success and these elements include: right product, at right price marketed through right channels at the right time and in right quantity (3, p.71) .3 Application of marketing segmentation strategy and differentiation will help us significantly in formulating of "genuine" product at adequate price with selection of right channels for its placement.

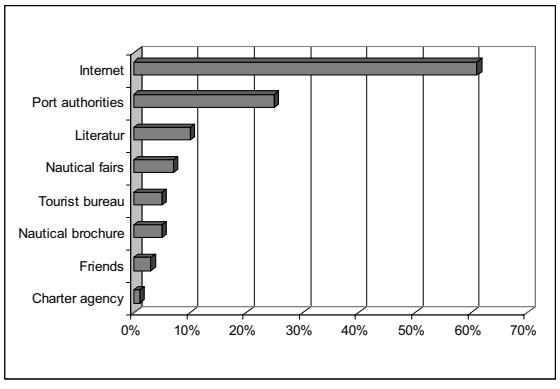
1.1. Promotion of nautical tourist offers of Montenegro

After formulating the product, which, after segmentation of market demand and anticipation of affinities of boaters' priority segments, is differentiated in that direction, follows, in selected markets, the promotion of that product. The main task of promotion of nautical tourist product of Montenegro should be informing and encouraging other nautical and tourist demand to come in that tourist destination. Promotional or so called communication strategy aims to establish a general picture of tourist destination on the tourist market and to build, maintain and enhance the image, provide relevant information about the offer, provide support to all participants in the offer and to rectify if there are incorrect and incomplete information about the destination. The process of communication (promotional) strategy of Montenegro as a nautical tourist destination in itself should contain several phases: 1. It is performed a selection of market whereby is promoted Montenegrin nautical tourist product on the basis of previously established characteristics of this market is carried out 2. determination of promotion objectives in that market,

after which 3. is determined appropriate message to be transmitted through the communication demand to targeted segment and then 4. choosing communication mix instruments (public relations, propaganda tools - TV, newspapers, radio, Internet, printed brochures, spatially plastic - fairs, exhibitions) and at the end it is needed to formulated the budget (source of funds for promotion) as well as the ability to control effects of promotional activities on emetive market (2; p. 133)[2]. Market selection is made on the basis of results of previously applied segmentation strategy. Results of all researches that the author conducted in previous years show that attention should be focused on markets of Western Europe, Russia and Serbia. Objectives of advertising performance in these markets are different, so for example, Montenegro is competitive in the market of Serbia and Russia as a destination whereby nautical tourists, due to suitable climate, traffic and historical connections leave their vessels during the whole year, so that it is for them always the start and end port. On market in Western Europe is present a strong competition in marinas in nautically highly developed countries such as France, Spain, Italy, so that Montenegrin propaganda in these markets should be aimed at attracting transit tourists cruising the Mediterranean, that are extremely profitable guests. Markets such as Austrian and German are very interested for motivating of nautical tourism demand for permanent residence in Montenegro, but it will be possible only after establishment of better transport links between these destinations. Depending on goals of advertising performance in certain markets will be formulated various propaganda messages that are intended for demand. There often comes to the fore the creativity of managers, who along with application of modern rules in the creation of propaganda messages for some media and analysis of target market may be its quality and originality to a great extent could improve the image and better positioning of Montenegro as a destination on international nautical tourism. Message to promote Montenegrin nautical tourism should be in accordance with the image to which tends Montenegro as a tourist destination and this is the "Wild Beauty" (wild / outrageous beauty). As far as media through which should be promoted Montenegrin nautical tourism are concerned, there are various opportunities that are represented in the practice of promoting this form of tourism. For a long time the best kind of promotion was through specialist magazines intended for boaters (Nautica, Euromarine, Show Boats, Yachts ...). The introduction of satellite TV "Sailing Channel" which is represented via satellite and cable TV receiver in a significant number of homes on the market in Western Europe, has opened new possibilities for future promotion of Montenegrin nautical tourism products targeted segment of demand (72 million viewers throughout Europe have followed this TV channel which is broadcasted in English and Italian languages). Finally, the phenomenon of Internet as a form of communication is a revolution in application of direct marketing and direct communication i.e. possibility of direct communication with boaters within framework that opens up a whole range of possibilities in terms of promotion and in other business segments in the nautical tourism.

The budget from which the promotion of Montenegro's nautical tourism should be financed, in beginning is to be helped by NTO, the competent Ministry and local governments in which cities are important nautical tourist facilities. Control of promotional activities should be done regularly in order to determine possible deviations from desired effects of propaganda and thus to provide a timely response, which would prevent the creation of a wrong image of the destination. Only the application of comprehensive communicational (promotional) strategy of Montenegrin nautical tourism guarantees success and proper positioning of products in consumers' awareness.

Chart 2. EXPECTATIONS OF BOATERS ON WHICH PLACE IS EASIEST TO FIND INFORMATION ON NAVIGATION CONDITIONS ON ADRIATIC (8, p. 63)



1.2. Organization of nautical tourist offers at the level of destination

After formulation of mission, goals and guidelines for development of nautical tourism in Montenegro and strategy and marketing mix which will be used in that development, it is necessary to carry out organization

of all elements of nautical tourist destination, as it could work successfully in the future. Namely, it is necessary to establish such an organizational form that in the best way will ensure its main task, which is to make harmonization and coordination of various and numerous parts of fragmented (nautical) tourist offer and with preservation and promotion of natural, social and other activities will contribute to accordant and harmonious development of tourist area. In organization of offer at destination occur various para-governmental bodies such as NTO - National Tourist Organization, mainly engaged in promotional activities and activities that are related to coordination of all participants on tourist offer side in business of tourism development. Nautical tourism is a specific form of providing tourist services, which requires the existence of certain services at destination without which it would not be able to develop. The role of these services in the system of nautical tourism ranges from promotional to organizational – safety ones. Most of these services during navigation through territorial waters of tourist destination provide services to tourists, boaters that are not organized just for them, but are there for all those who sail the sea for various purposes. The existence of such specialized services requires their constant adaptation to changes in nautical tourism, in order that level of their services would contribute to competitiveness of destination. Basic services, which the state organized on a coastal destination, and are used by tourists boaters are harbor authorities, police and army, services in charge for maintenance of waterways (navigation lights and other tags) and development of maritime maps, radio services, national registries of ships, meteorological service, search and rescue at sea service.

In addition to organization of previously mentioned services, for development of nautical tourism in Montenegro, it is necessary to organize a specialized agency that will coordinate activities of all participants in this form of tourism and other participants in the tourist offer at the destination. Activities of these agencies must be coordinated with the activities NTO of Montenegro in order to develop this form of tourism will maximally contribute to the quality and image of total tourist product at the destination.

CONCLUSION

New marketing researches of lifestyle show that people, as consumers, slowly but surely are leaving the dominating labor-intensive concept of living from the 60's and 70's. In some countries is shortened the working week to less than 40 hours. Consequences of this process is that people have more free time and resources, which have caused their increased interest in travel, leisure, recreation and culture (6, p. 212). Increasing of nautical tourism demand is one of consequences resulting from these changes. However, in addition to more discretionary income and expenditure that characterize nautical tourism demand it is, as well as other tourist demand, extremely sensitive to certain economic (discretionary income, prices, image) and out-economic effects (war conflicts, natural disasters and the safety of navigation, epidemic, crisis). For this reason it is necessary that creators of Montenegrin economic policy plan activities indispensable to be undertaken in order to protect Montenegrin tourist product in crisis situations (global economic crisis - as well as economic and influenza A1H1as pandemic outbreaks are current crisis that burden total tourism development).

The condition of offer at Adriatic is such that in the Northern Adriatic side boaters on vessels up to 6 meters in length have the highest share in total number, while this share changes ranging from the eastern coast to the south. The reason for this lies primarily in a worse road infrastructure and greater time distance from the main southern destinations from main Western emitive markets. Boaters on larger vessels can easier visit greater distances and frequently leave their vessels in the winter in some of local marinas. Offer in the southern part of the eastern Adriatic, intended for these tourists is much weaker than in the north. The range of services in marines in the south of Croatia is such that somehow satisfy requirements of boaters, while Montenegrin marinas provide offer holder are offering only elementary services (berth, water, electricity, toilets). Regional cooperation (Montenegro - Dubrovnik County) in the development of nautical tourism offer, may contribute to a considerable extent to better position of overall nautical tourism offer of the eastern Adriatic coast in the Mediterranean. Such forms of cooperation are one of the major projects through which the EU helps countries that have joined the association process. IPA program, which in the Balkans has replaced the previous CARDS program of European Union in order to strengthen stability, security and prosperity, of interest to all countries of the region, and to encourage balanced and sustainable development anticipates funds to help development of cross-border cooperation. Through this program holders of nautical tourism offer in the region can, on the basis of joint projects for improvement of infrastructure, compete for funds in the IPA budget for specific projects based on cross-border cooperation.

Building of unique nautical tourism offer at the level of Montenegro as a destination also has a number of advantages, especially if one bears in mind its size. The way of organization of certain holders of that offer should be such that it contributes to their individual interests, but that is compliant with development strategy of Montenegro as a high quality tourist destination. That type of organization allows the introduction of the so-called " cruising pass", increase safety of navigation, somewhat unifies way of providing some specific services related to boats and boating, simplifies administrative procedures, helps a unique performance nautical tourist offer holder in international nautical fairs and even more that can contribute to greater satisfaction of boaters and tourists during the stay at destination. Tourism is the economic activity of strategic importance for Montenegro and its future. Only by development of complex destinations products in which nautical tourism plays an important role such product can acquire the image, which makes it competitive on highly demanding international tourist market. Application of marketing concepts considerably helps that development.

Natural beauties of Montenegrin coast are the greatest treasure with which this country currently disposes of. This resource is limited and is under great pressure from various interest groups. Only 300 km coastline is the subject of interest of investors from different economic activities. Some of these investments are in accordance with plans for the future development of tourism in Montenegro, but there are a lot of those that represent a serious threat to these natural resources. Only with principled application of strict rules of sustainable development of tourism and other economic activities, Montenegro has a chance through built up offer and preserved natural resources leave to its descendants the quality inheritance, as in the form preserved nature today's generations have got from their predecessors.

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INDUSTRIAL ENGINEERING DEPARTMENT, FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF BELGRADE, SERBIA & STEINBEIS ADVANCED RISK TECHNOLOGIES, STUTTGART, GERMANY

TIME PHASING STRATEGY MAP

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Abstract: *Strategy map is one-page presentation in which the organization's goals are integrated into the four perspectives of the Balanced Scorecard. Strategy maps help organizations focus on their strategies in a comprehensive, concise and systematic way. Their main purpose is to facilitate the translation of strategy into operational terms.*

BSC is a multi-goals model that focuses on the decision-making where multiple criteria are involved. Since organizations usually comprise a large number of embedded activities leading to exhaustive list goals, it is appropriate to use AHP in identifying the performance drivers of the outcome measures and goals defined in strategy map. Particularly, we involve evaluation of the impact of each driver alternative on the financial business objectives. Result of pair-wise comparisons shows that it is possible to time phased strategy map in the sense that operational performance (achieving of operational goals) have dominant impact on financial.

Key words: *Balanced Scorecard, Strategy Maps, time-phasing, AHP*

1. INTRODUCTION

The business activity in the environment of quick changes, innovations, globalization, knowledge and information as a basic resource are characteristics of information economy. In the changing business environment traditional accounting based performance measures have been characterized as being financially based, internally focused, backward looking and more concerned with local departmental performance than with the overall health or performance of the business [1, 2]. As a consequence, in the early 1990s many different approaches to the design of new Performance measurement Systems (PMS) became apparent; all focusing on the most critical success factors in a company's strategy [2-5]. The simplicity and intuitive logic of the Balanced Scorecard has been a major contributor to its widespread adoption as it is easily understood by users and applied to their organization. "*The area which is most indicative of the evolution of performance management, and the area perhaps has the most identifiable stream of literature is that of performance measurement, and in particular that of the Balanced Scorecard, with which in many people's eyes it has become synonymous*" [6].

In this paper, decision support tool Analytic Hierarchy Process is utilized for developing a framework for analyzing and ranking previously determined strategic objectives presented in the form of strategy map. Goal of research was to answer the question: which management processes (and corresponding performance objectives) have a direct impact on the achievement of financial goals?

2. PERFORMANCE MEASUREMENT DEFINITIONS

Neely et al. [7] went to propose definitions of performance measurement, a performance measure and a performance measurement system:

"Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of action."

"A performance measure can be defined as a metric used to quantify the efficiency and/or effectiveness of action."

"A performance measurement system can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions."

On the other hand, the practice in leading companies highlights following characteristics of performance measurement (PM):

- PM refers to the use of a multi-dimensional set of performance measures. The set of measures is multi-dimensional as it includes both financial and non-financial measures, it includes both internal and external measures of performance and it often includes both measures which quantify what has been achieved outcomes, as well as measures which are used to help predict the future - drivers.
- PM is only relevant within a reference framework against which the efficiency and effectiveness of action can be judged. Now there is widespread support for the belief that performance measures should be developed from strategy.

- PM is now being used to assess the impact of actions on the stakeholders of the organization whose performance is being measured.

Although this can be considered „as quantifying the efficiency and effectiveness of action", e.g. in the case of measuring the impact of the organization's performance on customer satisfaction, it is not as obvious in the cases of measuring the impact of the organization's actions and performance on employee satisfaction or local community satisfaction.

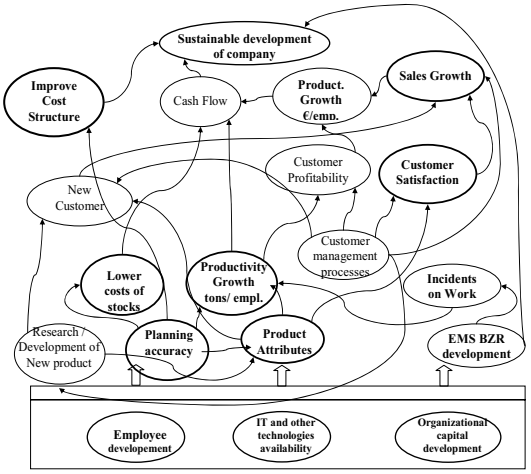

Figure 1. Complete Strategy Map

3. BALANCED SCORECARD (BSC)

The BSC [3, 8] is PMS framework that retains the financial performance perspective because financial measures are essential in summarizing the economic consequences of strategy implementation. In the customer perspective of the BSC, managers identify the customer and market segments in which the business desires to compete. Targeted segments could include both existing and potential customers. In the internal business process perspective, managers identify the critical internal processes for which the organization must excel in implementing its strategy. The internal business processes dimension represents the critical processes [8] (*operations management, customer management, innovation, regulatory and social*) that enable the business unit to deliver the value proportions that will attract and retain customers in targeted market segments, and satisfy shareholder expectations regarding financial returns.

3.1. Strategy Maps

Kaplan and Norton's defined strategy as „a set of hypotheses about cause and effect". Strategy maps provide a consistent way to represent the strategy, so that objectives and measures can be established and managed [8]. Strategy maps can be of benefit as follows:

- It provides the missing link between strategy formulation and strategy execution,
- It can be used to align business units and focus management processes,
- The strategy map clarifies the path from non-financial success factors to financial results and facilitates the implementation of a performance measurement system,
- It is a tool for supporting performance measurement in organizations by trying to highlight a company's important matters, i.e. the matters which should be measured,
- It clarifies a company's strategy to employees by showing how their duties are linked to the organization's overall goals.

According to Kaplan and Norton, the design [3, 8] of a strategy map should begin with defining the objectives of an organization and then proceed to the means for reaching the objectives. The defining of the objectives begins with identifying the reasons for a company's existence. After this, the management of a company defines the vision. Defining of the strategy follows the vision. The next stage is to collect critical objectives of a company and the relations between these objectives in line with the four perspectives of the Balanced Scorecard. Kaplan and Norton have not explained in detail how to execute the designing process of a strategy map.

3.2. Some Limitations of Concept

Although the BSC of Kaplan and Norton has managed to be welcomed by a large number of companies all over the world, there is a literature on its limitations.

Lorange (1998) argues that, in a world of international competition, the traditional, formal planning systems need to be replaced by procedures of *incremental* and *flexible* informal planning leading to strategies that will be continuously redefined. Thus, BSC should also change and become more flexible.

Norreklit [9] has questioned the theoretical foundation of the cause-effect relationship and the reliability of BSC by arguing (1) that there should be a time dimension in the BSC in order to be able to talk about causality, (2) that there is no proven cause-and effect relationship between some of the suggested areas of measurement in the BSC. She suggests that it is not generic that increased customer loyalty (and satisfaction) is the cause of long-term financial performance. Meyer [10] has stated that „if performance measures were strongly correlated, then all would contain essentially the same information…and there would be no need for a….balanced scorecard". Position that the BSC should combine generic and existing cause-and-effect relationships is also disturbing. Would strategy now be the same as following these generic regularities? How long would firms following known regularities sustain competitive advantage?

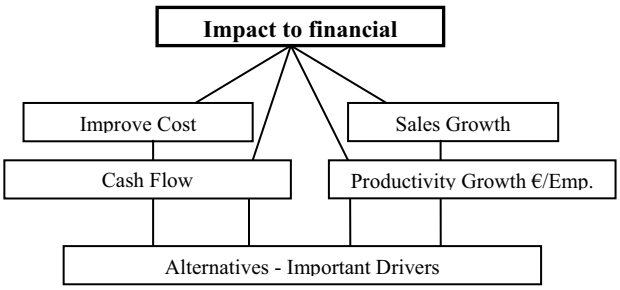

Figure 2. The considered BSC-AHP framework

4. RESEARCH METHODOLOGY AND RESEARCH SITE

The literature reveals that there is a lack of existing knowledge in the area of PMS implementation (particularly in SMEs or in the larger organizations with SMEs management characteristics). Certainly, to understand how integrated PMS can be introduced effectively into organizations requires an in-depth understanding of the context in which it will be applied. Qualitative understanding is required for drawing research conclusions and communicating the importance of the results. Therefore, for this research project, the case-based research method is considered as appropriate.

Participant observation and action research are used, along with interview techniques, as the primary methods of data collection. Action research holds that it is possible for the researcher to take an active part in the organization and, at the same time, observe the organization. The primary benefits of action research are that it enables the development of practical techniques for improvement, where the researcher provides the basis for the development of competencies of others participants. It is this collaborative relationship, whereby the researcher investigates the change situation whilst the participants in the research learn new methods for change, which makes action research appropriate for transferring new methods of introducing PMS into organization.

The case study was performed with participation of management team of Chemical industry, specialized in production of paints and varnishes, which have started introduction of strategic PMS system. Management team has included 17 members; 5 of them were top managers and the others functional managers (production manager, marketing manager, IT manager ...).

During, the development of performance measurement system, complete strategy map (Figure 1.) was build as a part of BSC solution. Strategy map illustrate the critical objectives of a company and the relations between these objectives in line with the four perspectives of the Balanced Scorecard. Selection of objectives was made using data collected for strategic initiatives which support achievement of defined targets.

Table 1. Priority weights for driver alternatives

Goal				Sustainable Development Of Company					
Objectives	Financial	Outcome	Criteria	Improve Cost Structure		,333			
				Cash Flow			,158		
				Product. Growth €/Emp.				,197	
				Sales Growth					,312
	Customer	Drivers	Alternatives	New Customer	**(0,064)**	,334	,685	,487	,807
				Customer Profitability	**(0,073)**	,622	,768	,682	,583
				Customer Satisfaction	**(0,083)**	,615	,897	,524	,919
	Internal Process			**Lower Costs Of Stocks**	**(0,098)**	1,000	1,000	1,000	,584
				Productivity Growth Tons/Empl.	**(0,078)**	,931	,867	,590	,418
				Customer Management Processes	**(0,063)**	,492	,642	,508	,621
				Incidents On Work	**(0,063)**	,562	,612	,585	,500
				Research / Development Of New Product	**(0,058)**	,380	,412	,642	,617
				Planning Accuracy	**(0,093)**	,856	,960	,809	,733
				Product Attributes	**(0,102)**	,831	,972	,818	1,000
				EMS BZR Development	**(0,056)**	,397	,436	,597	,575
	L & G			Employee Development	**(0,058)**	,403	,506	,532	,610
				IT And Other Technologies Availability	**(0,056)**	,445	,438	,470	,586
				Organizational Capital Development	**(0,055)**	,415	,513	,433	,572
CR 0,03 < 0,1									

4.1. The financial perspective evaluation model

The overall objective of this evaluation is to examine the contributions made by cost driver alternatives to the financial business performance. Under this objective, the model may consist of

evaluation criteria (financial objectives) and cost driver alternatives (objectives in the remaining perspectives). The criteria used here are those financial outcome objectives which have already been accepted in complete strategy map, *improve cost structure, cash flow, productivity growth-€/emp. and sales growth*. The alternatives here are the cost drivers identified from customer perspective, internal process perspective and learning and growth perspective (table 1.).

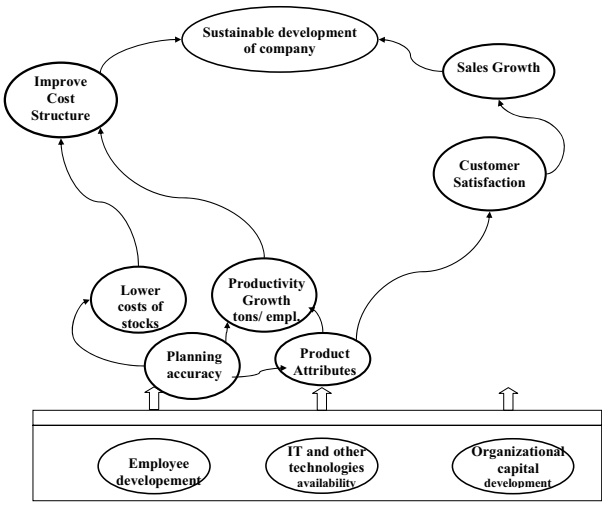

Figure 3. Strategy Map after selection of priority goals

4.2. The Analytic Hierarchy Process application

The Analytic Hierarchy Process (AHP), developed by Thomas Saaty (1980, 1996), allows decision makers to model a complex problem in a hierarchical structure showing the relationships of the goal, objectives, sub-objectives, and alternatives. The AHP is ideally suited to help resolve certain problems that arise when multiple criteria are used in performance evaluation. AHP facilitates the incorporation of non-quantitative measures into the evaluation scheme.

The pair-wise comparisons generate a matrix of relative rankings for each level of the hierarchy. After all matrices are developed and all pair-wise comparisons are obtained, eigenvectors or the relative weights, global weights, and the maximum eigenvalue (λmax) for each matrix are then calculated using Expert Choice software (Expert Choice, 2000).

The defined hierarchy of goals (in the decision thee – figure.2.) and weights is presented in the upper part of table 1. We can see that in financial perspectives (FP) most important are as goals: *Improve Cost Structure* and *Sales Growth*. Evaluation outcome, of pair-wise comparison, done by management team, was that 14 strategic drivers were ranked. Result of ranking (lower part of table 1.) was that strategic objectives of *operations management* processes have highest impact on financial outcome. Also Customer satisfaction (from *customer management processes*) has so high influence. As a result of this research few Strategy maps are created as map (figure 1.) with high priority for realization. AHP utilization was good learning example, for discussion, change of opinions and unification of possible measures that will play some role in future PMS.

5. CONCLUSION

Using concept of Strategy maps could be very useful in the processes of Strategy building and implementation. Here, new properties is added - time phasing, having in mind importance, urgency and capabilities of organization. As a main criterion, impact on financial outcome was used.

This is in accordance with Kaplan and Norton [8] "*financial benefits from improvements to the processes in the four internal perspective themes occur over different time period. Cost savings from improvements in operational processes deliver quick benefits*".

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SOME POSSIBILITIES FOR APPLICATION OF GERT METHOD AND MODIFIED PERT METHOD IN PROJECT PLANNING

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Abstract

Graphical Evaluation and Review Technique -GERT will be presented in the paper. This method is used when it is possible to evaluate the time of activity performance. Modified PERT method is also based on evaluation of possiblеduration times of activities. The possibilities for application of these methods are extensive in the area of project management.

Key words: *planning, control, stochastic network, GERT*

1. Introduction

Planning and control of activities are involved with providing availability of materials and other variable resources with the purpose of procuring goods and services which satisfy consumer's demands. Several different aspects of planning and control will be presented, including some of the specialized approaches which are used for particular types of operations.

2. Planning and control

By the means of planning, the managers set organization's goals and define necessary resources and activities which need to be performed in order to accomplish the goals, before the realisation of goals begins. Planning implies preparation of decisions on what will be done in the future; it implies contemplating today on decision which will be made tomorrow.

Planning and control deal with current activities of operations management in order to satisfy the buyers' requests. All operations require planning and control, though the degree, formality and details may vary. The purpose of planning and control is to provide effective and efficient initiation of the production process and production of products and services as requested by the buyer. Planning is contemplative activity which precedes any organised activity; it is formalisation of what should happen at a particular point in future as a realisation of the goal.

However, the plan does not guarantee that the event will really happen. Although the plans are based on expectations, during the execution of those plans things do not always turn out as expected. Plans give structure to the organisational activities on what should be done, how it should be done and who should realise it.

Controlling is an integral part of the management process. "Controlling will be defined as a managerial activity which measures, evaluates and compares planned and actual operations with the aim of undertaking corrective measures, if necessary." Controlling is the process of facing the changes throughout the plan (project) execution. This means that the plans can be corrected. Control represents adjustment which enables working towards accomplishment of goals set by the plan, even when the assumptions on which the plan is based are no longer valid.

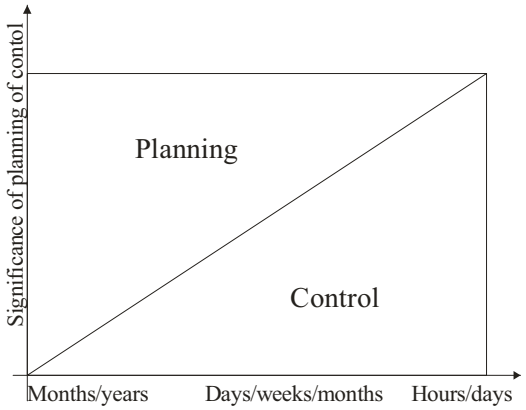

Figure 1. Balance between activities planning and control change into long-term, medium-term and short-term plans

Long-term planning and control

Long-term planning and control provide:

- presentation of benefits of demand prognosis,
- determining of resources in the collective form,
- so that the goals set in the functional sense are viable to a large extent.

Medium-term planning and control

Medium-term planning and control provide:

- existence of benefit from partially classified demand prognoses,
- determining of resources,
- determining of goals and operations in the financial sense.

Short-term planning and control

Short-term planning and control provide:

- complete classification of prognosis or current needs of the project,
- interventions on resources in order to correct deviations from realisation plans,
- ad hoc consideration of operations goals.

Projects related to conquering new products carry out estimation of alternative values by means of modelling. If we have a conflict with unfavourable external conditions, it might be necessary to change the strategy. Due to the increase of complex projects, in addition to well-known network methods CPM and PERT, it is necessary to use GERT method (Graphical Evaluation and Review Technique) as well.

3. Graphical Evaluation and Review Technique - GERT

Projects related to conquering new products often apply estimation of alternative values by means of modelling. The basis for applying GERT method is use of stochastic networks. A stochastic network has the following properties:

1. A branch consists of events (nodes), which realise logical functions, and operation branches.
2. A branch expresses the probability for execution of operation which it represents.
3. Operations presented by branches are characterised by a set of parameters.
4. Realisation of network diagram implies realisation of a particular set of operations and events.
5. If the operation time is random value, then the new value of that time is selected for each operation, in line with given probability schedule. [1]

GERT represents a synthetic procedure which uses the theory of oriented graphs, theory of random processes and PERT for solving stochastic problems.

The goal of any network method is project modelling by means of particular logical organisation of its operations. GERT modelling, which is different from other network methods due to the existence of both stochastic and determining events, uses special symbols to mark them. GERT allows not only one-sided diagram orientation, but it also allows loops (closed circles), which can start with any event and end in any previous event. This is all in line with the iterative character of operations in project realisation. Therefore, when GERT is used, particular attention is given to graphic presentation.

In GERT model, each branch (operation) is realised by performing modelling several times (predetermined number) in different situations. This enables collecting of statistic data for events with the aim of project analysis.

Network GERT consists of events (nodes) and directed operations-branches, the properties, i.e. descriptions of which are expressed by the term – number of degrees of freedom. The number of degrees of freedom shows how many incident operations (immediately proceeding to the event) should be performed in order to realise the event. For example, if the number of degrees of freedom equals one, and four operations are the incidents of the event, then the realisation of any of the four operations is sufficient for its realisation. If the number of degrees of freedom equals four, then the event will be realised only when all four operations which are its incidents are performed.

The number of degrees of freedom can be bigger than the number of events which are incidents of the activity. For example, if one operation is the incident of the given event, but for the realisation of that event that operation has to be performed three times, then the number of degrees of freedom equals three.

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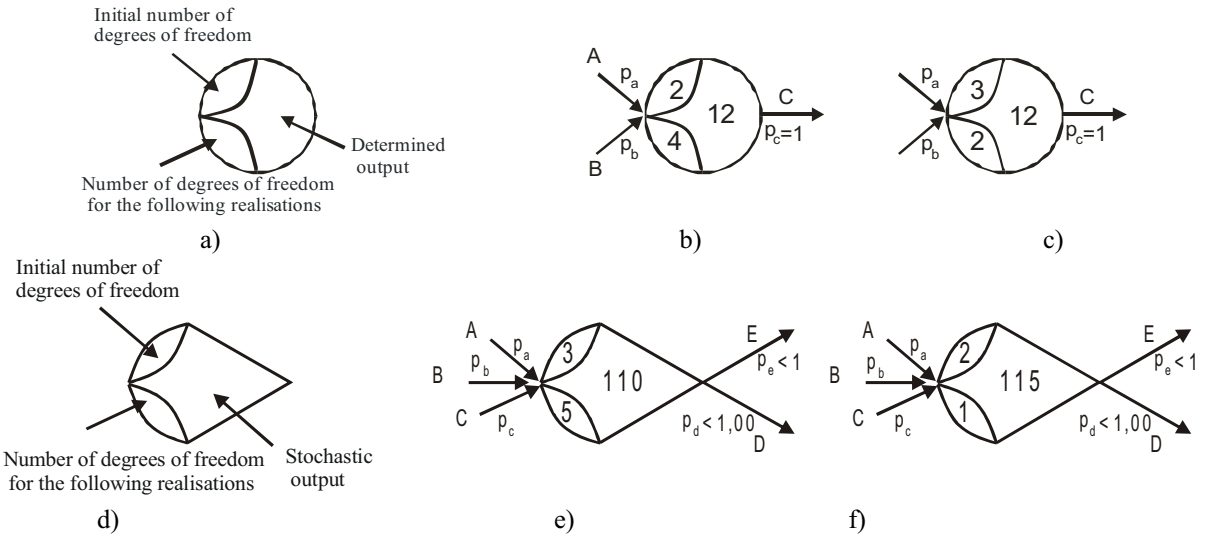

Figure 2([1],pg. 386)

Circular arc in the right section of the event corresponds to the determined output, as shown in figures 2b and 2c, where the probability of output operations equals 1. Data on incident branches are registered in the two segments in the left section of the event, which is its input. The number of degrees of freedom of the event, necessary for its first realisation, is marked in the upper segment of the event in figure 2a. The number of degrees of freedom of the given event for its following realisations is registered in the lower segment. The event in figure 2b has two incident branches. For the first realisation of the event it is sufficient to perform any of these two operations. For further realisation of the event it is necessary that its incident operations are realised three times in any combination.

Operations which follow from the initial event start in zero moment of time. That event has no input operations. The final event has no output operations. Network plan can be considered as realised if the necessary number of final events had been realised. Different initial and final events are shown in figure 3.

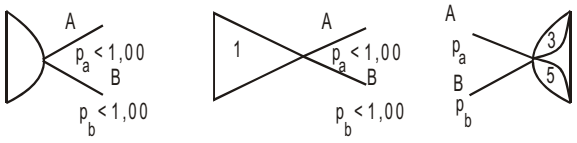

Figure 3 ([1], pg. 387)

Throughout GERT modelling, the statistics on the number of event realisations are significant. Other statistical data related to the realisation moment are collected as well. The event for which such statistical material is collected is called statistical event. All final events are statistical events. Sometimes it is necessary to calculate the time between realisations of two events. In that case, the moment of realisation of the previous event is taken as time of countdown beginning (calculation beginning), which makes it possible, in modelling, to register particular times in network plan until a statistical event.

We have two more properties of operations. Those are the indicators of the number of operation realisations and the number of operations. Numbers of operations are registered on particular arrows, which facilitates modification of network plan and makes possible differentiation of operations with equal initial and final events. Modification of network plan can include substitution of one event with the other with the aim of temporary or permanent change of network logic.

For the realisation of operations which follow from the realised event or from the initial event, main GERT procedure is used; it consists of obtaining (cumulative) function of schedule, starting with the totality of parameters and schedule type. By means of random numbers generator, actual realisations are obtained in line with obtained schedule. These realisations give time of operations ending. The described procedure is repeated for each operation which is the incident. If the event is realised, modelling is prolonged with operations which follow from that event and is continued until appropriate final events are realised. Modelling is repeated as many times as necessary, after which statistical data obtained for all appropriate events are reviewed.

4. Modified PERT method

Modified PERT method is based on evaluation of possible duration times of activities and probability of their realisation. For this method, the expected time is determined as mathematical expectation:

$$t_e^{'} = \sum_{i=1}^{n} x_i p(x_i)$$

where: x_i-is evaluated duration time of activity (not only three alternatives are possible, there can be a larger number),

$p(x_i)$-is related probability, probability that the activity will be realised in evaluated time.

We can also determine dispersion by using proper formula:

$$\sigma^2(t_e^{'}) = \mathrm{E}(t_e^{'2}) - [\mathrm{E}(t_e^{'})]^2$$

where

$$t_e^{'2} = \begin{pmatrix} x_1^2 & x_2^2 & ..... & x_n^2 \\ p(x_1) & p(x_2) & ..... & p(x_n) \end{pmatrix}$$

The example of practical application of this modified procedure will be shown by means of dependence die (table 1). Modified approach gives wider possibilities for defining initial data, that is in evaluations of time and probabilities, which is given in table 1, which shows how to determine the expected time (as mathematical expectation) and dispersion. Figure 4 shows network diagram.

Table 1.

Act.	"i-j"	Evaluation of duration x_i	Probability $p(x_i)$	Expected duration $t_e^{'}$	Dispersion $\sigma^2(t_e^{'})$	Costs C	Expected. cost $C_e^{'}$
A	1-2	13 14 15 16	0,2 0,4 0,3 0,1	14,3	0,81	500 400 300 200	370
B	2-10	7 9 10 11	0,1 0,7 0,1 0,1	9,1	0,89	700 500 400 300	490
C	2-4	12 13 14 15	0,2 0,4 0,3 0,1	13,3	0,81	500 400 300 200	370
D	2-3	9 10 11	0,2 0,6 0,2	10	0,4	500 400 300	400
E	2-5	2 4 5 6	0,1 0,7 0,1 0,1	4,1	0,89	900 700 500 400	670
F	4-7	16 18 19	0,1 0,8 0,1	17,9	0,49	1000 700 500	710
G	3-7	16 18 19 20	0,1 0,7 0,1 0,1	18,1	0,89	800 700 500 400	660
H	5-8	11 12 13	0,2 0,6 0,2	12	0,4	1000 800 700	820
I	6-9	22 24 25 26	0,1 0,7 0,1 0,1	24,1	0,89	600 500 300 200	460
J	7-8	15 16 17	0,2 0,6 0,2	16	0,4	1100 800 500	800

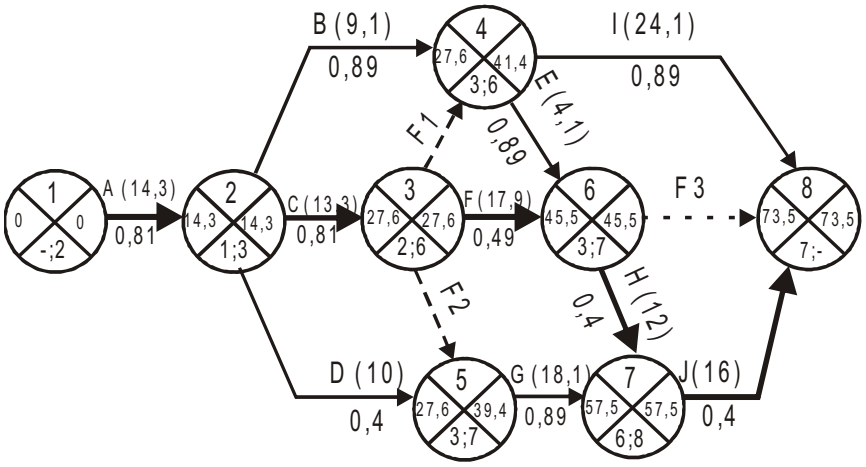

Figure 4 Network diagram

5. Conclusion

The analysis of GERT network is very difficult and complex and is relatively rarely used in practice. Modified PERT method makes possible calculating of expected time and dispersion if the evaluations of activities durations and their realisation probabilities are known. This modified method offers possibilities for a wide application if its designers have significant experience with technology of the work they do and have necessary knowledge of network planning technique. In this way, possibilities for more precise determining of expected times and related variances are made.

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BIG CHANGES AND UNVIODBLE PROCESS IN ENTERPRISES

M.Sc Katja Paunovic

Summary: The most developed companies of western countries in the XXI century are aimed robotization complete production process, as a source of exceptional results and competitiveness to the adoption of world markets. The tendency is to be unified quality products and opportunities, cheaper, and thus appealing to consumers. New markets in which companies need to compete are increasing globally and increasingly dependent on technology. Only armed with knowledge, they can change something in terms of creating new and better products, services and processes. Also in the professional literature on the subject, facing the implementation of new methods such as:
"Business process reengineering",
"Business process management,
"Business process improvement,"
"Business process benchmarking", etc..

Keywords: knowledge, quality, innovation, responsibility

1. INTRODUCTION

Reengineering has emerged as a response to the Japanese concept of quality management and access to the program changes in accordance with the American way of business thinking.
Target-oriented business in the modern business does not always give the best results. The company must be focused on the business about the process and not about function.
Changes of the process or even the introduction of completely new processes are not possible without changing the culture of the company. From the workers in such conditions is expected wider competence and resourcefulness, and he must be given the authority in order to process freely the work, employees also must be able to use new technology and modern robotization that allows the introduction of new process and more importantly must realize that it is responsible to the buyer and not the immediate superior to the process of satisfying work and to improve the business performance of the company.

2. REENGINEERING

Reengineering necessary to promote a new approach to the process of affirming his integrity, rather than up till now the single fragmentation process of a large number of such simple task. The reason for its very quick application to numerous areas of human activity undoubtedly lies in its attempt to connect, unify and integrate multiple separated works, in a one coherent process, which among other things, provides better and easier selection of key business processes (the creation of new and better services and process research and development, marketing, communication, distribution, etc.) that should be the main focus of attention.

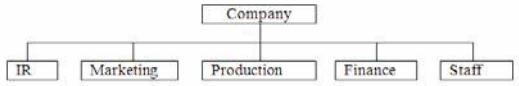

Figure 2.1. Place IR units in the organizational structure of enterprises

Marketing management includes the processes of planning, organizing, monitoring and control of all activities necessary to meet the desires and needs of consumers and achieve the planned profit companies (Figure 2.2).

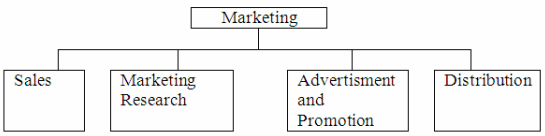

Figure 2.2 General model of organizing marketing functions

Focusing on the processes means that attention shifts from the end results (product / service) in one chain of activities that shape the product / service for example it leads to asking questions: "How to produce a result?", unlike as far - "Who is doing what?"
In this way, the roles are changing of all involved in the process of obtaining results, and Senior management provides the vision and policies (environment), in the way these problems are

solved. Associates provide inventiveness and creativity, and processes are those that allow jobs to do.
Focusing attention on the processes means that the way of looking at the process applied to a comprehensive enterprise level (Figure 2.3).

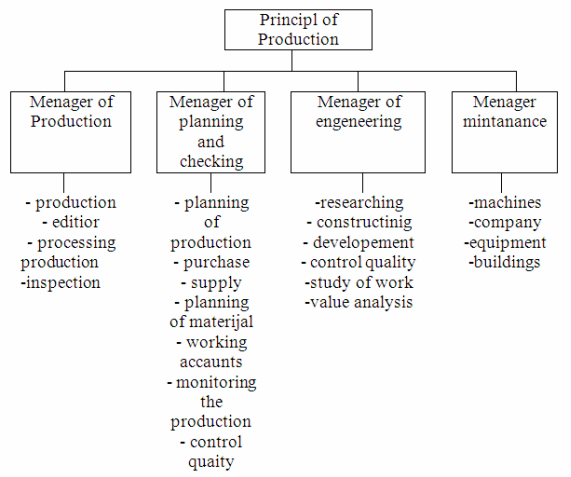

Figure 2.3. Model of organization the production functions in the organization of production

The company can be viewed as a system, for example network of independent components that synchronized and work together to achieve their goals. Disadvantages treatment system in this way, lie in the fact that here can not see clearly how the system meets the comprehensive goals. The aim of the company is not only to conduct market research, quality control, improves employees, etc., but to meet real needs - the wishes of customers / users of products and services.
According to the experiences of companies in developed countries can determine a clear trend in our economy must determine, that is to receive the services of greater importance.
For this purpose there are three important reasons:
1. The market will consume more and more services in relation to consumption goods,
2. Courtesy of the total offer will receive much greater importance (up to 70%),
3. Robotization and automation within the manufacturing will lead to the fact that most of the activities of the companies provision of services for internal purposes (even thought they are with us on misunderstandings due to lack of understanding of business process inefficiency is expensive and companies that only removal of unnecessary activities and implementation of IT technology can reduce costs and up to 50% and therefore the company can become a leader within their specialty)
As a result of constant successful technical change, many companies in our environment is changing and adapting to new market needs, and can be seen among other things, the example PC, car and other technical products, like as inside many other areas. Existing companies, functional organized not ready for constant changes, but are prepared to develop unique activiety within different disciplines. Over many decades, this type of companies gave very good results, and the price they have paid in the form of increased demand and compliance to ensure that all the different disciplines work is still relatively low.
By many companies put the demands to be constantly in a state of change, every function must (suddenly) alone will be able to understand how to contribute to common tasks. When changes become normal state, too much to expect from the manager that they change the company from its foundation. Instead, they must be involved by, starting from the common tasks, continuous conformity of their problems.
Orientation of the management processes, but not people, becomes the necessity to create conditions for achieving the objectives as follows:
1. Creating conditions for observing the way through the process associates provide the necessary knowledge so that they were able to make relevant decisions.
2. Creation of conditions that through the observation of how the process makes the company capable of change by implementing continuous improvements and settings workers are getting the situation changes in internal and external environment.
3. Economy knowledge would improve the quality of employment, transferring it to the workplace with higher qualifications, higher added value and creativity.
To achieve the desired result and take advantage of IT must break with traditional thinking and move with special activities on the processes that cover all costs of labor, from the beginning - the customer requirements, manufacturing process and in the end to the exploitation of the product by the customer.
Hence, it is necessary knowledge about information technology and the point is to combine IT skills with knowledge of the functioning of companies and knowing what it achieves in its various processes, which is a condition that only then realize the real advantages of information technology. This requires far more knowledge about the IT management staff, but also, and better knowledge of the company and its business by IT experts. Knowledge does not only make work concrete, it also brings continuous social progress. Advances in fields such as health, nature conservation, sustainable energy supply is based largely on the progress of knowledge.
Process management is working on changes, which in practice is rarely seen, in the way models are recommended, and is of central importance for understanding the development of various questionnaires and techniques which must be

master of the company that wants to work in management processes.
These companies must keeping in mind your unique situation to develop its own model suitable for management processes in your company, in order to improve the process and continuously conducted (Figure 2.4).

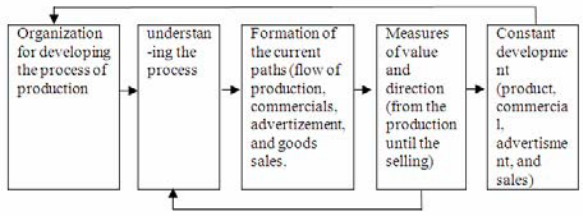

Figure 2.4 Five phases model for process control

Consequently, management would say that the mode of action, eg. one type of philosophy but not the method of work. It is a key phrase within this philosophy, but not the only important part. To successfully manage activities within the company imposes a requirement for comprehensive fundamental changes in the company, starting from:
- Creating a vision of what the company wants to achieve with engineering process.
- Definition of processes in the company,
- The creation of concepts for process control
- Analyzing, improving and reinverting process
- Creating conditions that it is possible to follow the processes throughout the company.
If companies do not perceive the manager how his company to look after the fundamental change, ie. re-engineering, can be expected that the company faces big problems. To be defined clearly and communicate about what we want to achieve with the re- engineering company, is to be a vision as an important and significant factor. The vision in question involves defining the process and strategy, its organization for the successful re-engineering, as well as the existence appropriate strategies for the implementation of process reengineering. For success in reengineering the company should rely on three key principles, which are appropriate:
1.The Preparation
2. The Future, and
3. Aplication of reliable methodology.
Need for new fundamental changes in processes face the common inability to exploit opportunities offered by new IT. Instead of the way of work adapt IT solutions, new techniques are often used just to speed up the traditional way of work. It is time to stop thinking that way, because the new methodology of creating new assumptions that require new processes.
The new philosophy of work required to remove in processes, ie. boundaries and thus create conditions that one person or team perform all tasks in a process from beginning to end (expert systems allow this).

3. CONCLUSION

The new time puts us in front of new challenges, which require that the companies solve problems in a new way. The dynamic development of information and robotized technology, telecommunications, and that led to the information economy, so strongly influenced changes in the company, that with the right to speak about the need for establishing a T-shaped organization and technological dependent organization. The final goal of such a new organization after the re-engineering business processes, should result in reducing costs. I add that all the sharper competition, which occurs in a market that is increasingly globalize and every one company that wants to survive in such conditions, to reduce market uncertainty, it must make permanent changes.
Like never before, the buyer becomes the center around which everything moves. Reengineering is used as a term that means the IT revolution and the consequences of applying information technology on the consequences of work in enterprises.
Under the influence of information technology in the enterprise is qualitatively quite different way, so that we can say that it is the emergence of new types of companies.

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INDUSTRIAL PRODUCTION IN SERBIA - CHANCES AND LIMITATIONS FOR SME DEVELOPMENT

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Abstract: *Since 90-ties Serbia is in the process of privatization and extensive reforms, in highly difficult economic and social conditions and with great backlog with developed countries of the West at all economic parameters. The final goal of these reforms is creation of market economy with accomplishment of full economic and social efficacy, respecting private initiative and principles of free market. The economic development strategy emphasizes the need of strengthening the real sector, more dynamic industrial development, creation of economy of scale, innovation promotion and synergistic effects in the economy. In this paper the impact of inadequate conduct of policy of industry development in Serbia is analyzed and also the stagnation and fall of industrial production with retrospective view on experiences of undeveloped countries and developing countries that have specialized in the sphere of raw material production. Also discussed will be the possible measures for development of companies in industrial sector as well as measures for alleviating the consequences of economic crisis on companies in the field of industrial production.*
Key words: *Industrial production, product, economy of scale, innovation, competitiveness.*

1. INTRODUCTION

The starting thesis of this paper is that the main causes of fall of economic activity in Serbia and deepening of the crisis created primarily by internal problems, should be looked for in the crisis of competitiveness of real goods production due to unregulated economic system, inadequate economic policy and failed operationalization of up to now adopted strategies and policies in Serbia.

Serbia, on the way of completion of the transitional changes, approaching and integration into the European Union is still facing huge problems caused by slow changes in social and economical sphere. The backward and in many cases improvised changes have as the consequence the continual lagging in the competitiveness of domestic products production, downfall of the industrial production volume, decrease of the already low level of technological and economic performances of the industry.

The model of development of transition economies based on foreign-indebtedness with tolerating the budget deficit and the deficit of the current transactions has also been characteristic of Serbia as well. The budget consumption is from year to year becoming the increasingly great problem for preservation of macroeconomic activity and the too heavy burden for already weak domestic production. Despite the need that the products and processes in manufacturing organizations are to be unburdened of the insuperable burdens of assigning for the public consumption needs, this measure that is long term and of great strategic importance for recovery of industrial production, has been absented. In order to cover the consumption it is necessary to> have developed production, attract new foreign investments (the problems due to crisis in the foreign funds and banks from which the investors are financed from), yielding from the remained privatizations that are in course (some of them already been cancelled or failed), to indebt at foreign banks and funds, spend foreign exchange reserves or to decrease-reduce the budgetary consumption in the way that it is necessary to perform structural, institutional and strategic changes [12]. The indebtedness of Serbia from several years back is increasing by collective credit arrangements and with plenty of conditioning and prerequisites with the regards to the reforming steps. The foreign exchange reserves of Serbia (on 30.09.2009, **10.683,3** million euros [11]) are insufficient for covering the budgetary deficit, especially if

considered in middle terms, and their spending for those purposes is not even recommendable.

The first phase of economic transition in Serbia, related to the changes of the economy structure with the purpose of replacing the plan economy with modern, open and market competitive economy is, according to the estimation of the World Bank analysts, over. The expected changes in the ownership structure have not contributed to the more serious increase of the production scope, structure of the product and its competitiveness. Further reforming activities are directed towards restructuring and ownership changes of large and public companies, institutional changes in order to build socio-economic ambient that will simulative and competently affect on the activity of the companies at domestic and foreign market, support of founding and development of the competitive sector SME (small and medium enterprises), decrease of unemployment and surplus of employed in the public sector and at the level of local communities, development of undeveloped infrastructure.

The changes that have ensued in the already fragile industry, with outdated technology, without the economy of scale, the necessary level of innovation and synergy, have contributed to incapability of the industrial companies to more seriously compete with the forthcoming organizations on domestic market and especially on the incomparably more competitive international market. The effects of global economic crisis have worsened the state of the economy as a whole and especially in the industrial sector, influenced on the aggregate demand, decrease of interest of investment funds for investing into the projects with smaller profit rate, into economies with great risk for capital return, liquidity of the banking sector and on the capital cost.

The consequences of overflow of the crisis from financial on the real sector of Serbia, are reflected in the lack of necessary foreign investments, increased outflow of capital from the economy and unavailability of financial resources to a large number of organizations, limited financing of the credits, having as the consequence the aggravating the production and slowing down of the economical growth.

The strategy of development of small and medium enterprises, respecting the potentials of this sector, predicts that it will be the bearer of the economic development the next period with great number of innovative work places with necessary advancement in development of management, promotion of quality system and innovations through continual improvement of products, services and processes within the companies. Some economical sectors have the special strategic importance owing to the capability of adding new values to natural resources, contributing to foreign currency inflow increase, and influence on employment increase, encouraging the regional growth and generating conditions of the Republic of Serbia using the possibilities that are being opened by advancement in new technologies development. In that sense, as the sectors having the greatest economic potential for future growth and development identified are: processing of agricultural products, industrial production, tourism and electronic business (e-business).

2. Global economy and industrial production in Serbia

Comparing the economic theory and economic history the particularities that condition significant differences between the theory and practice can be perceived. Rich countries, viewed from historical distance, have had in their economies and industries in practice completely different implemented measures from the recommendations and advocacies that their theorists and esteemed economists have recommended in the economic theory and those imposed on poor countries. These cognitions date hundreds of years back (Adam Smith, *The Wealth of Nations*, 1776. advocated for free trade which has been accepted by England but only as an applicable recipe on the international market outside its own borders), whereas, during the total one century after the book was published, it has been barricaded from several import customs than France that is considered of presenting the strongest fortress of protectionism today [5, pp. 9]. Today at the level of mutual Washington institutions: the World Bank and the IMF (International Monetary Fund) [8] we have almost the same policy. despite the “cognitions of the effects of deindustrialization" on economies of economically undeveloped countries, the policies of Washington institutions are unfaltering in their requirements towards the undeveloped countries and developing countries, to conduct the concept of recommendations distancing them form building their own industry, promoting the industrial policy, whereby they are becoming even poorer. Without their own industry and production neither country has succeeded in improving the living standard of the employed un agriculture that represent the significant portion of the population in large number of countries throughout the world. Despite the fact that the gap between the rich and poor is increasing, that the rich become richer and that by implementing the recommendations and measures the poor become even poorer, the policies of these institutions are directed towards prevention and elimination of the impact of the authority on the economic activity and their own economy. The examples are numerous and this paper’s purpose is not to analyze the experiences if industrialization in other economies, but they are pointed out in the context of cognitions that even today many regions and cities in the world are spending millions of dollars in order to create the fruitful ground for development of the high-

technology companies (investment of the city of Chicago in creating conditions for high-technology companies development) [5, pp. 9] and that the official policy is propagating the preservation of the free market and principle of non-interference of the policy in the economy.

The disturbance on the global financial market, have caused serious difficulties in the sphere of production, trade- free exchange on the international market. The causes and consequences of the crisis point out to unsustainability of the theory of self-regulation of the market and the need of building additional mechanisms by which the activity of the companies with global business operations would be controlled. The market disturbances, especially on the labour market are manifested through mass dismissals, as the result of the decreased demand and fall of investment activity that inevitably postpones new employments and hampers dynamic development. Economies, even of the most developed countries, depend on the global trends, changes and occurrences on the market of capital and goods and especially of those goods the value of money depends on (oil and gold). According to the estimates of the IMF the downfall of the social gross product of the key European economies in 2009 will amount approximately to 4 %. The projections for 2010 also point that the rate of economical growth of the mentioned countries will be negative with the signals of slow recovery. The USA economy several years back has had problems with fall of consumption as the consequence of the increased deficit in the balance of current transaction. The European Union countries and Japan also record the recession or are at the margin of recession. Table 1 shows the forecast of the estimate of the growth rate in 2009 relative to the realized growth rate in the previous year.

3. Industrial development and industrial policy

The strategic goal of Serbia is realization of the pre-approaching procedures for European integrations and association with the EU. This highly important goal will have essential significance if the benefits are accomplished that Serbia economy and society expect from the effects of the association. The achievement of the agreement among the EU member countries on the application of the transit trade agreement with Serbia will create additional difficulties too Serbian economy with regards to business operations on the internal market of the EU. The domestic companies, in order to have successful business operations on the European market should have: quality products, adopted and applied international standards, developed system of application of innovative solutions, healthy financial structure, efficient management, built system of flexible adjustments to changes and influences from the ambient. In one word, the integration processes require from Serbia an adequate strategy of economical growth and industrial policy having the possibility to contribute the industrial production development.

Table 1. The forecasts of the economic growth rate in 2009 in the selected countries in % in relation to the previous year [17]

Country	Economic growth rates
World	-4.3
The European Union	-4.6
USA	-2.9
Japan	-6.7
Germany	-5.6
Italy	-4.4
Great Britain	-4.1
Spain	-3.3
France:	-3.0
Switzerland	-3.0
Russia	-6.0
Checz	-3.5
Hungary	-3.3
Poland	-0.7

We think that it is not necessary to perform deeper analysis in order to show that Serbia does not have an effective industrial policy and that the production factors are exploited at a very low level. Basic function of economic policy is, probably, maintenance and strengthening the positions of key distribution-oriented coalitions in allocation of national wealth and social product [1]. Creating such circumstances can be explained by "non-existence of the need for efficient industrial and in general any national developmental policy".[8] If from the distance of four years later, the occurrences on the market are analyzed characterized by great business incapability of domestic companies and intermediation of the state in decreasing the due claims of the producers from the key distribution-oriented coalitions, it can point out to the great probability of the set thesis.

The liberal market under conditions of competitive incapability of domestic companies on the market of Serbia can be deathly for industry and manufacturing companies. It is to be expected that the manufacturing sector moves to the sphere of production of raw materials whereat the demands for technologies, available technique and resources are at the level of production of low degree of finalization. It is well-known that for many economies the expectations from the liberalization of market have remained unrealized, that the actual occurrences after the liberalization have made many economies deindustrialized and poorer for a longer period of time.

At the beginning of deliberation of industrial development and industrial policy in Serbia, several questions have to be posed on which the answers

should be found as soon as possible and make the alternative strategies:

1. What is the basis for strategic increase of export and decrease of deficit,
2. What is industry capable of producing and placing on domestic market and to simultaneously withhold the pressure of the forthcoming companies,
3. What is the "sustainable" level of downfall of industrial production and to what extent will decrease of business activities influence on decrease of the needs for workers and losses of work places,
4. What represents the source of new business and new work places for new or repeated employment?

Table 2. shows the indices of industrial production, employment and productivity for the period 2004-2008. Despite the decrease of business activities in industry, decrease of labour productivity, the number of employed in industry from 2005 records a mild rise. It can be concluded that the decrease of work productivity is the result of decrease of activities in the sphere of more quality business and orientation on simpler business creating minor value on the market.

Table 2. The indices of industrial production, employment and productivity for the period 2004-2008. (previous year = 100) [15]

	2004	2005	2006	2007	2008
Industrial production	107,1	100,8	104,7	103,7	101,1
Number of employed	95,2	92,4	91,7	91,9	94,5
Labour productivity	112,5	109,0	114,2	112,9	107,0

The indicator of decreased labour productivity under conditions of relatively smaller competition on the market, than the expected one in the next period, suggest further worsening if the industrial policies are not effectively changed and applied. The ensuring of the sustainable expansion of the production with respecting the social and ecological criteria delegates to the SME sector the importance of the key factor for increase of the Gross Domestic Product-GDP, generating new businesses and new jobs.

4. The role of SME in industrial production development

It has been expected from small and medium enterprises to play the key role in the process of transition of the countries of Central and Eastern Europe, in the sense of their faster development and easier association with the developed market economy of the EU member countries. The sector of small and medium enterprises should have prompted and make it easier the transition from plan to market economy, as well as to assist the large companies to more easily adjust to demands from the competitive market through their restructuring processes. However, these optimistic expectations have not fully been accomplished because in the transition countries there has been no appropriate institutional support to development of this sector due to bad heritage from the previous period. Especially small number of these companies has been registered in the field of industry, only 13%; mainly operating as independent companies and a small portion are the branches of other, large companies. This ratio is explained by the fact that there is a significant difference in the level of initial investments into production in relation to the trade and services. Table 3. shows the data on average annual turnover, average number of employed per company and the annual turnover per employed in the EU for industry and trade. The industry on average has 1,66 times greater number of employed (10), 2,4 times smaller average turnover per employed and 1,45 times smaller average turnover form trade. It is undoubted that the trade records more efficient and effective business operations than the industry and that by the measures of industrial policy the activity of the manufacturing SME should be encouraged.

Table 3. The economic power of the SME in the European Union industry (2005).

Branch	Average annual turnover (in 000 euro)	Average number of employed per company	Average annual turnover per employed (in 000 euro)
EU	**1724**	**7**	**241**
Industry	1828	10	166
Trade	2658	6	405

Development of small and medium enterprises in Serbia should contribute to the following economic effects:

- Significant increase of employment
- Increase of living standard and decrease of differences between average incomes in the Republic of Serbia and the European Union countries.
- More powerful and even regional development
- Strengthening of the international trading connections, especially with the EU countries
- Increase of the available resources for other social sectors, first of all to education, health care and pension funds.

Small and medium enterprises are the synonym for the private sector and entrepreneurship; they should be the engine of the economic development. The entrepreneurship development is precisely what is

present in Europe and in the world and it is the issue on which further economic and industrial development of Serbia should be based on. The basic comparative advantage of small and medium enterprises is that they are flexible in the sense of adapting to fast changes and possibilities of satisfying the market demands. These companies can very fast modify the existing as well as introduce new ways of business operations, and all of it for the purpose of maximum satisfaction of the consumers and achieving the market success. The consumers' satisfaction- the success of small and medium enterprises- better functioning of the total economy, is the chain of accomplishing the total individual and social (state) success.

The strategy of development of small and medium enterprises and entrepreneurship in the period of 2003-2008, adopted by the Government of Serbia, has had as its goal "the promotion of entrepreneurship and creating frames for creation of sustainable, internationally competitive and export oriented sector of small and medium enterprises and entrepreneurship in the period of five years." To what extent is the mentioned goal realized is very disputable, but it is completely certain that the cognizance on importance of the small and medium enterprises is increasing, both form the aspect of the state and from the aspect of the individual, even though many issues concerning the state inn this period j=have merely remained on a declarative level.

The selection of business areas is the basic decision of small and medium enterprises founders. They can have their own differentiated programs directed towards the chosen target market, participate as the cooperants of large companies or be a member of greater business system. At choosing the business area one should have in mind the so called "market angles" that are not adequately covered by production programs of great companies in neither national economy, but they are the areas of manufacturing and service activities that have been "reserved" for small and medium size companies.

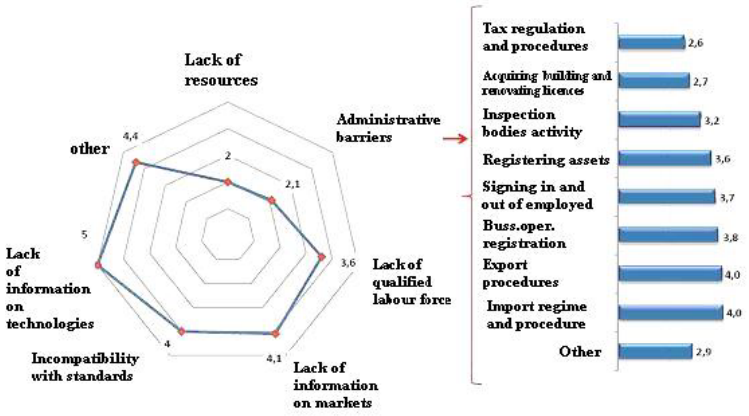

Figure 1. Main problems in SME business operations [14]

Figure 1 shows the results of the research- State, needs and problems of small and medium entrepreneurs and entrepreneurship. Having respectability towards the results of research and sharing the belief on the significance of them, we think that the problems in business of the small and medium enterprises in Serbia are to a largest extent caused outside the identified limiting factors. The manufacturing companies' problems in Serbia are that they generate their business on the principles of the economy of scale, innovation and greater participation of the synergistic effects. The offer of the international market is not missing due to export procedures but due to non-competitiveness of the product because of huge lagging in the applied technologies, outdated labour means, insufficiently followed changes in relation to the competition, small scope of production that is loosing its pace not only with the global products but also with the products not having the marks of global and coming from the international markets from industries of the economically developed countries. We think that the current problem of the companies in industry of Serbia encourage and on them is to a greatest extent reflected:

- Decreased demand for products and services on domestic market
- Decreased demand for products and services on foreign market,
- Inadequate general and business ambient,
- Insufficiently designed legal regulation for protection of contracts in the economy and the ownership rights,
- Incapability of state bodies, first of all the judicial ones, to settle issues regarding the initiated receiverships, disputes regarding the claims collections, protection of rights of ownership and restitution,
- General illiquidity of the economy including the influences on liquidity according to the basis of non-fulfillment of obligations of the state in the transfer of the funds to budgetary beneficiaries

and the creation of the chain of damage due to delay in performance of contractual obligations of the beneficiary towards the suppliers and producers,

- Lack of capital with interests approximately equal to those for the EU member countries for short-term, medium-term and long-term credit arrangements for financing development and increase of the SME competitiveness,
- Uncertainty with regards to stability of the foreign exchange rate on a longer term.

Although to an insufficient measure, due to the mentioned limitations, in the period 2001-2008, noticeable are the drifts in improvement of general conditions of the sectors of small and medium enterprises; however they are insufficient of influencing the economic growth to a greater extent and the increase through the necessary export. Undoubtedly, the greatest contribution of the SME is to the new and repeated employment. The afore mentioned reasons have influenced on the business success of the companies although many have from the very founding been predetermined to the business success. Namely, the entrepreneurship for someone who possesses a quality entrepreneurship idea represents the challenge and to other an attempt with great uncertainty in advance or faith. Large number of workers that have been dismissed and with the possibility of employment at some other employer has started their own business and not having for it the necessary knowledge, skills and resources. With the lack of mechanisms of help of the newly-founded companies they are, subjected to the market influence, to a greatest extent surrendered in front of the requirements coming from the market and the challenges of the necessary adaptations to market.

5. Conclusion

The economy of Serbia is in the state of decreased economic activity and for the recovery the decisive and complete reforms are necessary. The existing measures of the economic policy do not encourage the revival of the industrial production and do not predict that there will certainly come to the turning point in relation to domestic production and domestic product. The lacking factors of the economy of scale, technological changes and synergistic effects cause a powerful decrease of the economic activity. The economic policy measures do not provide necessary impulses to the economic growth and without "the capital of spirit and will": new knowledge, innovations, synergy, entrepreneurship, management and capabilities of the organization to respond to the challenges from the ambient cannot be efficient.

The changes in the sphere of economic policy should encourage the investment activity and lead to the economic growth on the principles of strengthening of the market economy influences. The experiences coming form the cognition on the genesis of the global economic crisis teach that the self-regulation of the market is not enough, that the existing regulatory mechanisms are not capable of ensuring a quality ambient for sustainable growth and development. The regulation is necessary because the doom of financial organizations, manufacturing organizations and any form of impact on business activity beyond the power of "the ordered market" damages the capital owners, decreases the interest in investing, contributes to loosing the jobs and non-accomplishment of the interests of the rest of the stake holders in the process of business operations over the company. Changes are necessary at all influential levels on the business activity. In the sphere of banking business, they would contribute that the business goes there where there is the potential for its growth and not where the controls are loose, thereby creating the possibility of provision of financial resources at more favourable conditions.

The change of economic policy that would result in increased interest of the investor for investing into production, would make a quality leap towards upheaval of the economic activity, decrease of the costs of production factor by decreased allocating for the needs of the state, the price competitiveness of the product would be strengthened on domestic and foreign market.

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SESSION B – QUALITY, MAINTENANCE AND LOGISTICS MANAGEMENT

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A REPLICATIVE STUDY OF ORGANIZATIONAL STRUCTURE AND QUALITY MANAGEMENT RELATIONSHIP

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Abstract

The paper considers interdependence of organizational structure and quality management (QM), both in terms of concepts and dimensions. Experimental investigations on the sample of 111 Serbian industrial companies confirm the deductions of previous foreign investigations indicating that QM practice is better in larger-sized, certified and mechanistically structured companies having higher formalization and technocratic specialization level. Organizational structure dimensions correlate most strongly with procedures of systemic and process approach as well as with quality improvement as concept. The impact on other QM dimensions is also significant, however, lesser.

Key words: organizational structure, QM

1. INTRODUCTORY CONSIDERATIONS

Contingency approach to organizational theory and practice was developed in the 1960s and its testing and empirical promotion are still in progress, along with a growing trend of quantifying the contingency factors impact and increased complexity of investigations, all having the same goal – it is expected that the overall efficiency of the company can be increased if the impact of contingency factors is kept under control.

Organizational structure as a set of basic relations within and between the most significant organizational elements [3] is described by the most prominent dimensions. Burton and Obel [2] place emphasis on organizational complexity (horizontal, vertical and spatial differentiation), formalization, centralization and coordination and control as basic organizational structure dimensions. Germain and Spears [4] consider formalization, technocratic specialization and decentralization. Vickery [13] believes the number of hierarchy levels, management range and decentralization to be basic organizational structure design parameters. Robinson enlists 13 most commonly mentioned and explained organizational structure dimensions [3] . Robinsons' 13 dimensions can be reduced to 3 basic ones: complexity, formalization and centralization. Works related to QM theory and practice, on the other side, have been emerging since the early 1970s to the present day and most often give theoretical recommendations or describe QM practice through case studies. However, works of the respective area were in real expansion in the 1990s treating the following topics (according to [1]):

- Identification of QM critical factors
- Recommendations for QM appplication
- A relation between QM and the company's performances
- Human resources management within the QM context, and
- A relation between ISO 9000 standard and TQM.

2. IMPACT OF ORGANIZATIONAL STRUCTURE DIMENSIONS ON QM

The basic organizational structure dimensions to be considered in the present work will involve the parameters common to the investigations [4, 13, 3 and 2], such as:

- number of hierarchy levels (number of layers)

- management range (span of control)
- technocratic specialization (because industrial companies are considered)
- spatial differentiation
- formalization, and
- decentralization.

The area of factors identification is also of importance for this work, because they are QM critical components leading to improved indicators of the company's performances. After the analysis of frequency incidence in the available literature the following TQM critical factors can be segregated by frequency of appearance:

1. Leadership and management support for quality program (17)
2. Training and involvement of employees (17)
3. Process approach (14)
4. Systemic approach and documentary evidence for quality system (13)
5. Beneficial interactions with suppliers (11)
6. Permanent quality improvement (9), and
7. Product design according to user demands (7).

Notable are also some investigations attempting to answer the essential questions of the QM concept. As early as 1995 Watson and Korukonda [14], in their work about theoretical jungle in the sphere of quality, wondered if the QM concept is organic or mechanistic in its nature. In 2001 Jack E. et al. [8] wrote a summary of doctoral dissertations on QM thus providing a resource for studying the mentioned issues. However, they have not been solved to the present day.

In available works a relation between company organizational structure and TQM is described by various authors as follows:

- According to Madu (1998), the flatter the organizational structure (reduced hierarchy levels, but increased management range), the better TQM indicators,
- According to Germain and Spears (1999), with increased formalization, specialization and decentralization levels, TQM practice is better,
- According to Beyer et al. (1997), in the initial stages of applying TQM, mechanistic organizational structure should be put into use and later on elements of organic structural organization should be introduced, so as to radically change employees behavior, and
- According to Lagrosen and Lagrosen (2003) in a simple organizational structure and adhocracy (small-sized companies), TQM practice is poor, therefore machine or professional bureaucracy, or divisional forms should be exercised.

1.1.Experimental investigations of the impact of organizational structure dimensions on QM

In this work the term industrial companies applies to the companies dealing predominantly with industrial production [5], or activities supporting the production: maintenace, storage and the like. Of such Serbian small- and large-sized companies, there are only 1228 (calculated after [11]). The number of large-sized industrial companies, according to [11], was only 471 in the year 2004. In total, the population of Serbian industrial companies, whose prevailing activity is production, comprises 1699 companies. The sample initial size is 500 industrial companies dealing with industrial production, maintenance, storage and the like, which accounts for nearly 30% of the population. The response to the delivery of 500 questionnaires equalled 112 companies, one questionnaire being rejected due to insufficiency of a larger amount of data and an error in a control question. Therefore, the response amounted to 22.22%. It is deemed that the presented size of the sample of 111 companies provides an adequate description of the population, so deductions can be generalized for Serbian industrial companies. The 42% of sampled companies are certified for quality standard.

In a given sample of companies the average number of hierarchy levels in the overall organizational structure is 4.9, while the span is from 2 to 9 hierachy levels at the most (even though 5-6 levels are not recommendable aside from the size). The average managing director's span of control is 5.24 employees, and ranges from 1 to 32 employees (such extreme values are unsuitable). The companies are chracterized by poor strategic decentralization (4.1, while 5 designates total decision-making decentralization), which is unsuitable. Formalization level amounts to 2.93 on a 5-level scale. Technocratic specialization equals 2.71 on a 5-level scale, even though it comes to industrial companies (the companies are characterized by a high per cent of administrative staff). The duration of certificate possession is approximately 4 years.

Correlation analysis of collected data by investigated concepts confirms largely the relations hypothesized

by the theoretical model of interaction between organizational contingency factors and QM. Therefore, the organizational structure was correlated with the demographic variables, technology and environment, and considerably affects QM practice (high correlation) – Tab.

The relation between features, susceptible to higher or lower deviations, is referred to as correlation [5]. The variable whose value is affected is called the dependent variable, while the one producing the effect is the independent variable.

	Leadership	Training	Systemic approach	Process approach	Interactions with suppliers	Quality improvement	Product design	Quality management
ORGANIZATIONAL STRUCTURE	.379 p=.006	.384 p=.005	.708 p=.000	.599 p=.000	.412 p=.003	.633 p=.000	.450 p=.001	.652 p=.000

Tab. 1 Impact of organizational structure on QM dimensions [12]

When the dimensions of organizational structure and QM are viewed individually, the correlation analysis indicates the following significant interdependences:

-larger-sized companies have increased horizontal, vertical and spatial differentiation and possess a certificate longer time than smaller-sized companies,

-certification contributes to improved application of systemic approach and QM of the supplier, and implies increased decision-making decentralization, vertical differentiation and technocratic specialization,

-increased horizontal differentiation of the company implies better application of the systemic approach,

-increased horizontal differentiation implies a wider range of activities in the domain of quality improvement,

-increased formalization means improved documentary evidence for quality system, supplier's better quality system and a wider range of activities in the domain of quality improvement,

-increased technocratic specialization leads to higher values of all QM critical factors, except for supplier QM,

-increased horizontal and vertical organizational structure differentiation, formalization and technocratic specialization as well as delegating tasks by the management imply better application of the systemic approach principle,

-more intense technocratic specialization, management proactivity and employee collectivism imply improved application of the systemic approach principle,

-increased formalization along with power decentralizatiomn imply supplier's better QM,

-higher number of hierarchy levels and increased formalization and technocratic specialization along with the management inclined to long-term planning and proactive employees of collective spirit entail better quality improvement practice,

-increased horizontal differentiation implies a wider range of activities in the domain of quality improvement,

-increased formalization means improved documentary evidence for quality system, supplier's better quality system and a wider range of activities in the domain of quality improvement,

-increased technocratic specialization leads to increased values of all QM critical factors, except for supplier's QM,

-more intense technocratic specialization is followed by better training of employees involved in the domain of quality,

-more intense technocratic specialization, management proactivity and employee collectivism imply better application of the process approach principle,

-increased formalization along with power decentralization imply supplier's better QM,

-a larger number of hierarchy levels and increased formalization and technocratic specialization along with the management inclined to long-term planning and proactive employees of collective spirit entail better quality improvement practice.

3. CONCLUSION

The conclusions of correlation analysis are largely in accordance with the results of previous investigations which also most often deployed correlation analysis. The QM practice is better in larger-sized, certified, mechanistically structured companies with higher formalization and technocratic specialization level.

Organizational structure dimensions produce the strongest impact on systemic and process approach procedures as well as quality improvement. The impact on other QM dimensions is significant, but lesser. The conclusions of this replicative study confirm the conclusions reported by Germain and Spears [4], Beyer et al. [1] and Lagrosen and Lagrosen [9]. The potential shortcoming of the investigations is the fact that correlation analysis does not indicate the direction of relation and analyzes strictly the bivariant interdependence. Therefore, the conclusions of correlation analysis demand further testing by advanced statistical techniques, for example Structural equations modeling technique, and this should be the orientation of further investigations.

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QMS DEVELOPMENT

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Summary: *ISO technical committee ISO/TC 176 is responsible for the ISO 9000 family of standards for quality management and quality assurance. National delegations of 81 countries (February 2009) participate in its work, while another 21 (February 2009) countries have observer status. The ISO 9000 family of international quality management standards and guidelines (totally 18), has earned a global reputation as a basis for establishing effective and efficient quality management system. This paper show basic information about ISO 9001:2008, ISO 9004:2009 and future ISO TC 176 on advanced QMS model (probably ISO 9001:2015).*
Key words: *Quality Management, Quality Improvement, Quality Policy.*

1. INTRODUCTION

ISO's portfolio of more than 17800 (in Nov. 2009) standards and related documents address all three dimensions of sustainable development: economic, environmental and social. ISO's rules for the development of standards require their periodic review to decide if they need revising, maintaining or withdrawing. Compared to the 2000 revision of ISO 9001, ISO 9001: 2008 – the fourth edition of the standard – represents fine-tuning, rather than a thorough overhaul. It introduces clarifications to the existing requirements in ISO 9001:2000, based on user experience over the last eight years, and changes that are intended to improve further compatibility with the ISO 14001:2004 standard for environmental management systems.

The new edition of ISO 9001 does not introduce additional requirements, nor does it change the intent of the ISO 9001:2000 standard. A certification to ISO 9001:2008 does not represent an increase in the level of quality to be expected, and any organizations certified to ISO 9001:2000 should be considered on the same level as those already holding a new certificate to ISO 9001:2008. This paper support references [1 – 11].

2. ADVANCED QMS MODEL

The last study of ASQ published recently concludes more explicitly that the future of Quality is moving from the single product quality dimension to a multi dimensional discipline which has to encompass the whole universe an organization is operating in and the different challenges it meets to satisfy the needs and expectations of all its customers. When applying the concept of multi dimensional Quality at the organization level, some difficulties are revealed in the process of understanding the "expectations and needs" of the customer.

The difficulties origin from a preliminary step that is often overlooked by organizations. This step is the one of clearly defining the organization's customers. How could we understand and define customers' needs and expectations if we have no clear idea who they are? Only after clearly defining who are the organization's customers it can proceed to define their needs and expectation which, of course, will differ from one type of customer to the other. The group of customers of an organization (beyond the customers of its products/services) are usually referred to as the organizations stakeholders or its interested parties. The concept of interested parties is used also in the ISO 9000 Quality Management family of standards and is defined in paragraph 3.3.7 of ISO 9000:2005 as follows : *"interested party - person or group having an interest in the performance or success of an organization.* In a more descriptive language interested parties are described in ISO/FDIS 9004:2009 as : *"Interested parties are individuals and other entities that add value to the organization, or are otherwise interested in, or affected by, the activities of the organization"*. Each of them giving a different meaning for the Quality of the organization: Customers (Internal and External), Shareholders/Owners, Employees, Society, Suppliers/Partners, Table 1.

Table 1. Examples of interested parties and their needs and expectations

Interested party	Needs and expectations
Customers	Quality, price and delivery performance of products
Owners / shareholders	Sustained profitability Transparency
People in the organization / Employees	Good work environment Job security Recognition and reward
Suppliers and partners	Mutual benefits and continuity
Society	Environmental protection Ethical behaviour Compliance with statutory and regulatory requirements

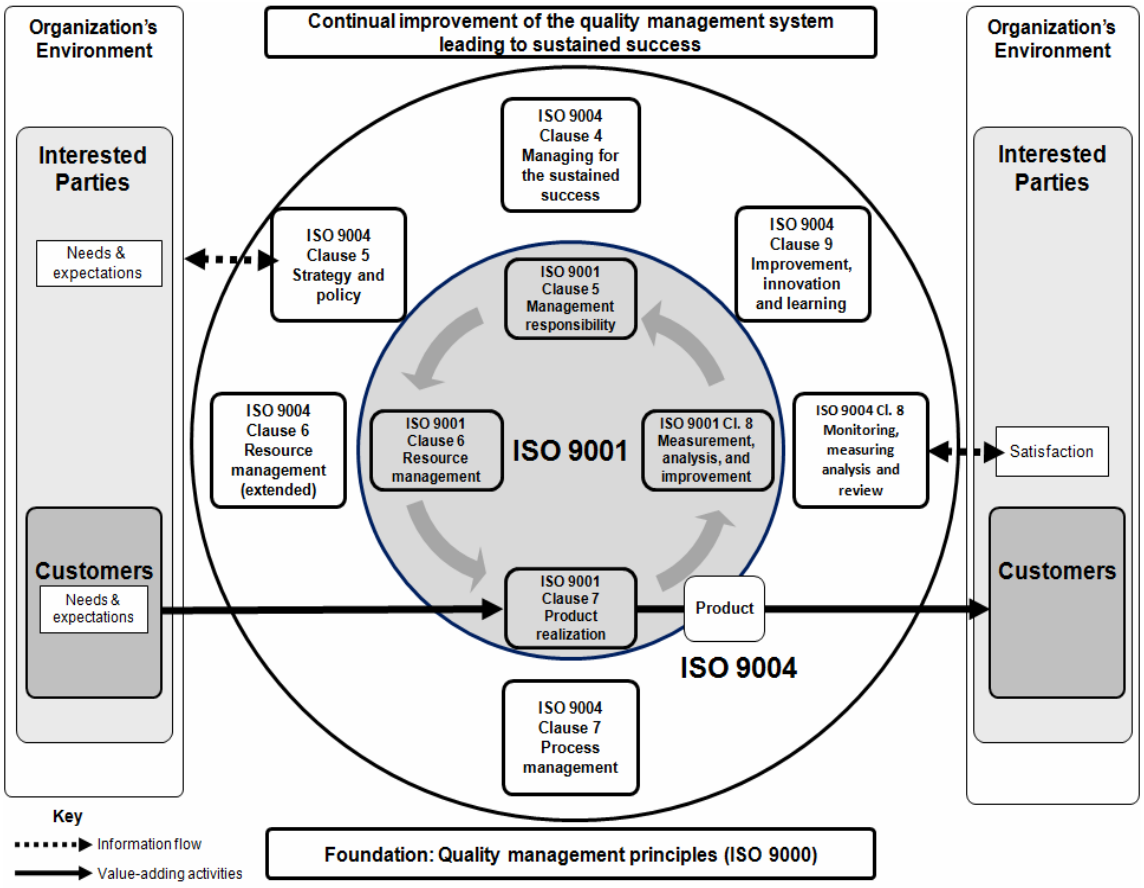

Figure 1. An extended model of a process-based quality management system [5]

Of course interested parties differ between organizations, industries, nations, cultures and may change over time. The Secretary presented a chart to show that if about 3 years were to be permitted for the two streams to come together into an approved project, and then a further 3 years were permitted for the drafting activity, we would be looking at a target of around 2015 for the publication of the next edition of ISO 9001. A separate new Task Group also held its first meeting, to update the ISO Handbook: *ISO 9001:2000 for Small Businesses*, to align it to ISO 9001:2008.

3. ISO 9004:2009 – BASIC CHARACTERISTICS

ISO 9004:2009 was prepared by Technical Committee ISO/TC 176, *Quality Management and Quality Assurance*, Subcommittee SC 2, *Quality Systems*. This third edition cancels and replaces the second edition (ISO 9004:2000) which has been technically revised. Managing for the sustained success of an organization is a major change in focus for this standard, leading to substantial changes to its structure and contents.

The sustained success of an organization is achieved by its ability to meet the needs and expectations of its customers and other interested parties, over the long term and in a balanced way. Sustained success can be achieved by the effective management of the organization, through awareness of the organization's environment, by learning, and by the appropriate application of improvements and / or innovations. ISO 9004:2009 provides a wider focus on quality management than ISO 9001; it addresses the needs and expectations of all relevant interested parties and provides guidance for the systematic and continual improvement of the organization's overall performance.

An extended model of a process-based quality management system incorporating the elements of 9001:2008 and 9004:2009 is given in Figure 1 [5].

This model has nine modules and three annexes. Main modules are: Managing for the sustained success of an organization; Strategy and policy; Resource management; Process management; Monitoring, measurement, analysis and review; Improvement and innovation and learning. Annexes are: A self-assessment tool; Quality management principles and Correspondence between ISO 9004:2009 and ISO 9001:2008. Interested parties are individuals and other entities that add value to the organization, or are otherwise interested in, or affected by, the activities of the organization.

Meeting the needs and expectations of interested parties contributes to the achievement of sustained success by the organization. In addition, the needs and expectations of individual interested parties are different, can be in conflict with those of other interested parties, or can change very quickly. The means by which the needs and expectations of interested parties are expressed and met can take a wide variety of forms, including collaboration, cooperation, negotiation, outsourcing, or by terminating an activity.

Factors that are within the control of the organization and critical to its sustained success should be subject to performance measurement and identified as key performance indicators (KPIs). The KPIs should be quantifiable and should enable the organization to set measurable objectives, identify, monitor and predict trends and take corrective, preventive and improvement actions when necessary. Top management should select KPIs as a basis for making strategic and tactical decisions. The KPIs should in turn be suitably cascaded as performance indicators at relevant functions and levels within the organization to support the achievement of top level objectives. KPIs should be appropriate to the nature and size of the organization and to its products, processes and activities.

They need to be consistent with the objectives of the organization, which should, in turn, be consistent with its strategy and policies. Specific information relating to risks and opportunities should be considered when selecting the KPIs. In selecting the KPIs, the organization should ensure that they provide information that is measurable, accurate and reliable, and usable to implement corrective actions when performance is not in conformity with objectives or to improve process efficiency and effectiveness. Such information should take into account: (i) the needs and expectations of customers and other interested parties, (ii) the importance of individual products to the organization, both at the present time and in future, (iii) the effectiveness and efficiency of processes, (iv) the effective and efficient use of resources, (v) profitability and financial performance, and (vi) statutory and regulatory requirements, where applicable.

The completion of a self-assessment should result in an action plan for improvement and/or innovation that should be used as an input to top management for planning and review, based on the elements of this International Standard. The information gained from the self-assessment could also be used to: (i) stimulate comparisons and share learning throughout the organization (the comparisons can be between the organization's processes and, where applicable, between its different units), (ii) benchmark with other organisations, (iii) monitor progress of the organization over time, by conducting periodic self-assessments, and (iv) identify and prioritise areas for improvement. During this step the organization should assign responsibilities for the chosen actions, estimate and provide the resources needed, and identify the expected benefits and any perceived risks associated with them.

4. CONCLUSIONS

ISO TC 176 working very hard last time on the new version ISO 9004:2009 and advance version ISO 9001:2015. On the last meeting, was held in February 2009, the closure of the validation programme meant that the SC2/WG18/TG 1.21 had completed its formal activities. Consequently the TG spent time in Tokyo to develop its project review report, so that SC2 can learn from its activities and improve its processes in the future for the control of design specifications and for conducting verification and validation programmes. The project review report will be circulated to SC 2 in due course. In support of the publication of ISO 9001:2008, SC2/WG18/TG 1.22 had updated the "ISO 9000 Introduction and Support Package" documents, with the assistance of ISO/TC176/SC1.

The member bodies of both SC1 and SC2 had been invited to submit comments on these documents, and the TG reviewed these before producing final versions of the texts. *Additionally, the TG focussed its attention on providing supporting documents for ISO 9004:2009. It*

continued the development of: (i) a brochure on quality for Top management, (ii) a guide on the use of the ISO 9004 Self-Assessment tool, as well as starting new projects, (iii) an ISO 9004:2009 "Implementation" guide, (iv) a "Journey to Organizational Sustained Success" guide, and (v) a "How to sell and promote ISO 9004" guide for national standards bodies.

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OUTSOURCING AS A BUSINESS TOOL

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Abstract
Outsourcing isn't a new concept. At a basic level, all businesses must determine what to build and what to buy. That decision-making process is a balancing act in which cost-effectiveness and strategic fit must be carefully assessed for every activity from the drawing board to final production and delivery. The potential benefits and risks associated with outsourcing are outlined along with the inter-organizational relationships that have been adopted as a result of the trend towards outsourcing. Active outsourcing implementation was started in the world scale when the idea of "Make or buy" became a leading part of enterprises management.

Key words: outsourcing, production management, business tool, stakeholders

1.WHAT IS OUTSOURCING?

Outsourcing is a key strategic business tool. It delivers the flexibility needed to adapt in a fast changing environment and can transform an organization's ability to create significant competitive advantage and realize its strategic ambitions. There are series of definitions of outsourcing: "acquiring a product or service rather than producing it yours"; "the contracting out of a company's non core, non revenue producing activities to specialists"; "transfer or delegation to an external service provider the operation and day-to-day management of a business process". Outsourcing as an organizational decision has the following characteristics:

- Dominating application of principles of functional theory in management.
- Presence of vendor (supplier) and customer typically in the outsourcing contract.
- Most of the outsourcing contracts are oriented to long-term period with a strategic purpose.
- It is not necessary for both parties to be close to each other in the space.
- Organizational structure in the company remains solid and regulated
- There is no existence of strong objects share between the vendor and customer.

Many authors outline a number of key developments in the business environment that have occurred including globalization, advances in information technology, reforms in the public sector and more demanding consumers. These changes have forced organizations to be more flexible and responsive to customer needs. As a result, many hierarchically controlled organizations that have previously performed the majority of business activities internally have been forced to create more network-oriented organizational structures, which involves outsourcing activities to specialist suppliers.

Outsourcing has enabled companies to concentrate on their core competencies and provide customers a greater value faster, at a lower cost and higher quality. Time to market is normally a prime consideration. By outsourcing non-core functions, companies are able to look at the broader business

issues, such as redirecting resources to develop new tools, technologies and procedures.

The outsourcing industry covers technology, design, manufacturing, test, information technology, administration, customer service, finance, human resources, real state, sales and marketing, distribution, transportation, health care and more. Although other areas are growing, IT (information technology) continues to dominate outsourcing. Key process steps in outsourcing are discussed with emphasis on the outsourcing software development supplier selection.

2. THE CONCEPT OF OUTSOURCING

Outsourcing is a drastic change that normally requires to full transformation. Particularly in offshore outsourcing, savings are normally directly proportional to percent of work performed offshore vs. onshore. Difficulties entailed in foreseeing future risks and market tendencies and risk that contract is not sufficiently flexible to adapt in future or such changes are to costly.
Manufacturing outsourcing transforms both the supply chain and the product development environment into a much more complex network of internal and extended stakeholders who need to work as one efficient and integrated team, with segregated and secured information exchanges. Product outsourcing is a form of division of labor and involves to getting done any of the stages of product development from organization which specializes in that task making it possible to concentrate on the core activities.
It differs from the traditional Division of Labor in that the division of activities is not among departments of a single organization, rather among organizations. The process of product development outsourcing is affected by a numerous of factors; major ones include Costs involved, resource planning flexibility, intellectual property rights, transfer and acquisition of knowledge and time-to-market conditions. Need for such a concept has been stemmed by the ever-increasing complexities in networks which makes it necessary for businesses to search for new ways of streamlining their operations.[1]

Outsourcing involves the sourcing of goods and services previously produced internally within the sourcing organization from external suppliers. Outsourcing can involve the transfer of an entire business function to a supplier. Alternatively, outsourcing may lead to the transfer of some activities associated with the function whilst some are kept in-house. Outsourcing can also involve the transfer of both people and physical assets to the supplier. Outsourcing is not just a straightforward financial or purchasing decision. In many cases, outsourcing is a major strategic decision that has implications for the entire organization. The evaluation and management of the outsourcing process involves a number of important elements. A starting point in the evaluation process involves analyzing whether outsourcing an activity is appropriate for the organization. This involves considering issues such as the capability of the organization in the activity relative to competitors, the importance of the activity to competitive advantage, the capability of suppliers to provide the activity, the level of risk in the supply market, potential workforce resistance and the impact upon employee morale. Where the decision to outsource has been made, a number of important issues have to be considered including supplier selection, contract negotiation and the transitioning of assets to the supplier. Significant attention should also be given to managing the relationship with the supplier to ensure that outsourcing meets its intended objectives.[2]
By considering the economic reasons for outsourcing-activities, it appears that the search for a greater degree of specialization and the ability to obtain economies of scale is the most important motive. Cost advantages guide outsourcing or make-or-buy decisions, as the production of certain components that cannot be produced cost-efficiently is contracted-out by the motor manufacturers. In respect to labor costs, outsourcing-strategies are primarily respond to fluctuations in demand, respectively in the phases of intensive production. However, another labor-cost related reason for outsourcing is that smaller companies tend to have lower labor costs due to their company organization.

3. BENEFITS OF OUTSOURCING

Organizations can benefit greatly from accessing the capabilities of suppliers in a range of areas including catering, security, design, manufacture, marketing, logistics and information technology. The benefit of outsourcing is comprised of several components: reduced costs, focusing on core business operations, and relying on experts in the field for your production needs. Organizations can benefit greatly from accessing the capabilities of suppliers in a range of areas including catering, security, design, manufacture, marketing, logistics and information technology
The benefits of outsourcing of course are variable, dependent upon the nature and situation of the

[1] Ronan McIvor, (2005), The Outsourcing Process - Strategies for Evaluation and Management, Cambridge University Press

[2] Ibid, p.12

organization. However, the following is a list of common reasons why outsourcing is undertaken:

- Lower costs due to economies of scale
- Ability to concentrate on core functions
- Greater flexibility and ability to define the requisite service more readily
- Specific supplier benefits. For example, better security, continuity, etc.
- Higher quality service due to focus of the supplier
- Improved internal management disciplines resulting from the exercise itself
- Less dependency upon internal resources
- Control of budget
- Faster setup of the function or service
- Lower ongoing investment required in internal infrastructure
- Greater ability to control delivery dates (eg: via penalty clauses)
- Lack of internal expertise
- Increase flexibility to meet changing business conditions
- Purchase of industry best practice
- Improve risk management
- Acquire innovative ideas
- Increase commitment and energy in non core areas
- Improve credibility and image by associating with superior providers
- Generate cash by transferring assets to the provider
- Gain market access and business opportunities through the supplier's network
- Turn fixed costs into variable costs [3]

What are the **problems of outsourcing**?

Cost entailed in its preparation can be substantial and time consuming: 1. of finding right supplier, 2. defining, negotiating and completing an agreement with such supplier

Costs entailed in finalizing or transferring production are very significant and require time to be amortized. Unless in cases when company does not internally produce and no transfer costs exist, cost advantages of outsourcing will generally only be compensated in the medium/long term. Thus, early termination normally results in significant losses.

Current market trends (high quality, diversity and mass customization of products) can make outsourcing a risky option for many companies:

Outsourcing may be a simple option for:

- labour intensive, highly repetitive, commodity products.
- High volume items with predictable demand

Outsourcing may not be so simple for production of other kind of products:

- May not allow small production of high-risk products to test market acceptance.
- Product variety makes it more complex (e.g. may require segmenting production) and difficult to manage.
- Adapting business to market trends requires immediacy and coordination that is hard to achieve

Costs entailed in training, coordination and supervision of outsourcing provider may significantly reduce the advantages of outsourcing. Depending on supplier:

- Risk of receive complete information that can be necessary to adopt business decisions
- Potential delays in response time to problems
- Lack of a back up if supply fails.
- Possible business culture conflicts with supplier
- Risks derived from transferring confidential information and know-how and from misuse of intellectual property.

Costs entailed by large inventory to be able to timely meet client orders

Costs and difficulties that would entail restarting production internally and terminating outsourcing may make it a one-way road.

This business model lowers life cycle costs, improves time to market, reduces capital investment, improves risk management, provides access to state-of-the-art manufacturing efficiencies, and allows companies to focus on their core business. Outsourcing allows companies to concentrate on their strengths and deploy everything else outside. In the age of *hyper-competition*, company management cannot afford to divide its attention between various partial functions and background activities while the smallest lapse in the main profile is instantaneously taken advantage of by competition. This factor is increasingly influential in decisions regarding outsourcing. However, many organizations have failed to achieve the desired benefits associated with outsourcing and experienced the consequences of outsourcing failure. Such a trend has increased the likelihood of outsourcing suffering a similar backlash to those that have followed Total Quality Management and Business Process Re-engineering.[4]

[3] Lucia Cusmano, Maria Luisa Mancusia, Andrea Morrisona, (2007), Globalization of production and innovation: How outsourcing is reshaping an advanced manufacturing area, DIME Working paper 2007.14 in the series on "Dynamics of Knowledge Accumulation, Competitiveness, Regional Cohesion and Economic Policies"

[4] Ronan McIvor, (2005), The Outsourcing Process - Strategies for Evaluation and Management, CUP

4. CONCLUSION

An effective manufacturing outsourcing process facilitates the setup, coordination, and execution of manufacturing outsourcing projects. It reinforces the use of common rules and tools, and streamlines collaboration on engineering, manufacturing and outsourcing requirements and design. Manufacturing outsourcing engages a very diverse group of stakeholders from different business entities who need to work closely together from initial design until full-scale production.

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ENTERPRISE EUROPE NETWORK – SERBIA, SUPPORT FOR BUSINESS DEVELOPMENT

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ABSTRACT

Problems connected with the utilization of R&D results within production facilities resulted in creation of IRCs. Today, network of IRCs is presented by 71 regional centres in over 33 countries, dealing in world wide technology transfer. Other problems, which have derived during the formation of EU, considering availability of information on the issues linked with the new surrounding, were solved by the creation of EICs network. Shortcoming of having no one place to get all of the needed information and support, predominantly needed by SMEs, resulted in creation of Enterprise Europe Network-EEN. Republic of Serbia decided to join that network and provide, to its own business base, the best possible support, all of which is based on the existing experience with EIC and IRC.

Key words*: EIC, IRC, EEN, business support*

INTRODUCTION

Division onto so called "white" and "blue" collars was very well noticed within industrially developed countries. The main consequence was decreased flow of scientific and technical achievements fro R&D institutions into the production, due to the unwillingness of researchers to work closely and/or within the production facilities themselves. Answer, which provided a good solution to the problem, was the establishment of Innovation Relay Centres (IRCs) [1]. Today, these centres (71 regional centres) are present in more than 33 countries (including Serbia) [2], with role of intermediary party, dealing in world wide technology transfer.

Formation of EU, made apparent other issues concerning new legislative, establishment of cooperation, new markets and regulations linked with them, financial instruments and their availability, etc. Generally, information considering new and ever changing business environment were needed. This implies especially to SMEs, which represent 99% of all legal persons in EU, generating 47% of the income [3]. The answer was founded in creation of Europe Information Centres (EICs).

Still, both networks have shoved certain shortcomings. Mainly, there was no one place to get all of the needed information and support, again predominantly needed by SMEs.

Through combination of these two networks, along with added value for the clients, with the utilization of "no wrong door" concept, a new network (Enterprise Europe Network-EEN), providing full range of the services to its clients, arose. Today, this network is constituted by over 600 members [4], whose role is to provide full support to the clients, dominantly SMEs.

BACKGROUND

Situation in Serbia, especially in the light of the proclaimed State policy of joining the EU, economic and social transition, rapid emerging of the SMEs sector, and internally generated, and even more frequently, externally imposed problems was even more severe than in the EU countries, thus, requiring even more support to the business. Official statistics, showing the distribution of SMEs and large enterprises in Serbia, by sectors, is presented in Table 1.

Main constraints and needs perceived within sectors, determined through various studies:

- Unsatisfactory competitiveness level of Serbian industry/businesses - World competitiveness list created on the basis of Global Competitiveness Index shows decline in the competitiveness of Serbian industry/businesses in period 2004-2006 (from 85th in 2005, to 87th in 2006).

Table 1: Distribution of SMEs and large enterprises in Serbia, by sectors [5]

Sectors:	**Small**	**Medium**	**Large**	**Total:**
Agriculture, hunting and forestry	3769	141	24	3934
Fishing	85	3	0	88
Mining and quarrying	259	13	9	281
Manufacturing	18098	721	288	19107
Electricity, gas and water supply	221	69	26	316
Construction	553	167	59	779
Wholesale and retail trade	38073	530	148	38751
Hotels and restaurants	1676	57	8	1741
Transport, storage and communication	5679	85	33	5797
Financial intermediation	376	5	118	499
Retail estate, renting and business activities	12575	130	34	12739
Education	1067	0	1	1068
Health and social work	376	5	0	381
Social and personal services	1941	44	6	1991
Total:	**84748**	**1970**	**754**	**87472**

Table 2: Consortium members' expertise [5]:

Partner	**Expertise**
SADSMEE	• Statistics and analysis of SMEs identifying the needs and potentials • Participation in the creation of the: development strategy for SMEs, national regulations • Building market infrastructure for the establishment and development of SMEs • Support for SMEs in the area of new technologies and to their innovation related activities (creating links between R&D, Universities and SMEs) • Promotion of entrepreneurship (Business Incubator Support Centre) • Direct support for SMEs (consulting, info, match-making, networking, facilitation of access to financing, organisation of fairs etc.) • Coordination of the Republic Network of Regional Agencies/Centres for supporting SMEs • Preparation and realisation of educational programmes for trainers and for training of entrepreneurs and SME managers
Ubg	• High-skilled academic staff/faculties (4700 employees, 31 faculties, 8 institutes) • R&D activities within different university institutes in the fields of: ICT, agro food, micro and nano-technology, biomedicine, electrical and mechanical engineering etc. • Experience in different projects, including EU FP projects, related to R&D • Formation of Business Technology Incubator (BTI) and Science Technology Park (STP), • Existence of Innovation Centre at the Faculty of Mechanical Engineering
MPI	• R&D in information and communication technologies • Complex systems engineering • Technology transfer • Business incubation
UNS	• High-skilled academic staff/faculties • R&D activities within different university institutes in the fields of: ICT, agro food, micro and nano-, and medical technology, etc. • Experience in EU projects related to R&D • High-tech Business Incubator (NOSIC), Technology Transfer Centre and Centre for Entrepreneurship, Enterprises and Management (CEEM) • High level of spin-off activity (36 spin-off companies)
UNi	• High-skilled academic staff/13 faculties • R&D activities within different university institutes in the different fields: economic research, environmental protection, mechanical technology, medical technology and research, society policy etc. • Experience in EU projects related to R&D • High-tech Business Incubator, Centre for Economic Research (including Entrepreneurship, Enterprises and Management) • High level of cooperation with regional companies by providing economic, legal and financial consulting to SMEs

Table 3: Consortium activities, by project modules [5]:

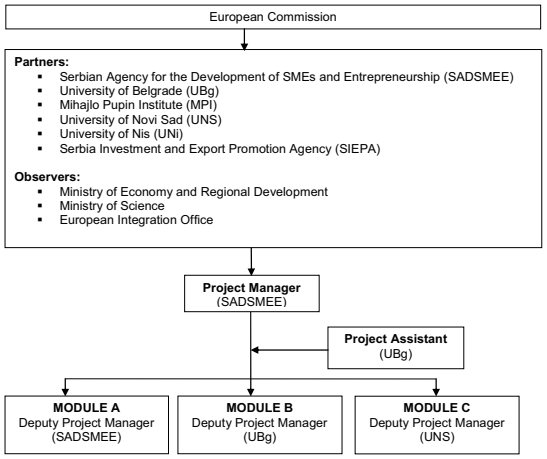
Module	Activities
A	❖ Dissemination of Information Related to the Functioning and Opportunities of the Internal Market for Goods and Services Including Signposting and Tender Opportunities ❖ Promoting Pro-Actively Community Initiatives, Policies and Programmes Relevant For SMEs and Providing Information to SMEs on the Applications Procedures for such Programmes ❖ Operating Tools to Measure the Impact of Existing Legislation on SMEs ❖ Operating IT Tool to Mange the Consortium Client's Data Questions and Answers in Order to Ensure Good Integrated Service of the Centre and Easier Reporting to the Commission ❖ Assisting SMEs to Develop Cross-Border Activities and International Networking, Signposting SMEs to Find Relevant Partners from Private or Public Sectors through Appropriate Tools
B	❖ Disseminating information and raising awareness regarding innovation–related policies, legislations and support programmes ❖ Engaging in the dissemination and exploitation of research results ❖ Providing brokerage services for technology and knowledge transfer, and for partnership building between all kinds of innovation actors ❖ Stimulating the capacity of firms, especially SMEs to innovate ❖ Facilitate linkage to other innovation services including intellectual property related services
C	❖ Raising awareness among SMEs on the Community Framework RTD Programme ❖ Identification of RTD needs of SMEs and partner search ❖ Assisting SMEs in the preparation of project proposals for the participation in the Community Framework Programme for RTD

- Lack of information on laws and regulations and non-harmonised legal procedures - Slowness in adopting new laws, large number of by-laws and administrative procedures (often not harmonised), and not completely defined and distributed to the public functions/bodies.
- Lack of accurate information on markets - Main focus of SMEs in Serbia is on the local market, though they are partly relying on foreign one(s) (more in supply than in the sales).
- Lack of standards and harmonisation with EU - Very small number of the SMEs has introduced some of the valid quality systems and other standards (HACCAP, etc.). The level of intellectual property protection is not satisfactory.
- Lack of information on modern technological solutions, innovations and relevant partners - Lack of links between the SME sector and scientific institutions (faculties, scientific institutes, associations of inventors, etc.) exists. The innovation support system lacks a number of key elements of a well-functioning mechanism such as technology transfer advisory services, product development facilities, technology training, innovation management support, R&D results commercialisation support, possibilities for financing, etc. Other barriers to an effective support system include issues related to the poor information flow and awareness about the services offered.
- Insufficient use of non-financial services – Habit, for the majority of local SMEs, of usage of certain types of non-financial services of the Republic Network and the international and non-govrnmentalorganisations is, more or less, non-existant. The needs in this area primarily relate to the support in terms of promotion of companies, linking with relevant partners, market research, education, marketing and consulting, as well as support in the field of technical and technological improvements.
- Lack of adequate sources of financing - Self-finance is dominant in all types of SMEs regardless of their size. The state incentives are relatively limited, and bank loans are very expensive and not accessible for the most of SMEs.

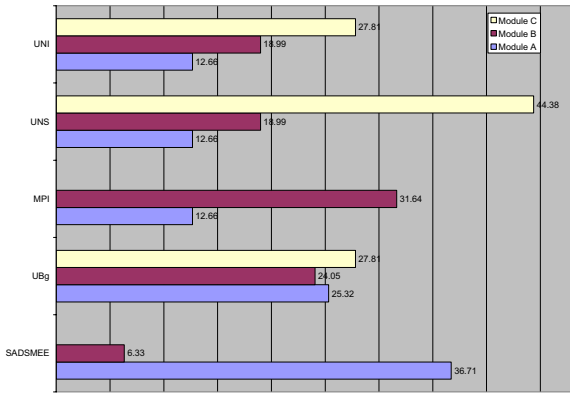
EEN – SERBIA

After formation of the Consortium, and successful submission of the project proposal (ref. ENT/CIP/07/0001a), followed by signing of the Contract with EU Commission, formation of EEN-Serbia, began. Macro organizational structure of the project is depicted on picture 1.

The work, itself, is divided into three modules (A, B and C). Generally speaking, Module A represents information dissemination (area of the EICs network), and the load it caries is appx. 47%; Module B represents technology transfer (area of IRCs) enriched with the business cooperation and caries appx 47% of the engagement; while Module C represents offer of support to clients in connection with EU programmes, such as FP and CIP, and present appx. 6% of the total project engagement. Envisaged engagement on particular module, by particular partner is depicted on picture 2.



Picture 1: Macro organizational structure for the project realization [5]



Picture 2: Envisaged engagement on particular module, by particular partner [5]

During the process of creating/writing of the project proposal, objectives (main and specific) were determined, as well as items on which special emphasis must be put on.

Project objectives

Main objective: establishment of integrated services in support of business and innovation for SMEs in Serbia, as the main client, in order to help them increase their competitiveness on EU and domestic market and the possibilities, and enhanced information access considering EU and domestic RTD possibilities.

Specific objectives:

- Raise awareness about technology transfer opportunities and increase competitiveness
- Raise awareness among SMEs regarding Community policies and opportunities
- Participate in the creation of the Europe-wide network of excellence

Special emphasis is on:

- Support to the female and young entrepreneurs
- Stronger regional cooperation in Western Balkans
- More uniformed regional development across Serbia
- Promotion of innovation culture through the SMEs
- Building capacity for applied R&D, innovation and technology transfer

Main activities to date

Since the official start of the project in Serbia, January 01, 2009, activities of the Consortium vent into two directions. First direction was defining of the micro organizational structure and defining of the work methodologies and procedures and their bringing into accord with EU Commission. Parallel with this, endeavors to promote the network were undertaken. Such actions were comprised of printing of the promotional material, participation on TV and radio shows, publishing of articles, etc. Second direction was the work with clients, either through direct approach for promotional purposes, or through particular services, such as: providing the information on EU directives, recommendations and regulations, presentation on possibilities provided by EU market, and markets of other countries included into the Project, presentation on possibilities for business cooperation establishment, providing information on the programs and funds available to SMEs, creation and posting of technology and business request and offer profiles.

CONCLUSION

Experience in developed countries has proved that, in order to facilitate the best support service to the market oriented legal entities, in the ever changing business environment, especially after the creation of EU, there must be a single place with concentrated activities where those entities, dominantly SMEs can receive the needed support. This led to the formation of EEN.

Identified problems in Serbia, with the situation even more complex than that in EU countries, suggested that it would be of advantage to join such a network. This was accomplished by the Consortium, which has begun its work with clients in Serbia.

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4th INTERNATIONAL SYMPOSIUM OF INDUSTRIAL ENGINEERING

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INDUSTRIAL ENGINEERING DEPARTMENT, FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF BELGRADE, SERBIA & STEINBEIS ADVANCED RISK TECHNOLOGIES, STUTTGART, GERMANY

OPTIMIZATION OF DECISION-MAKING PROCESS WITHIN MANUFACTURING FACILITIES

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ABSTRACT

Decision making spans over entire process of production, regardless of the system's output characteristics and product intended purpose. Consequently, mistakes committed within it, or spending of far too great time length while making a decision, will affect the entire process, thus affecting the whole system. Naturally, graveness of the repercussions will depend upon the decision-making level – the higher the level, the more serious the consequences are. Taking into account fact that, today, effective management within the existing surroundings depends upon possibility of having the information in real time, and the possibility of extracting the needed/useful information form the rest of the background, due to the present information flux, along with the necessity of transferring it into the realm of operative use, only increases the importance of optimal decision making process. This especially implies for the top level of decision making.

Key words: *algorithm, decision, management*

INTRODUCTION

In order to achieve competitiveness of the product, it is of a necessity to have at ones disposal information concerning: current and needed equipment characteristics and its maintenance methodology, which system-wise observed represents more of an "inward" approach.

Otherwise, apart from stating of existence of similar product and its price, the knowledge of manufacturing and maintenance technology, types of materials used not only on the production equipment, but, also on the product itself, etc., is important – making this approach more "outward".

Meanwhile in the certain cases, specific conditions for quality and/or functions, which the product must fulfill, ways of manufacturing and exploitation, may be dictated by the surrounding, or, even, by the law obligations.

All of this directly affects the decision-making process.

DECISION-MAKING ALGORITHMS [1]

Any product represents a final system output, thus making a product technology dependant.

According to general methodological systematic approach, utilization and full operative usage, of the technology, in practice, implies:

1. Defining, in clear manor, of the problem, deriving from the information on what, within the existing system, can be improved process-wise, and represents the feed back form the production and/or maintenance function. Within this approach, focus is being concentrated on the processing equipment, and the idea is improvement of the technology for production of existing products.

   Other approach is one which puts surrounding into focus, i.e. the requests it imposes, thus putting the technology in first plain, since it is necessary to determine by which technology is possible to produce the product with required characteristics, while the process being economically sound.

   Defining of technical and technological demands and conditions, as well as the quality conditions, which developed solution must satisfy, presents the specific and most complicated part of solution defining process.

2. Realization of development and starting use of the solution, which implies:
   - Forming of the team which will execute the analysis of technical and technological level,

known/implemented solutions and existing experiences within the designated area.

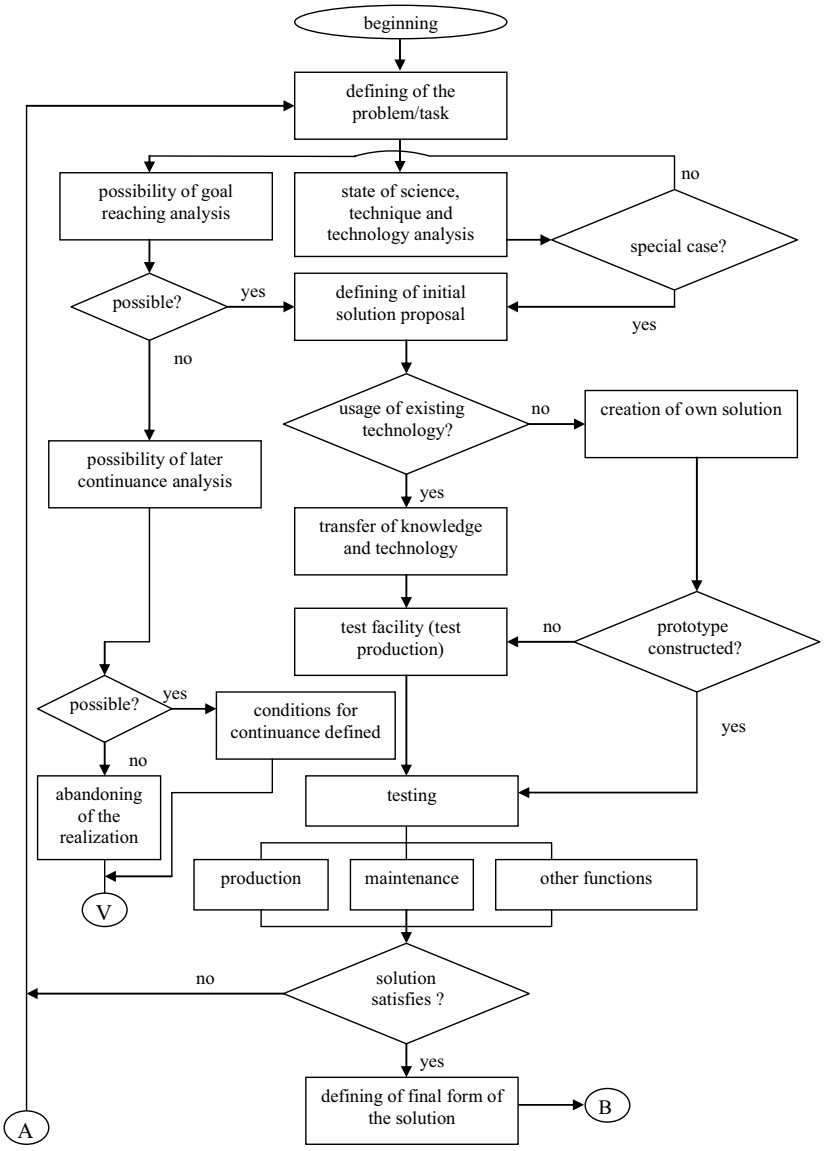
- Creation of proposal for solution, based on the executed analysis, which can be:

1) implementation of existing technology – transfer of knowledge and/or technology, with provision of services offered by specialized companies (accompanied with making of techno-economic and feasibility studies), including the engagement of own recourses in all of the phases, or
2) proposition to embark the development of own solution, with own recourses, or through cooperation with other interested parties, followed by defining of idea-level solution, also accompanied with making of techno-economic and feasibility studies.

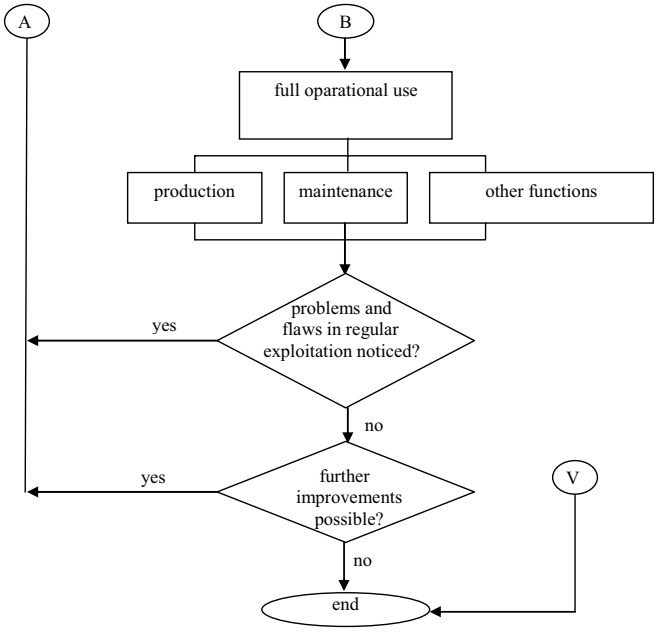
3. Construction of prototype or test-facility and/or introduction into trial use, accompanied with necessary testing - laboratory and other wise, with the correction of noticed flaws, all of which leads toward determination of final form of the solution.

4. Introduction into practical use, accompanied by manufacturing of necessary documentation in written form, informational logistics, etc.

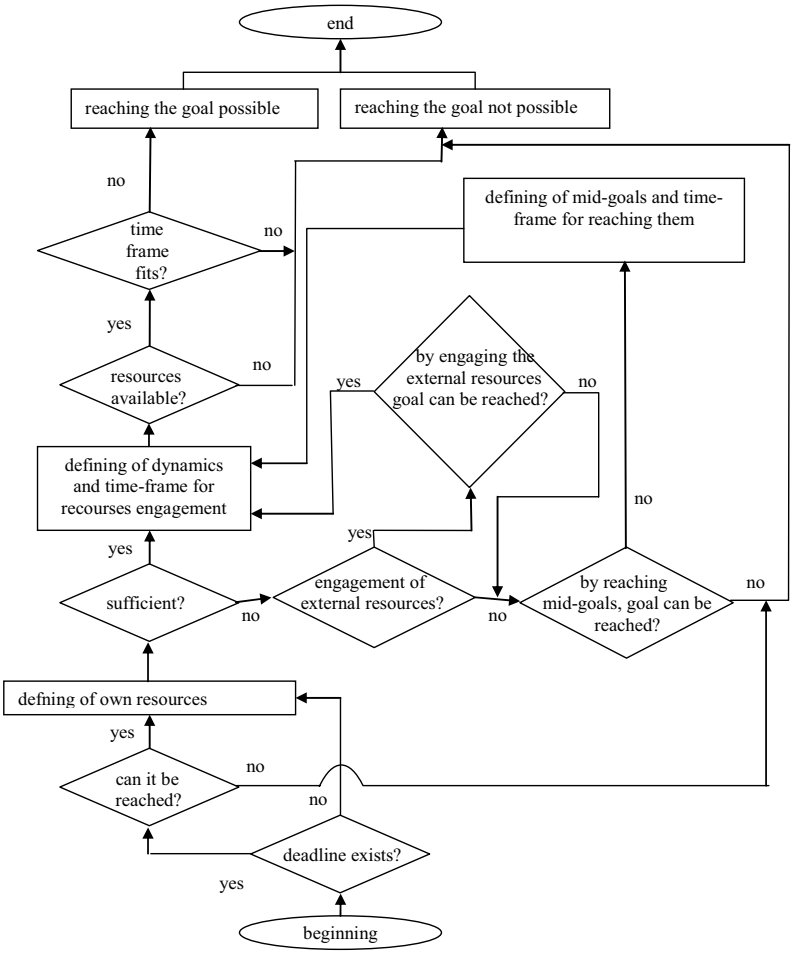
5. Further improvements.



Picture 1: Algorithm of technology practical and full operative use, with assessment of possibility of goal reaching by the parameters of availability and time-frame (first part) [1]



Picture 2: Algorithm of technology practical and full operative use, with assessment of possibility of goal reaching by the parameters of availability and time-frame (continued) [1]



Picture 3: Algorithm of assessment of possibility of goal reaching by the parameters of availability and time-frame [1]

Described methodological systematic approach corresponds with the diagram depicted on Pictures 1 and 2, in cases of existence of special case (question shown on the upper right-side corner of the Pic. 1).

Special cases become apparent in the case of limiting factors absence. Operation-wise, certain limitations can be present by the existence of different parameters: presence of time-frame limitation, i.e. deadline, as well as availability of materials, technical and human resources, which means that for majority of operational and practical researches, for any given system, limiting factors of time and resources, must be taken into account, since it can arise in any phase of research, development and operative use, and thus create significant obstacles, or, even, lead to abandoning of the research. Still, there are some cases when limitations presence can be neglected, depicting the cases when algorithm presented on Pic. 1 and 2 becomes algorithm of technology practical and full operative use:

1) For new systems - founding of the system occurs only after, based on the analysis of the level of science, technique and technology, starting solution, offering the most chance for success, is being defined
2) For the existing systems
   2.1. completion of analysis and knowledge on state-of-the-art within the areas of science, technique and technology, in line with the area of engagement, shows a strong presence of indicators for successful completion
   2.2. system is positioned as leader, which, in combination with own recourses that have to be considerable, can lead towards unique position on the market
   2.3. existence of the strategic decision, whose character can exceed boundaries of one state.

Mentioned cases represent boundary conditions for utilization of depicted algorithm, when limitations can be neglected.

In all other cases, presence of the limiting factors must be taken into account. On the Picture 3 algorithm of assessment of possibility of goal reaching by the parameters of availability and time-frame [1] is presented. In this case as limiting factors parameters of resource availability and time-frame are identified. This does not mean that other factors can not be taken into account, especially if the limitation that have occurred by some other parameter, bears a direct influence on time-frame. Good example is the area of energy input and consumption, for example utilization of renewable energy sources (RES) [2], especially in the light of different EU directives [3, 4] concerning with the matter. But other restrictions, limitations and/or desired parameters [5] can be included into analysis, as well.

The analysis, whose algorithm is depicted on the Picture 3, does not represent a stand-alone phase (although it can be used in that manor), but set of between-phase activities, conducted between the analysis of science, technique and technology, and defining of initial solution.

CONCLUSION

In order to obtain a product of market oriented characteristics, and successfully implement, in full operative use, of technologies/equipment, accompanied with management of good quality, and all of it spreading from idea, over R&D up to full operative use, along with constant improvements, decision-making process is of importance. Without good decision-making process there is no management of good quality, thus leading to lack in needed results. Within this paper, strategic level algorithms are presented, which enable optimization of decision-making process, while taking into account limiting factors: time-frame, over to availability of recourses up to ecology. Behind it lies a span of phases and activities corresponding to each element of the algorithms.

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FORMATION OF INNOVATION RELAY CENTRE - SERBIA, CONSTITUTIVE PART OF BUSINESS LOGISTICS

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ABSTRACT

Division onto so called "white" and "blue" collars created problems connected with the utilization of R&D results within production facilities resulted in creation of IRCs. Today, network of IRCs is presented by 71 regional centres in over 33 countries, dealing in world wide technology transfer. While conducting the activities on different State financed projects, similar problems in Serbia, as they were identified in EU, have been identified. Thus, as a solution for problems considering technology transfer, it was decided to implement existing, well proved solutions, adapted to domestic surrounding, and, at the same time, exchangeable with EU, resulting in innovation project, whose main task was establishment of IRC Serbia. Realization of the project led towards expected results, but, in the same time, facilitated the opportunity for Serbia to join other networks and become a constitutive member of Enterprise Europe Network.

Key words*: IRC, business support, SME*

INTRODUCTION

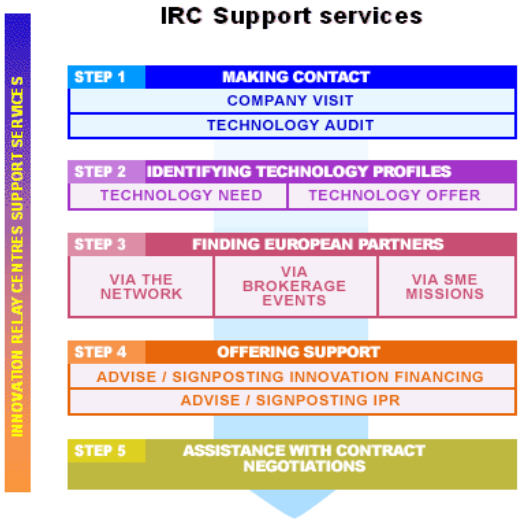
Division onto so called "white" and "blue" collars was very well noticed within industrially developed countries. The main consequence was decreased flow of scientific and technical achievements fro R&D institutions into the production, due to the unwillingness of researchers to work closely and/or within the production facilities themselves. Answer, which provided a good solution to the problem, was the establishment of Innovation Relay Centres (IRCs) [1].

The mission [2] of the IRCs is to support innovation and transnational technological co-operation in Europe with a range of specialised business support services. IRC services are primarily targeted at technology-oriented small and medium-sized enterprises (SMEs), but are also available to large companies, research institutes, universities, technology centres and innovation agencies.

The first Innovation Relay Centres were established in 1995 with the support of the European Commission. The aim was to create a pan-European platform to stimulate transnational technology transfer and promote innovation services.

Today, 71 regional IRCs span 33 countries - 27 EU Member States, Iceland, Israel, Norway, Switzerland, Turkey and Chile, while available data, for the period 1995-2000 [2], depicts the engagement: assistance in over 12,500 technology transfer negotiations; helped more than 55,000 client companies to meet their technology needs and to exploit their research results; have facilitated more than 1000 transnational transfers of technology - signed agreements for the sale, licensing, distribution or joint development of new technologies; more than 1000 employees (year 2000); almost 220 partner organisations (Chambers of Commerce, Regional Development Agencies and university Technology Centres). IRC network also have cooperation with other networks, such as: CORDIS, EBAN, ESA, EUREKA, IPR-Helpdesk, IRE, ProTon Europe, etc.

Methodology of IRCs work is depicted in Picture 1, with the main forms being Technology Offer (TO) and Technology Transfer (TT), which, after preparing, are being posted and exchanged between the network members.



Picture 1: Methodology of IRCs work

BACKGROUND

Through the realization of the activities: on the preparation of National Strategy of Innovations and within the project "Feasibility study for the founding of scientific-technological parks in Serbia", no. TR-7026A, financed by the Ministry of Science and Environmental Protection, the following was identified [3]:

1) Building of infrastructure for innovations, in Serbia, is at the very beginning, and that there are a small number of organizations within it: few incubators and scientific-technological parks (NTPs), with constituted Business-Technology Incubator of Technical Faculties of Belgrade University.
2) Restructuring of Serbian economy along with the transition towards market economy implies the necessity of more innovative oriented company behaviour. Lack of knowledge on available technologies, as well as the knowledge on mechanisms for market realization of own technologies, is present.
3) Lack of knowledge on how innovative system in of one economy functions, along with its mechanisms is widely spread. Non existence of appropriate infrastructure with the role of supporting the innovative system and its functioning is one of the major constraints in further development.
4) Especially difficult situation is within the sector of SMEs, which do not possess personal, material and financial resources to develop and/or obtain the technologies needed for further improvements.

All of these reasons created a need for implementation of proven solutions, which led to the Innovation project "Development of the infrastructure for Innovation Relay Centre in Serbia", which was approved and being financed to date by Ministry for Science and Technological Development.

BASIC ELEMENTS OF THE PROJECT [3]

Object of the project is being the creation of infrastructure for offer and demand of technologies and innovations.

Main objective: Creation of infrastructure for offer and demand of technologies and innovations, as an important segment of innovation infrastructure, as well as promotion of the culture of entrepreneurship and innovation activities within the Serbia's society and economy, all of that as a constitutive part of realization of the National strategy of building of national innovative system, with simultaneously inclusion in the IRCs network in EU, allowing direct exchange of technology and innovation requests and offers with more than 33 network country members.

Specific objectives:

- Formation of IRC Serbia, through gathering around Innovation Centre of Faculty of Mechanical Engineering (ICMF), of interested domestic partners, along with signing of Consortium Agreement with chosen partners.
- Creation of data bases on national innovative resources and results of innovation work.
- Promotion and offering of technological solutions and innovations of domestic R&D institutions and individuals, in Serbia and abroad – through the IRC network in EU
- Infrastructural support to technological development of SMEs within the process of choosing the necessary technologies for their field of engagement, as well as promotion of their own technological solutions and innovations, on domestic and foreign markets through the IRC network in EU.

Through the realization of the project, the following was and is being set up:

- Part of the missing infrastructure within the economy of Serbia
- Process of learning and knowledge transfer on innovation activities in the economy of Serbia
- Mechanisms for providing help to SMEs in the organization of their technological development
- The project itself represented the condition for joining the IRC network in EU

Importance of the project can be summarized, as follows, for:

1. SMEs in Serbia, especially ones based on high technologies – they have organized approach to information on technologies available domestically and abroad and channel of communication for promotion of their own solutions,

2. registered innovative organizations – main advantage for them is the existence of defined procedure for presentation of results their innovative work to potential clients, domestic or foreign,
3. organizations/companies dealing in provision of infrastructural support – form them, direct access to available technological solutions is facilitated,
4. innovation centres – the main advantages are the same as for SMEs, with the addition of them being, in the same time, the source, users and evaluators of all contents of activities and services developed and offered by IRC Serbia,
5. business-technological incubators – the service of major importance that IRC can offer to this kind of establishments is the preparation for commercialization of developed technologies, whit whose characteristics are being recorded within data bases of IRC,
6. scientific-technological parks – besides the incubation, the more complex phase of additional development, commercialization and diffusion of technologies is facilitated through the usage of services offered by IRC and its channels,
7. scientific-research (S&R) and R&D organizations, including the organizations dealing in high education – help and support in the process of commercialization of already developed technological solutions, guidance of S&R and R&D sector towards user-oriented development, is being offered to these organizations,
8. researchers and teaching personal, as well as individuals-innovators and entrepreneurs- main benefits for this segment of the population can be drown from promotion of entrepreneurial skills and knowledge and through the increase of commercialization of results in connection to R&D,
9. registered innovators, as individuals – provision of help in rational approach to IP and utilization commercial potentials of their innovative work is being offered to them, while they are being supported in every connecting segment,
10. institutions in charge of guidance of innovation system of Serbia development – those institutions have insight in Serbia's real innovative potentials, development concepts and capacities, and into competitive capacities of domestic R&D sector for presence on the international market of technologies and innovations, in real time.

RESULTS OF THE PROJECT – PERIOD: NOVEMBER, 2008-APRIL, 2009 [4]

The easiest part was obtaining of the necessary equipment. But, in order to be able to benefit from the experience of others, transfer of that experience was needed. For that reason certain study and working visits have been undertaken, in Brussels, Istanbul and Norway. During that visits main does and don'ts have been aquatinted with, along with the best practices of conducting the work with clients. This was a direct result of establishment of contacts with IRCs located in different countries and cities outside of Serbia.

Since the work methodology of existing IRCs have been adopted, due to their efficiency, certain results, in connection to the steps within afore mentioned methodology, have, also, been made, as follows:

- Step 1: Making contact – company visit / technology audit – during 2008 and the beginning of 2009, procedures have been determined and formalized within developed set of forms. Since it was of the necessity for these forms to be unified with forms utilized within the existing IRCs network, two sets have been developed: one in English which could be exchanged through the IRCs network channels, and one in Serbian which could be used during company visits. The main obstacle was the list of numbers depicting the area of engagement of the firm, since these numbers did not match domestic nomenclature. It was decided to keep the English version of that list since this data is inputted by the IRC Serbia staff, anyway. The rest of the period was dedicated to visits themselves, conduction of audits and creation of company profiles, including technology offer/request (more than 5 have been created).
- Step 2: Identifying technology profiles – technology need / technology offer – the same as for Step 1 implies.
- Step 3: Finding European partners – via the network / via brokerage events / via SME missions – the first two items did not produce relevant result within afore mentioned period. Through the third mechanism two results have been achieved: firstly there was a successful transfer of knowledge (so called TTT Agreement) from principal partner of the Consortium towards a subsidary of foreign company in Serbia, and secondly a successful contact between private company in Serbia and EU partner have been established, with on-going negotiations.
- Step 4: Offering support – advise/signposting innovation financing / advise/signposting IPR – all of the companies mentioned within the description of Step 1 have attended the organized events devoted to dissemination of knowledge considering financing schemes and IPR, within afore mentioned period.
- Step 5: Assistance with contract negotiations – step is being defined by every particular situation. On-going assistance is being provided to a

company mentioned within the description of Step 3, while principal partner in the Consortium utilized the knowledge possessed within it, during the negotiations considering the mentioned TTT Agreement, leading to successful foreclosure.

Important result achieved in mentioned period was completion of the test version of informational system, with all of the constitutive elements.

Indirect result of the project, which is of great importance, was becoming a constitutive member of the Enterprise Europe Network, which was established on the broader base than IRCs network, providing full range of service to its clients, through combination of IRCs and EICs network, with the addition of full business support (IRCs main consideration is technology transfer, while EICs main activity is dissemination of information.

CONCLUSION

Experience in developed countries has proved that, in order to facilitate the best support for technology transfer service to the market oriented legal entities, in the ever changing business environment there must be a place with concentrated activities where those entities, dominantly SMEs can receive the needed support. This led to the formation of IRCs network.

Identified problems in Serbia, with the situation even more complex than that in EU countries, suggested that it would be of advantage to join such a network, adopting and adapting the procedures, which could allow work in domestic environment and, still, keep the quality of exchangeability. This was accomplished by the Consortium, which has begun its work with clients in Serbia, and partners of foreign origin.

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ANALYSIS OF THE IMPACT OF TIME AND MAINTENANCE STRATEGY ON AVAILABILITY OF COMPLEX TECHNICAL SYSTEM

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Abstract: *The paper considers reliability and availability of technical systems and highlights the fact that maintenance strategy based on "constant durability" is more favourable than maintenance strategy based on "constant date". Time analysis was carried out and basic expressions for operative and total availability are given. Reliability diagrams, failure intensity, and maintenance costs are presented.*
Key words: *preventive maintenance, reliability, availability, costs, time, strategy.*

1. INTRODUCTION

The results of the research on availability of complex technical systems are not sufficiently known yet. Bearing that in mind, and taking into account that availability can be presented in the percentage of the time of correct functioning of the system, or as a probability that at a point of time the system is operative, a study of a number of technical systems in iron and steel industry was carried out. As a motive of research it can be mentioned that availability also depends on strategy of preventive maintenance. The results of the research are obtained in conditions of real exploitation of technical systems (results for Aglo-machine are presented here), whose reliability have impact on the production which is worth around 10,000,000,00 RSD (Serbian Dinars) (about 107,000 EUR) a day.

2. EXPLANATION OF TERMS MALFUNCTION AND PROBABILITY OF OCCURRENCE OF MALFUNCTION

The aim of maintenance is to provide functionality of technical systems. We should try to keep the systems and their functionality, and not only operational aspect used by operators. Redundancy improves functional reliability but also increases the costs of life cycle in the sense of preparations and keeping the level of work of technical systems.

Types of malfunctions are specific malfunctions of equipment which result in functional malfunction of a system and/or a subsystem. Dominant types of system malfunction are those which are responsible for importance of proportion of all malfunctions within them. Not all the types or causes of malfunctions justify preventive maintenance or maintenance according to the condition due to low probability rate in their appearance and their inconsistent effect. For addressing technical content, analysts and planners have to establish if the existing maintenance activities cover all identified potential types of malfunctions and result in desired/expected levels of reliability. Type of malfunction must be envisaged or the existing maintenance activities will not be effective in identifying type of malfunction. Later, it can result in incorrect identification in distribution of fundamental probability in malfunction of function. A lot of information can be proved or upgraded through reliability checks.

Reliability can be presented as probability of a unit to function successfully in a defined operational period under specific operational conditions, without malfunctions, which is usually expressed as a life cycle, period until malfunction, or period between two malfunctions. Conditional probability in appearance of malfunction measures probability of a unit with defined operational period of work without occurrence of "state of malfunction" which will eventually lead to malfunction within the interval. If the conditional probability of occurrence of malfunction increases with time elapsed, technical system will show characteristics of wearing out. Level or frequency of malfunction is relatively insignificant for maintenance program, being too simple to be measured. Frequency of malfunctions is useful for the process of decision making regarding expenses, as well as for establishing maintenance intervals, but gives us no information on what maintenance activities are suitable or which, on the other hand, will be a consequence, i.e. result of malfunction. Solutions regarding malfunctions

should be estimated within sphere of safety and economic consequences which we want to prevent. Maintenance activities must be applicable, with the aim of their efficiency.

In table 1. a possible method of quantifying probability of malfunction is presented. In case historical data is available, »powerful« tool for establishing rank can be provided. In case historical data is not available, ranking can be estimated based on experience with similar systems within a company.

Contemporary maintenance methods are focused on a whole technical system. They are meant more for maintenance of functionality of whole system than functionality of its components. Reliability is the base for making decision. Characteristics of malfunction of technical systems must be understood in order to establish efficiency of preventive maintenance. For successful realization it is necessary to constantly search for knowledge of conditional probability in occurrence of malfunction in specific time period (possibility that malfunction will occur in every supposed operational period).

We should always consider safety first, and then economic reasons. Safety must always be preserved. When safety is out of question, preventive maintenance must be based on economic reasons.

Table 1. Categories of probability in occurrence of malfunction

Rank	Effect	Description
1.	1/10000	Small probability of occurrence of malfunction, i.e. it would be unreasonable to expect it
2.	1/5000	Low probability of occurrence of malfunction, similar to previous plans in the past which had low level of occurrence of malfunction for given volume / load
3.	1/2000	Low probability of occurrence of malfunction, similar to previous plans in the past which had low level of occurrence of malfunction for given volume / load
4.	1/1000	Accidental occurrence of malfunction, similar to previous plans in the past which had low level of occurrence of malfunction for given volume / load
5.	1/500	Medium probability of occurrence of malfunction, similar to previous plans in the past which had low level of occurrence of malfunction for given volume / load
6.	1/200	Medium – high probability of occurrence of malfunction, similar to previous plans in the past which had low level of occurrence of malfunction for given volume / load
7.	1/100	High probability of occurrence of malfunction, similar to previous plans in the past which had high level of occurrence of problems
8.	1/50	High probability of occurrence of malfunction, similar to previous plans in the past which had high level of occurrence of problems
9.	1/20	Very high probability of occurrence of malfunction, almost certain to cause a problem
10.	1/10	Very high probability of occurrence of malfunction, almost certain to cause a problem

3. DEPENDENCE OF OPERATIVE AND TOTAL AVAILABILITY ON TIME

Availability of technical system in a general case can be presented by time relationship:

$$A = \frac{T_{ot}}{T_{or} + T_z} \qquad (1)$$

where: T_{or} – average time at work,
T_z – average time in failure.

It can be said that availability is in direct correlation with the exploitation capacity of a technical system, excluding the causes of failure (breakdown). In a general case, availability includes:

- proper availability A_V,
- operative availability A_{OP}, and
- total availability A_U.

The same can be calculated by applying the following patterns:

$$A_V = \frac{T_{oz}}{T_{oz} + T_{pog}}, \qquad (2)$$

$$A_{op} = \frac{T_{op}}{T_{op} + T_{po}}, \qquad (3)$$

$$A_u = \frac{T_{op}}{T_{op} + T_{pov}}, \qquad (4)$$

where: T_{oz} – average time between the failures,
T_{po} – average technical time of duration of repair after a failure,
T_{op} – average time between two consecutive maintenance interventions,
T_{pog} – average technical time of duration of repairs after failures, and

T_{pov} – average time of duration of repairs including the stand-by time.

In this paper, the time when preventive maintenance intervention should be performed, is the time when the total maintenance costs (RSD/hour) are minimal. Account was also taken of reliability magnitudes $R(T)$ and failure intensity $\lambda(T)$ in the process. The highest operative and total availability for the minimal maintenance costs (RSD/hour) can be calculated:

- for preventive maintenance based "on constant date" (D) (the elements are replaced at pre-set moments of time, regardless of the 'age' of elements):

$$A_{OP_D} = \frac{T\left(C_{D_{\min}}\right)}{T\left(C_{D_{\min}}\right) + T_{pog} + H_m + T_{pop}}, \qquad (5)$$

$$A_{U_D} = \frac{T\left(C_{D_{\min}}\right)}{T\left(C_{D_{\min}}\right) + T_{pov}(g) \cdot H_m + T_{pov}(p)}, \quad (6)$$

where: $T(C_{Dmin})$ – the period of work when total maintenance costs are minimal,

T_{pop} – average technical time of duration of repairs for operations of preventive maintenance,

$T_{pov}(g)$ – average time of repairs, including the stand-by time (repair after a failure),

$T_{pov}(p)$ – average time of stand-by (repair in a preventive intervention),

H_m – restoring function (average number of restoring),

- for preventive maintenance based on "constant durability" (T) (elements are replaced when they reach a certain life):

$$A_{OP_T} = \frac{T_{op}\left(C_{T_{\min}}\right)}{T_{op}\left(C_{T_{\min}}\right) + T_{pog} \cdot F(T) + T_{pop} \cdot R(T)}, \qquad (7)$$

$$A_{U_T} = \frac{T_{op}\left(C_{T_{\min}}\right)}{T_{op}\left(C_{T_{\min}}\right) + T_{pov}(g) \cdot F(T) + T_{pov}(p) \cdot R(T)}, \quad (8)$$

where: T_{op} (C_{Tmin}) – average time between two consecutive maintenance interventions for the period of work
when total maintenance costs are minimal,

$F(T)$ – distribution function,

$R(T)$ – reliability function $[R(T) = 1-F(T)]$.

The quoted patterns (5),(6), and (8) can be used for calculating the availability for any time period of work, and also for some current system availabilities $A^*_{op_D}$ and $A^*_{op_T}$ average time of duration of repair (system restoring time T_{pop}) can also be calculated. If the expressions are minimized:

$$\frac{T_{pog}}{T(C_D)} \cdot H_m + \frac{T_{pop}}{T(C_D)} = m_1 \quad \text{and} \qquad (9)$$

$$\frac{T_{pog}}{T_{op}(C_T)} \cdot F(T) + \frac{T_{pop}}{T_{op}(C_T)} \cdot R(T) = m_2 \qquad (10)$$

then the maximum availability can be obtained, which is, in fact, the basic aim. By applying the relations (9), and (10), the following is obtained:

$$T_{pop}(D) = \left(\frac{1}{A^*_{op_D}} - 1\right) \cdot T(C_D) - T_{pog}(D), \qquad (11)$$

$$T_{pop}(T) = \frac{T_{op}(C_T) \cdot \left(\frac{1}{A^*_{op_T}} - 1\right) - T_{pog}(T) \cdot F(T)}{R(T)}. \quad (12)$$

4. RESULT AND DATA PROCESSING

The data on performance of the technical system are obtained from the "Report on system performance" and refer to the time period of system work between two average repairs. In order to enable defining of appropriate conclusions on possibilities of increasing the availability by organizing maintenance actions in real conditions of exploitation on the basis of all the recorded data, the obtained data are arranged in a new way, as shown in Table 1 and Table 2.

Time period (T) of occurrence of a failure has been chosen in the time interval of 100 hours, considering the periodicity of maintenance teams' work in shifts. In other words, it turned out that the occurrence of failures in particular time intervals also depends on the makeup of the workgroups – maintenance teams.

By χ-square test, the hypothesis of normal (Gauss) distribution of probability of failure was verified. It was also determined that average time between failure (failure-free operation) has a normal distribution which facilitated calculating the restoration function (H_m). Maintenance cost estimate was performed for one preventive intervention, for both preventive maintenance based on "Constant durability", and "constant
date", taking into account total costs for failure elimination (C_g) and for preventive intervention (C_p) as follows:

$$C_D = \frac{C_g \cdot H_m + C_p}{T}, \qquad (13)$$

$$C_T = \frac{C_g \cdot F(T) + C_p \cdot R(T)}{T_{op}}. \qquad (14)$$

Maintenance costs were calculated by applying the relations (13) and (14), and are shown in Table 2. From Table 2 and Figure 2, it can be seen that the minimal maintenance costs (187,93 RSD/hour) are for the operation time of 2,000 hours, and it is for maintenance strategy based on "constant durability". For this period of time, the highest operative and total availabilities can also be calculated by applying the patterns (5), (6), (7), and (8):

$$A_{op_D} = \frac{2000}{2000 + 1{,}72 \cdot 8{,}211 + 68} = 0{,}96066\,, \qquad A_{op_T} = \frac{1264{,}2}{1264{,}2 + 1{,}72 \cdot 0{,}853 + 68 \cdot 0{,}147} = 0{,}9910\,,$$

$$A_{U_D} = \frac{2000}{2000 + 1{,}76 \cdot 8{,}211 + 72} = 0{,}95856\,, \qquad A_{U_T} = \frac{1264{,}2}{1264{,}2 + 1{,}76 \cdot 0{,}853 + 72 \cdot 0{,}147} = 0{,}9505\,.$$

TABLE 1

Ordinal No.	Period T(h)	Number of failures (N_i)	Probability of failure occurrence ($f=N_i/\Sigma N_i$)	Unreliability ($F=\Sigma f$)	Reliability ($R=1-F$)	Failure intensity $\lambda=f/R$	Average number of restoring ($Hm=\Sigma F$)	Average duration time of repair (T_{PO} /h/)
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1	100	6	0,046	0,046	0,954	0,048	0,046	5,580
2	200	3	0,023	0,069	0,931	0,024	0,115	11,110
3	300	5	0,038	0,107	0,893	0,042	0,222	27,275
4	400	1	0,007	0,114	0,886	0,007	0,336	27,395
5	500	7	0,053	0,167	0,883	0,063	0,503	32,015
6	600	4	0,030	0,197	0,803	0,037	0,700	32655
7	700	6	0,046	0,243	0,757	0,060	0,943	35,845
8	800	4	0,030	0,273	0,727	0,041	1,216	40,835
9	900	9	0,069	0,342	0,658	0,104	1,558	53,705
10	1000	6	0,046	0,388	0,612	0,075	1,946	55,165
11	1100	5	0,038	0,426	0,574	0,066	2,372	56,875
12	1200	5	0,038	0,464	0,536	0,070	2,836	61,095
13	1300	9	0,069	0,533	0,467	0,147	3,369	64,135
14	1400	5	0,038	0,571	0,429	0,088	3,940	67,435
15	1500	3	0,023	0,594	0,406	0,056	4,534	67,915
16	1600	7	0,053	0,647	0,535	0,150	5,181	77,715
17	1700	4	0,030	0,677	0,323	0,092	5,858	78,605
18	1800	3	0,023	0,700	0,300	0,076	6,558	79,085
19	1900	13	0,100	0,800	0,200	0,500	7,358	84,205
20	2000	7	0,053	0,853	0,147	0,036	8,211	85,965
21	2100	10	0,076	0,929	0,071	1,070	9,140	89,295
22	2200	8	0,061	1,000	0,000	2,070	10,140	95,255

TABLE 2

Ordinal No.	Maintenance costs with "constant date": Expenses caused by the occurrence of a failure Cq·Hm /RSD/	Maintenance costs with "constant date": Total maintena-nce costs C_D /RSD/h/	Maintenance costs with "constant durability": Average time between two maintenance interventions Top /h/	Costs caused by the occurrence of a failure Cg·F /RSD/	Costs caused by reventive interventions Cp·R(T)	Total maintena-nce costs C_T / RSD/h /
1	*10*	*11*	*12*	*13*	*14*	*15*
1	1485,56	10148,51	100,0	14851	954000	9688,51
2	43971,991	5219,85	195,4	26,385	931000	4899,61
3	213120,00	4043,73	288,5	102720	893000	3451,36
4	3282,45	3682,46	377,8	114	886000	2348,10
5	120720	2241,44	466,4	40080	833000	1871,95
6	27222,21	1712,03	549,7	7661	803000	1474,73
7	23195,82	1461,70	630,0	5977	757000	1211,07
8	364070,4	1705,088	705,7	81736	727000	1146,00
9	1165955,3	2406,6	778,4	255943	658000	1174,13
10	174111	1174,11	844,2	34764	612000	766,12
11	184289	1076,62	905,4	33102	574000	670,53
12	722366	1435,30	962,8	118190	536000	643,53
13	625346	1250,26	1016,4	98174	467000	566,05
14	785383	1275,27	1061,1	113824	429000	510,60
15	131571	754,38	1106,0	17239	406000	382,67
16	3106535	2566,58	1146,6	387943	353000	646,20
17	315160	773,62	1181,9	36469	323000	304,14
18	190274	661,26	1214,2	20315	300000	263,80
19	3115504	2166,05	1244,0	338736	200000	433,06
20	872039	936,01	1264,2	90592	147000	187,93
21	17449797	1307,13	1278,13	177361	710000	194,19
22	3431309	2014,23	1285,0	33894	0	263,34

It is obvious that higher availability values are obtained for the maintenance strategy based on "constant durability" than for the maintenance strategy based on "constant date", which confirms again the fact that for the observed technical system, the most acceptable maintenance strategy is the one based on "constant durability". The results arouse special interest, because the exclusive maintenance strategy based on "constant date" has been applied to the technical system (Aglo-machine) until now.

By applying Table 1 and Figure 1, it can be noticed that the failure intensity $\lambda(T)$ begins to rise sharply after 1,800 hours of work, and thus the system should be covered and maintenance preventive action should be carried out. However, as maintenance costs for this period of time are higher that the costs for the period of time of 2,000 hours, the preventive activity is therefore delayed until the 2,000-th hour of work.

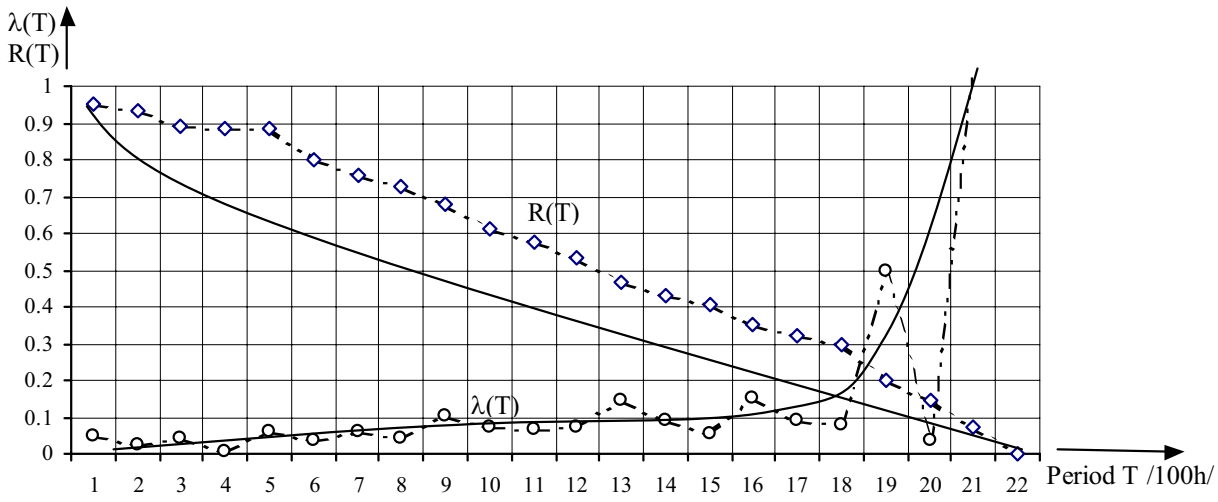

Figure 1. Diagram of Failure Intensity λ and Reliability R in the period of six months

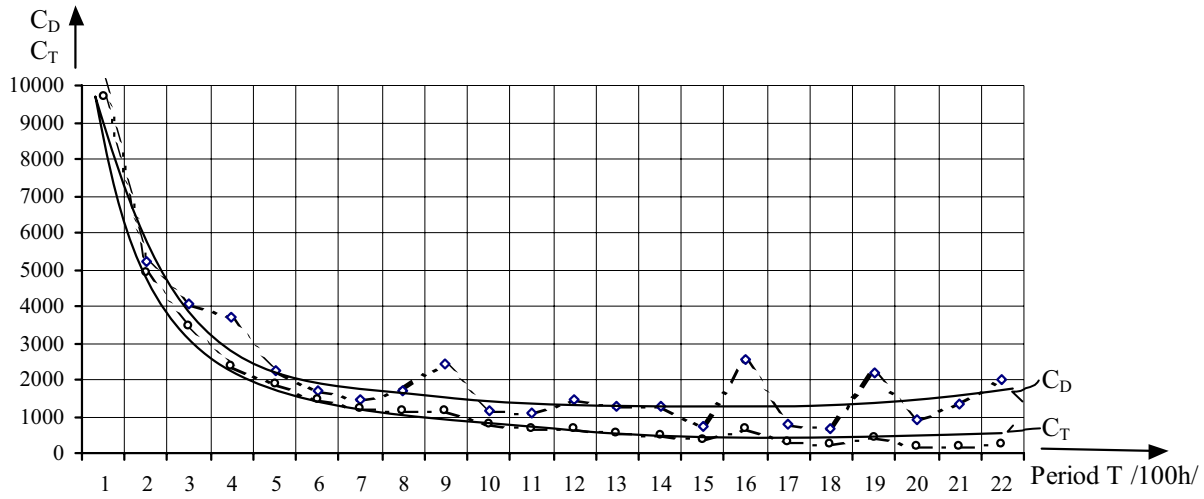

Figure 2. Diagram of costs of preventive maintenance based on constant date (C_D) and constant durability (C_T) for six months

5. CONCLUSION

It is common to estimate the state of a technical system each time when preventive maintenance is carried out. After realization of certain number of actions in preventive maintenance and recording them for each technical system, sufficient quantity of information will be available for establishing whether a technical system should be exposed to more or less frequent maintenance actions, and how frequently preventive maintenance should be carried out.

The research results provide the following conclusions:

1. The better preventive maintenance is, the better availability. The difference between operative and total availability gives the impact of preparation time for failure elimination.
2. However, total availability is lower than the operative one if maintenance organization is improved, and it is possible for total availability to come closer to the operative one in value. The ultimate goal should be operative availability.
3. The applied method of obtaining availability and total maintenance costs is suitable for maintenance planning. Detailed comments of all the results have not been given in the analysis of the given example, since the stress has been laid on defining availability, and the objective was to indicate to a possible way of calculating the availability of a complex technical system.

Optimizing available technical resources of a company with minimal expenses is a fundamental principle of contemporary business management. It is explained as a way of obtaining maximum time of flawless work and achieving value of every technical system. By applying the right form of maintenance, and at the right time, signficant financial savings can be made, thus increasing time of flawless work of a technical system.

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DEVELOPING NEW MAINTENANCE STRATEGIES ACCORDING TO THE CONDITIONS IN STEEL INDUSTRY

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Abstract: *The paper presents variants of maintenance policy of technical systems in steel industry, with the criteria such as total costs, readiness, reliability and safety of work. Development of maintenance strategy with parametre control according to the conditions is presented separately. Description of the change in technical conditions is also presented by providing an example of algorithm defining the history of change of conditions. Characteristic features which can help carrying out the selection of diagnostic parametres are also given.*

Key words: *maintenance, strategy, diagnostics, control, costs.*

1. INTRODUCTION

Shortcomings of traditional policies and strategies of corrective and preventive maintenance have in wide areas of practical work recently initiated development and introduction of new maintenance strategies according to situations. Basic advantages of maintenance according to the situation lay mainly in reduction of maintenance costs (direct and indirect) and increase in effectiveness (reliability and availability) of technical systems, but other positive effects can also be achieved, such as:

- ensuring the production in the requested volume and with the prescribed quality,
- reduction of energy and waste of raw materials,
- better relationships with customers,
- increasing the level of motivation for work with managers and workforce, etc.

In addition to this, maintenance according to the situation ensures a stronger link between the process of change of situation and process of exploitation of the technical system in relation to the classical strategies of preventive maintenance. Technical systems in steel industry offer the possibility of application of a larger number of maintenance strategies according to the situation. The researches [1] contributed to ranking these strategies into two groups:

1. maintenance according to the situation with parametre control, and
2. maintenance according to the situation with the control of the level of reliability.

Maintenance according to the situation with parametre control foresees permanent or periodical control and measuring of technical parametres with which technical condition of component parts and/or systems are determined. The decision on maintenance activities is brought when the values of the controlled parametres reach the usability limit, that is, pre-critical level. Maintenance according to the situation with control of the reliability level consists of gathering, processing and analysis of the data on the reliability level of component parts and/or the systems and elaboration of the decisions on necessary planned maintenance activities. When making this division of maintenance strategies according to the situation in [1], it is assumed that maintenance system is, in fact, the system of management of technical conditions and reliability of technical systems in the process of exploitation. Therefore, the problem is in increasing the effectiveness (readiness and reliability), or, in reduction of the number of failures, which will result in high coefficient of utilization, and with it in productivity.

2. VARIANTS, POLICY, AND STRATEGY OF MAINTENANCE IN STEEL INDUSTRY

Today, in steel industry can be applied three basic maintenance policies [2]:

- corrective maintenance (performed after the occurrence of a failure in order to restore the component parts and/or the system to the acceptable state),
- Preventive maintenance (performed at predetermined time intervals – in order to reduce the possibility of failure of the

component parts and/or the system from the acceptable state), and

- maintenance according to the situation (this is also preventive maintenance which is performed before the occurrence of a failure – but it is initiated as a result of knowledge of the technical condition of the component parts and/or the system, acquired by periodical or continuous monitoring of the technical condition).

The difference between the traditional preventive maintenance and maintenance according to the situation is, therefore essential – despite the fact that both policies represent preventive activities. While with the traditional preventive maintenance activities are performed after a predetermined period of time, with maintenance according to the situation, control of certain parametres of the condition (e.g. vibrations, noise, temperature, etc.) is performed and interventions undertaken only if technical condition is out of the prescribed limits.

Maintenance according to the situation (figure 1.) can signal most of mechanical problems in time necessary for minimizing unexpected malfunctions, risks and consequences of collateral damage, as well as prevent influence on security, operational function and environment. With it we can:

- increase the use of technical system and its functionality;
- minimize effects on mission of technical systems;
- reduce costs of maintenance (as well as for human work and supply of new spare parts);
- minimize costs and risks regarding proper functionality of technical systems which can appear as result of unnecessary repair and disassembling.

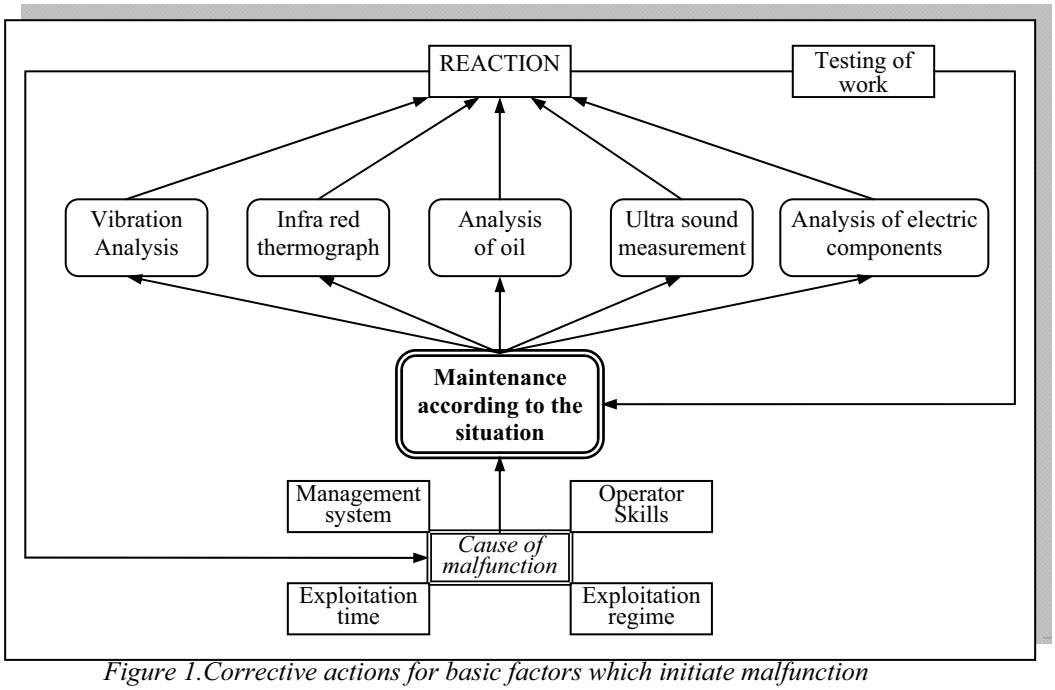

Figure 1.Corrective actions for basic factors which initiate malfunction

In today's literature can be found many models of maintenance according to the condition (Barlow's model, Balding's model, and other models) for technical systems with which a change of technical condition is momentary. Here, an attempt has been made to develop maintenance models according to the condition which will be applicable to technical systems with gradual (monotonous) change of condition in steel industry.
Researches in [1] have shown that more maintenance policies and strategies can be distinguished in steel industry, as shown in Figure 2. In principle, several criteria are applied here, such as:

- the level of incurred total costs,
- level of readiness and reliability of the system, and
- the level of safety of work.

3. DEVELOPMENT OF MAINTENANCE STRATEGY ACCORDING TO THE CONDITION WITH PARAMETRE CONTROL

This maintenance strategy must have a planning – preventive character. Periodicity and volume of work for technical diagnostics are planned, while the preventive character is ensured by continuous monitoring of the technical condition of the system aimed at discovering pre-failure

condition (ε_1) and limit of worn-out ($\varepsilon_2=\varepsilon_{max}$). If the condition parametre reaches the value ε_1, this means that some of the maintenance activities ought to be performed in order to avoid system failure (replacement or repair of a component part of the system is to be performed at the time of diagnostic control at $\varepsilon>\varepsilon_1$). In this case, it means that the magnitude of pre-failure tolerance ($\Delta\varepsilon = \varepsilon_2 - \varepsilon_1$) is connected to the magnitude of periodicity of diagnostic control ($\Delta T=T_2 - T_1$).

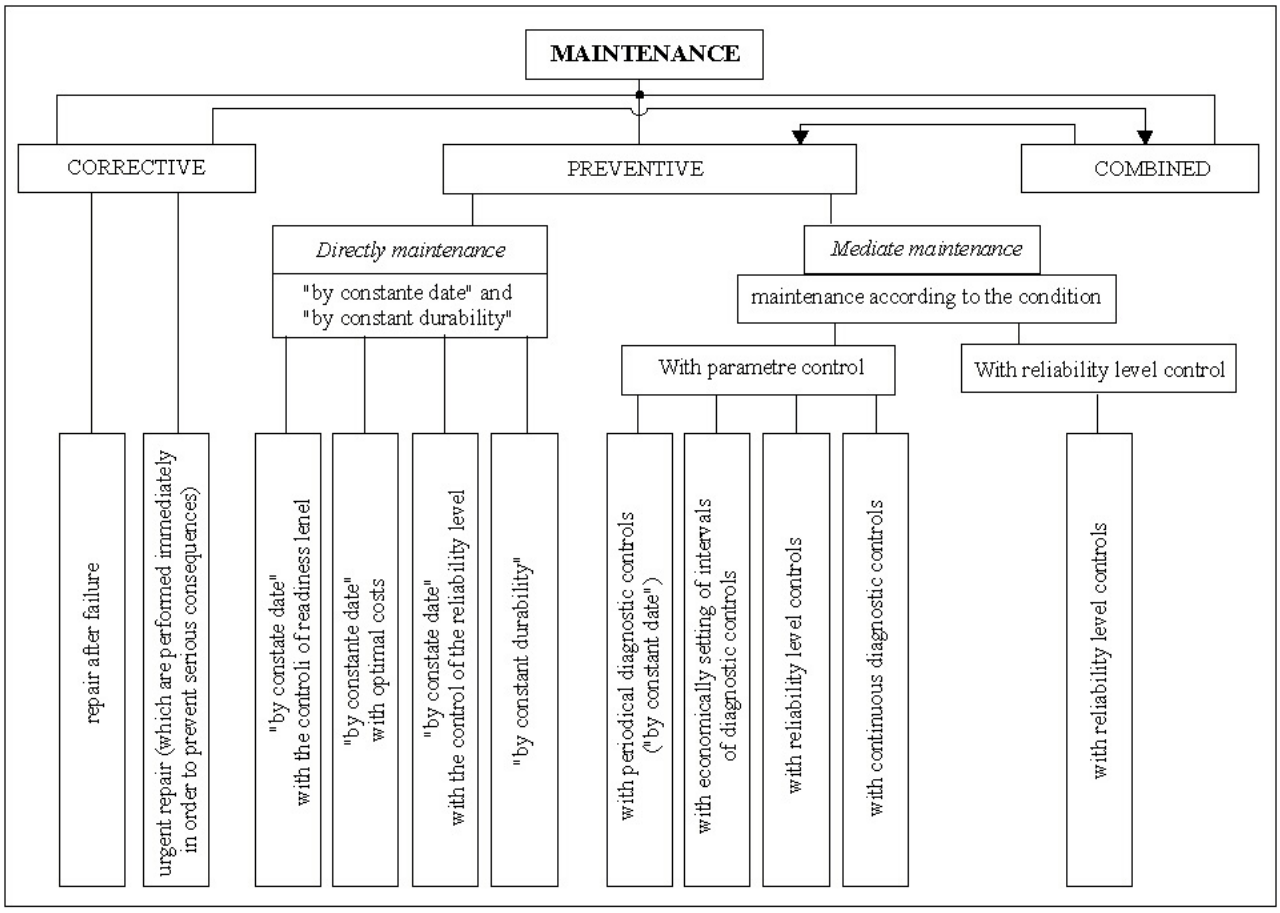

Figure 2. Variants of maintenance policis

Therefore, maintenance strategy according to condition with parametre control represents a set of rules for determining the frequency of diagnostics of the component parts of the system in a real exploitation process and decision-making on the necessity of their replacement, or for the necessary volume of maintenance based on the information on the real technical condition of the system. It represents the application of the method for defining:

- the pattern or regularity of the change of technical condition (on the basis of the history of change of condition),
- diagnostic system (evaluation of the condition in a given moment of time), and
- anticipation system (predicting the technical condition or predicting the usability reserves).

4. FORMAL DESCRIPTION OF THE CHANGE OF TECHNICAL CONDITION OF THE SYSTEM (THE HISTORY OF CHANGE)

The structure of a technical system is the characteristic of position, form, and dimensions of interactive component parts (macro structure); the character of union, surface quality (micro structure), and other characteristics. It is therefore characterized by structural parametres. A change in structural parametres of a technical system is reflected on the totality of its technical and exploitation characteristic features. A change in structural parametres, and with it a change in technical condition is a random process which is performed under the influence of a wide range of exploitation factors. This process can be most comprehensively described by the density of distribution of parametres of condition $f(\varepsilon,t)$ at any moment of time. Here, it is adopted that $\varphi(t,\varepsilon_2)$ complies with the normal law of distribution.

In order to determine the equation which links the functions of distribution density $f(\varepsilon,t)$, and $\varphi(t,\varepsilon_2)$ let us make use of Figure 3, while adopting the linear change in the condition of the system. The change in the condition can have the following trend: linear, linear-broken, exponential, graded, logarithmic, hyperbolical, logistic, etc. By adopting that T_1 and T_2 are corresponding moments in time of performing the first and the second diagnostic control, and t_x a random moment of intersection of levels ε_1 or ε_2, and by using Figure 3, the probability of correct operation of the system can be noticed by applying $\varphi(t_x,\varepsilon_1)$ and $f(\varepsilon,T_2)$ as

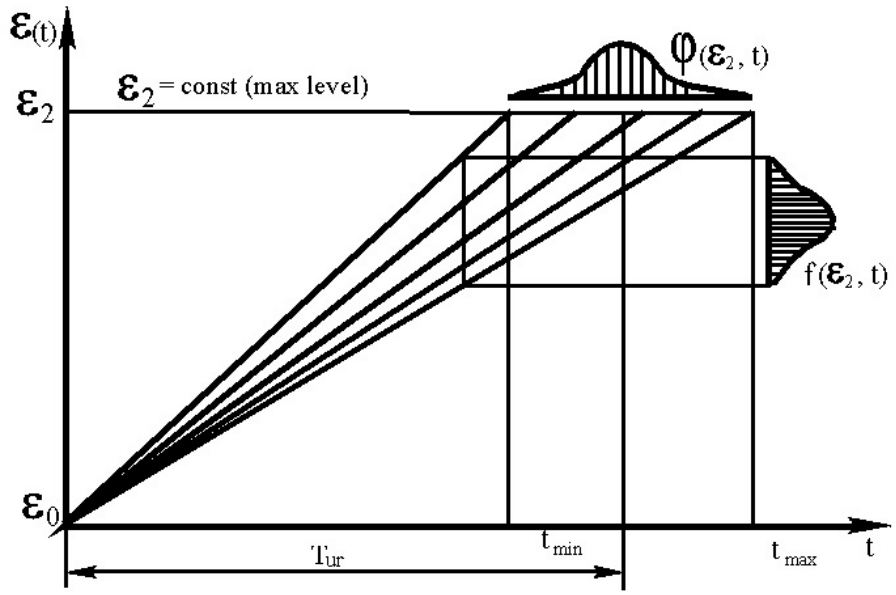

Figure 3. Reciprocal relations between parameters of technical condition and technical condition of the system

distribution density of random magnitude t_x at the level ε_1 and random magnitude $\varepsilon \in \varepsilon(t)$ in the moment T_2 [5,6]:

$$P = \{t_x \le T_1\}_{pri\varepsilon} = P\{\varepsilon > \varepsilon_2\}_{priT_2}, \qquad (1)$$

By applying the known laws from probability theory, the following equations can be written:

$$\int_{\varepsilon_2}^{\infty} f(\varepsilon,T_2)d\varepsilon = \int_{0}^{T_1} \varphi(t_x,\varepsilon_1)dt_x , \qquad (2)$$

$$\int_{\varepsilon_1}^{\infty} f(\varepsilon,T_2)d\varepsilon = \int_{0}^{T_2} \varphi(t_x,\varepsilon_1)dt_x , \qquad (3)$$

and after comparing equations (2) and (3), the following mathematical model can be obtained:

$$\int_{\varepsilon_1}^{\varepsilon_2} f(\varepsilon,T_2)d\varepsilon = \int_{T_1}^{T_2} \varphi(t_x,\varepsilon_1)dt . \qquad (4)$$

Thus, it can be concluded: for the monotonous process $\varepsilon(t)$ with the assigned T_1 and ε_2, the next moment of diagnostic control T_2 and pre-critical level ε_1 satisfy equation (4) for general conditions of technical exploitation of the system. During the real process of exploitation, all values $\varepsilon(t_x)$ will be grouped around the mean value $\varepsilon(t_x)$ and will have dispersion around it expressed by standard deviation σ_{uk} (standard deviation results from frequent starting and stopping of the system, because of different modes of exploitation process, etc.).

Now it can be given by the equation which completely describes the model of change of the parametres of condition by using the reliability interval $\pm\sigma_{uk}$:

$$\varepsilon(t) = u \cdot t + \varepsilon_0 \pm \sigma_{uk} \qquad (5)$$

where: u – rate of conditio change (u = dε/dt),
ε_0 – minimal value of condition parametar,
t – time of use, and
σ_{uk} – standard deviation.

Research in [1] showd us that 95% -on (1,96 σ_{uk}) total value of probability realization casual variable- usually is accep like a real limit for description a change of state a system in steel industry. If the set level of reliability is $p_z=R_z$ and alowed possibillity of failure accurence is $p_0=1-p_z$, we can write for some moment of time t_x:

$$P\{\varepsilon_2 < \varepsilon \le \infty\} = \int_{\varepsilon_2}^{\infty} f(\varepsilon,t_x)dt \le p_0 , \qquad (6)$$

that is:

$$P_0(t_x) = \int_{0}^{t_x} \varphi(t_x,\varepsilon_2)dt = \frac{\Phi[\varepsilon(t_x) - \varepsilon_2]}{\sigma_{uk}} , \qquad (7)$$

where: Φ - Gauss Function, and $\varepsilon(t_x)$ - mean value of change of condition.

Equations (6) and (7) represent characteristics link of the system reliability and parametres of technical condition. Therefore, the following equation results from theorem (4):

$$\int_0^{T_1} \varphi(t,\varepsilon_1)dt = \int_{T_1}^{T_2} \varphi(t,\varepsilon_2)dt\,, \qquad (8)$$

which can help explain the physical meaning of the stated theorem depending on whether continuous or periodic diagnostic control is in question. Let, for normal law on change of condition parametres, mathematical expectation $m_\varepsilon(t)$ and mean square deviation $\sigma_\varepsilon(t)$ be approximated by linear dependencies:

$$m_\varepsilon(t) = m_a + m_b t\,, \qquad (9)$$

$$\sigma_\varepsilon(t) = \sigma_a + \sigma_b t\,, \qquad (10)$$

where m_a and σ_a are parametres of technical condition in the moment t = 0, and represent deviation of condition parametres from its initial value ε_0, which could be construction permissible tolerance (e.g., initial clearance in a slide bearing). Such approximation will be of great use when determining the mode of diagnostic controls. Now the distribution density $f(\varepsilon, t_2)$ can be determined according to:

$$f(\varepsilon,t_2) = \frac{1}{\sqrt{2\pi}\cdot(\sigma_a+\sigma_b\cdot t)} \exp\left[-\frac{(\varepsilon - m_a - m_b\cdot t_2)^2}{2\cdot(\sigma_a+\sigma_b\cdot t)^2}\right] \qquad (11)$$

and distribution density of time of first intersecting of pre-critical level:

$$\varphi(t,\varepsilon_1) = \frac{1}{\sqrt{2\pi}} \exp\left[-\frac{(\varepsilon_1 - m_a - m_b\cdot t)^2}{2\cdot(\sigma_a+\sigma_b\cdot t)}\right] \frac{d}{dt}\left(\frac{\varepsilon_1 - m_a - m_b\cdot t}{\sigma_a+\sigma_b\cdot t}\right). \qquad (12)$$

It should be said here that for every controlled parametre (vibration and noise level, quantity of products of wear in oil, etc.) limits of failure (ε_2) should be determined.

At the end of this part is given a developed algorithm for defining the history of change of condition (Figure 4.), which resulted from the above-mentioned facts and conclusions. Here, a special place belongs to the input data, that is, to the technical and exploitation factors which characterize the change of condition. The researches [1] show that in the process of exploitation of technical systems in steel industry there are about 40 different factors which should be controlled.

5. TECHNICAL DIAGNOSTICS OF THE CONDITION

Technical diagnostics of the condition is a science which deals with recognizing the condition of the system with definite accuracy in a definite moment of time. Depending on the form of technical condition which has to be determined, diagnostics enables:

- checking the good working order of the system,
- checking the working capacity of the system,
- checking the functioning of the system, and
- failure investigating (place, form and cause of the failure).

The diagnosis can be made by finding the symptoms of malfunction, determining the values of certain condition parametres (by dismantling or without dismantling of the system), and comparing with the permissible (normal) values. Defining of the system of diagnostics of the condition in the process of forming the maintenance model according to the condition can be solved through several stages: selection of diagnostic parametres, selection of methods and means of diagnostics and evaluation of diagnostic parametres. When selecting diagnostic parametres of the system it is necessary to determine the character of their relationship to the parametres of condition. In the course, one or more diagnostic parametres can define only one parametre of the condition. Selection of diagnostic parametres (ρ) can be carried out on the basis of several basic criteria, and the following characteristics are used in the process: informativeness , relative relationship, agreement, variation and correlation.

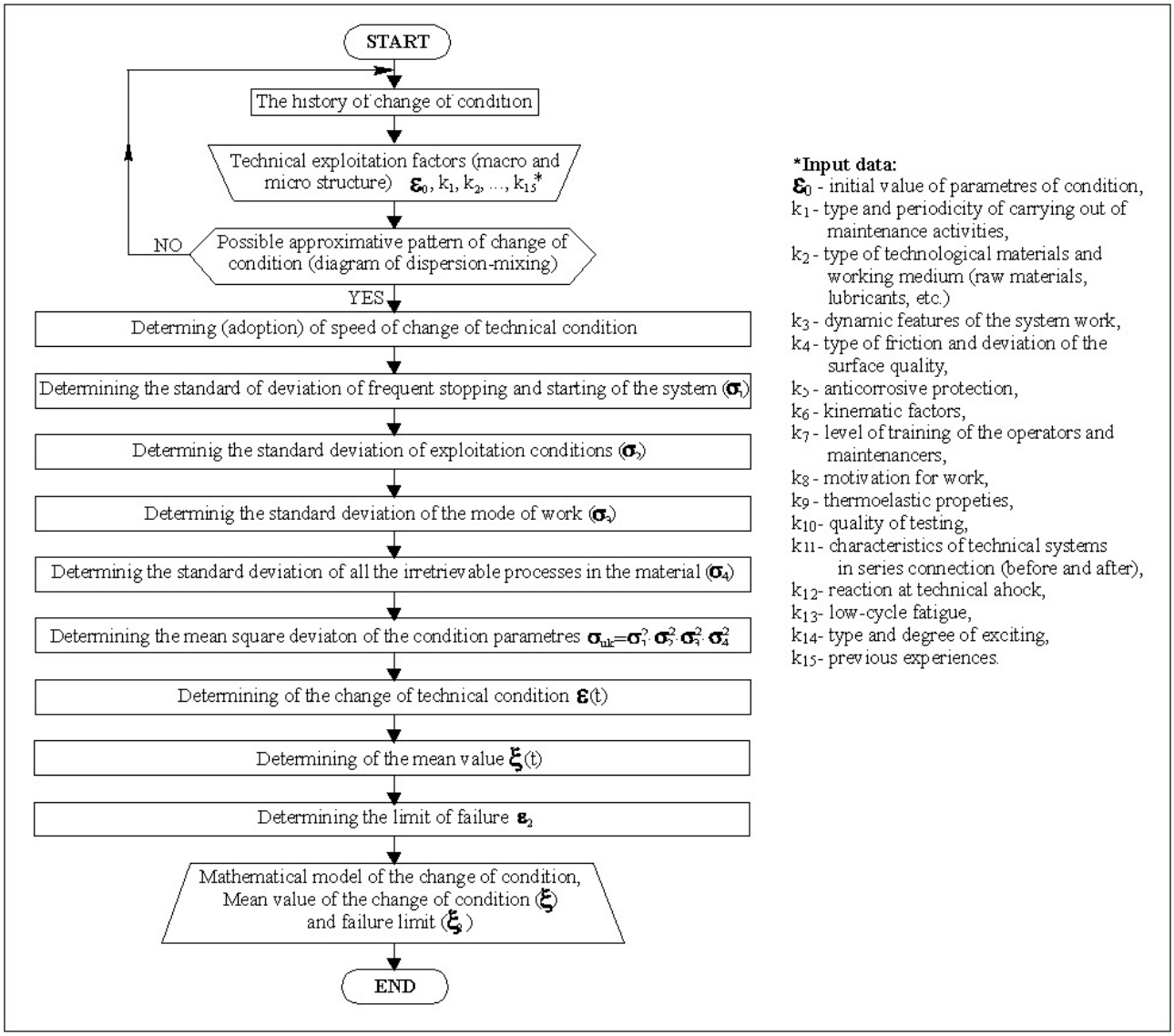

Figure 4. One possible algorithm of state condition history

Informativeness. Entropy [5] is used in information theory as a measure of a priori indefiniteness of a technical system (which is the object of diagnostics):

$$H(x) = \sum_{i=1}^{m_S} p_i \cdot \log_2 p_i \ , \qquad (13)$$

where: m_S – the number of probable conditions of the system *"x_i"*, and

p_i – probability that the system *"x_i"* will assume i-th technical condition.

Thus, the number of information on technical condition of the system I_k equals to:

$$I_k \rightarrow D = H(D) - E\left(\frac{D}{K}\right), \qquad (14)$$

where: *E(D/K)* – complete conditional entropy of the system *"D"* in relation to the system *"K"*.

Informativeness of the diagnostic parametre (or, "diagnostic weight") can be evaluated through a number of information on technical condition of the system which contains that parametre:

$$I_k = H(\varepsilon) - H \ , \qquad (15)$$

where: $H(\varepsilon)$ – complete system entropy, and

H_k – system entropy after performed technical diagnostics.

Higher informativeness of the diagnostic parametre I_k will be for lower entropy H_k, and for as much information as possible on the condition of the system which are found in a diagnostic parametre. Mean value of information can be used only for the selection of diagnostic parametres (ρ).

Maximum Relative Relationship. Maximum relative parametre relationship can be defined in the following way:

$$M_d = \frac{\rho_{\max} - \rho_n}{\varepsilon_2 - \varepsilon_n} = \frac{\Delta\rho}{\Delta\varepsilon}, \qquad (16)$$

in the process, M_d must have as high value as possible. The researches in [1] show that the most favourable relationship is $M_d>2,3$.

Agreement. Between the diagnostic parametres and parametres of technical state there must be the necessary agreement or, in other words, to the monotonous increase or decrease ε must correspond the specific change ρ, while a inversely proportional change may occur.

Variation. Variation represents deviation of diagnostic parametres from the mean static value.

Correlation. When solving concrete tasks as a measure of correlation between diagnostic parametres and corresponding parametres of condition, can be taken correlation coefficient r (in this case, r is the degree of correlation between ε and ρ).

6. BENEFITS OF TECHNICAL DIAGNOSIS OF CONDITION AND TESTING

By choice of process in technical diagnosis, the following results can be reached:

1. Decrease in maintenance costs;
   - identify/eliminate problems in a technical system before they become dangerous,
   - improve elimination of problems during maintenance process,
   - improve efficiency of human work (operators of technical systems and maintenance)
   - decrease quantity of inventory of spare parts,
   - identify and replace maintenance procedures and practices which proved less efficient,
   - improve workers' skills and achievements, and
   - increase period of terminating maintenance and maintenance »by constant date«.
2. Increase production output;
   - lower the number of unplanned halts of technical systems,
   - improve the speed of process and
   - improve the quality of product.
3. Decrease the level of financial expenses in cash which are necessary for major projects;
   - lengthen functionality of technical systems and
   - make decisions to repair, not replace technical systems.
4. Improvement in safety of workers;
   - reduce the number of »major« and critical malfunctions

Testing is carried out to establish whether the system satisfies chosen criteria and whether the user should accept the chosen criteria of the system. Approved testing is a black box of testing which should provide the client/user/ project manager with possibility to prove functionality of the system and check if it is usable before it is approved for use at a company, or before it is ordered. Approving testing is a duty of client/user or project manager, but it still has to be carried out with full support of the whole project team. It is of essential importance that during installation of technical systems basic reliability should be approved, so that it could be established if there is a problem in functioning of any of its components or the technical system as a whole, and with the aim of its mending and preventing the technical systems from failure. Information in basic level also helps to foresee malfunctions in a way that they will be compared with future readings.

The best practice of use maintenance technologies is accepting testing during construction of technical systems and during process of supply, i.e. making. During making of a new support construction for a technical system, major maintenance or repair of objects and installations, it is not unusual to find out that a technical system is not in horizontally ideal position and that it shows imbalance, that it has a hidden defect since the period of its production and installation within a company, or that it simply does not function the way it is expected to.

7. CRITERION OF RELIABILITY IN EVALUATING THE OBTAINED DATA

For evaluation of the obtained results can be used the reliability criterion μ_R:

$$\mu_R = \frac{r \cdot \sqrt{N_p}}{1 - r^2}, \qquad (17)$$

where: N_ρ – the number of pairs of characteristic features.

The researches in [1] show that the obtained result can be considered satisfactory if $\mu_R>2,6$. In this paper, linear regression, or regression line has been adopted:

$$\varepsilon = a_1 \cdot \rho + b_1, \qquad (18)$$

where: a_1, b_1 – coefficients of direction of the regression straight line.

The process of data gathering and obtaining numerical values of the correlation coefficients and coefficients of regression straight lines (a_1, b_1) can be performed by using the computer.

8. AUTOMATIC DIAGNOSTIC CONTROL OF THE CONDITION OF THE SYSTEM

Intensive development of IT technologies has enabled a qualitatively new approach to the problem of automatic control of a technological process, and likewise the path of automatic diagnostic control of the condition of the system. The generation of process computers has been developed with considerable advantages in relation to the commercially developed computers. Main pattern of a process computer system for controlling the condition of the system is shown in Figure 5.

In this way the following can be monitored: bearing temperature, bearing vibrations, temperature

and pressure of lubricating oil, rotor vibrations (specific), axial displacement of the rotor, relative rotor elongation, bearing housing dilatation, level in the oil tank, iron and copper temperature of the generator stator, temperature of the cooling water, drop in the pressure at the pump suction line, cooling water flow, etc.

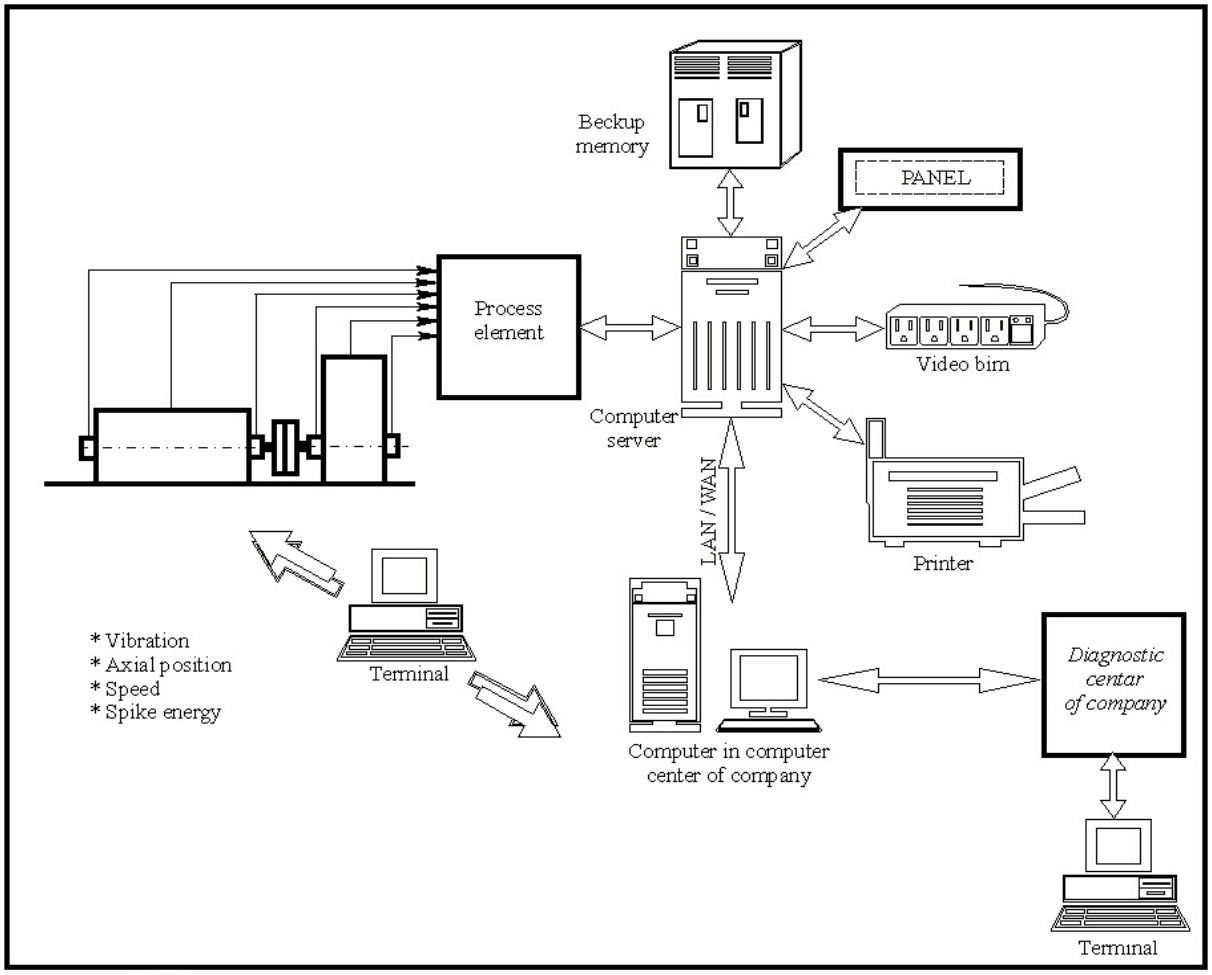

Figure 5. Main pattern of the computer system fir the control of the condition of the system

Thus, the majority the methods of diagnostics of the condition can be reduced to the systematic application of monitoring the following: vibrations, thermal state, lubricant control, corrosion, etc., which cover a wide area of application, while some methods correlate with special types of technical systems. Today, in steel industry worldwide, in 80% of the cases for the analysis of the condition of the system is used the method of vibrations and it is used for the control of the condition of: all power transmission, hoisting devices and cranes, rotary presses, conveyors, piston engines, systems for continuous steel casting, agglomeration systems, systems for oxygen production, etc.

9. CONCLUSION

Nowadays, in the world's leading companies it is almost incomprehensible to carry out maintenance strategies without accompanying software solution for managing maintenance function. For the purpose of connecting these two tools the most common solution is to manage maintenance function via Web base, i.e. the answer is in connecting strategy of maintenance according to the situation – maintenance function. By this connection the following segments should be provided:

- Information database with Web base for previous and current functioning of technical system (whatever the type of information – vibration, infrared thermograph, ultrasound, analysis of oil or any other analytic tool, including data from suppliers – information should be available 24 hours / seven days a week);
- Integration or independent work (depending on current possibilities of a

- company, solutions according to the situation should be created so that they can function independently until integration with software package for managing maintenance can be carried out);
- Motorized productivity (in nowadays businesses each minute is precious and therefore connectivity of tools for maintenance according to the situation with the Web would enable working teams to reach necessary information any time, in short period of time, wherever they might be);
- Report (multiple reports must be provided for user's convenience, i.e. well organized on screen, printed or with a possibility to be emailed).

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TRANSNATIONALIZATION AND MANAGING THE ORGANIZATIONAL QUALITY

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Abstract: In the end of last and beginning of this millennium, restructuring has been the key word for business and economy. Its meaning mainly referred to understanding of urgency at which enterprises should undertake implementation of quality work and behavior. Since it is so great in scope, with specific and highly-perspective, it is the task for all employees in the company, especially the managers.

Key words: restructuring, transnationalization, processes, process reengineering, TQM, Quality Management

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1.INTRODUCTION

Many of our companies, despite stagnation in business which they had in the past, still have significant unexploited potential. However, to make these potentials high quality used, it is previously necessary to perform the appropriate restructuring, ie . transnationalisation of companies. Such restructuring means the creation of conditions for high-quality usage of available resources to the competitiveness which company can reach its internal and external environment in order to manufacture the goods and services for selected target segments of the global market. It other words, it means that the restructuring of our company in order to realize the better usage of reliable potentials means to carry out company in way that will be in accordance with internationally recognize norms and standards.

This view largely negates firmly established opinion in economics, science and practice, that the main factor for the unsuccessful launch of our company in the present conditions is lack of funds and non-transparent system for regulation of the economy. Instead of thinking of such things as an weaknesses in the professional volutarizm in microeconomic using labor as factors of production. Master of voluntarism expressed in defininf and functioning of the internal organization, the creation of technical and commercial documentation, motivation, training staff and setting up information systems are fundamental barriers for transnationalization. . No business processes reengineering of and appropriate staff supporting in the revitalization of the function of improving the quality of business and maximizing customer satisfaction within the target segments of the global market, it is not possible to achieve conservation and recovery of the national economy and its translation into a state of development. The essence of business processes reengineering and the appropriate personnel revitalization is the implementation of the concepts of growth and development, which stems from the demands of customers and product users. On the other hand, the only real option for a breakthrough on selected segments of global markets is to connect with foreign strategic partners. The main role of strategic partners is to reconfiguration internal resources - providing additional distribution channels and commercial-technical development in order to adapt the production programmes to the requirements of target segments of the global market. The main obstacle to the establish this form of cooperation is the requirement that a company must guarantee in advance the fulfillment of all requirements in terms of quality, cost and production deadlines. Therefore, the concept of business processes reengineering, personnel and revitalization of the formation and realization of strategy of growth and development of companies, must be based on quality system implementation, based on the philosophy total quality management (TQM).

important factor in overcoming the current economic collapse , this view highlights

2. TRANSNATIONALIZATIO OF BUSINESS AND PROCESSES REENGINEERING IN COMPANIES

Process reengineering of basic processes, staffing companies and the revitalization of their mutual relations in the process of reproduction in order to prepare for global business conditions, requires dismissal of very serious structural uncompliance in the internal functioning. Successful strategies for business processes reengineering and personnel for the purpose of revitalizing transnationalisation has a short, medium and long-term aspect. In establishing a balance between emergency and strategic process of business processes reengineering and staff revitalization, next three main groups of activities have a key role - they are mostly implemented simultaneously:
The first group consists of activities for performing the essential changes, such as:
- Management restructuring,
- Insurance liquidity reduction of natural resources (space, equipment, employment)
- Reduction of costs of current reproduction by new forms of financing and cooperation with major suppliers and customers, and
- Increasing sales at existing market segments.

The second group of activities includes strategic requirements in the domain:
- Organizations in order to establish a structure made of flexible and competent parts of the combination of functional (marketing, research and development, production, suplay gallery) and economic (profit and cost-center) principles,
- Quality systems and commercial-technical performances of the existing program activities, and
- System for operational planning in order shortening time-cycle cost of financing business.
The third group of activities includes the provision of external resources to connect businesses with targeted segments of the global market. The main objective is the development of strategic coalition for organizing business under international competitive conditions in as many segments of the global market as possible. The main options for forming such a coalition are strategic oriented connections with foreign strategic partners. The main role of the strategic partnership is that on the basis of internal resources enable cooperation to reconfigurate companies by providing additional distribution channels and commercial-technical potential for customizing of the production requirements of target segments of the global market.

Therefore, the strategy of business processes reengineering and personnel revitalization in the present context is based on the changes, such as:
- Restructuring of management,
- Adjusting the organizational structure,
- Lowering costs and improving the performance of marketing, research and development, production, procurement, sales, accounting, etc..
- Investments should be directed primarily at:
- Training,
- Ordering process and the existing descriptive dokumenacije,
- Modernization of information systems,
- Revitalization of the production program, and
- Development of relations with the market.

In the operationalization of the concept transnationalisation it should be applied various forms of cooperation. Forms of cooperation should be established depending on the structure of the problem, the content of specific business activities and the expected effects.

3. IMPLEMENTATION OF THE TQMA IS TRANSINACIONALIZATION BUSINESS OPERATIONALIZATION

Building quality systems according to the TQM philosophy is a basic condition for transnationalization operations of each company. Quality together with the price and terms of delivery is the main factor of each product placement services. To ensure adequate quality with optimal consumption of production factors, it is necessary to achieve the appropriate level and connection of all business processes. Therefore, the concept of business processes reengineering and personnel revitalization must be based on the implementation of TQM-a.
The essence of TQM is simple. Each part of the companies has its customers and end users - internal or external, and the need to identify its requirements, so it can engage in their fulfilment. The concept of TQM philosophy is based on the approach which includes the following basic elements:
- Planning work processes and their inputs,
- Provision of inputs,

- Execution of working processes,
- Assessing outputs,
- Testing characteristics of working processes, and
- Modification of business processes.

Therefore, TQM system in the company must be relied on:
- Continuous evaluation of working process which have to satisfy the needs of customers and end users,
- Generating ideas for improving business processes,
- Performing improvement of business processes, and
- Reducing the variability of business processes.

The main objective of TQM is to create documented system through a learning process , to standardize the way the company is working, and on that base to provide a improvement of performance of work processes and their outputs. Basic conditions for the continuous improvement of business processes, as the primary generator of growth and enterprise development, are:
- Directing the company to customers and end users,
- Review inputs, work processes and outputs, and
- Training employees.

In all parts of the company must be understanding that the purpose of any work on improvements to customers and end users provide better products and services. This means that at any time through the system of measurement and feedback interface must have information of each specific customer and final user about their vision of the process output. For establishing satisfaction of each external customer or end user it is not allowed severing the chain of quality in any place, which means that it must satisfy all customers and internal users.

4. COMPANIES FUNCTIONING AND QUALITY SYSTEMS

In terms of complex and rapid changes and sharpened requirements in terms of costs, quality, delivery, etc., conducting business on the basis of setting and implementation of business processes has significant advantages over the operations organized by functions. The basic requirement for conducting business processes is the existence of appropriate organizational procedures that describe the processes. The term "business process" is determined as a group of activities in which the company achieves specific involvement in the total business. Every process has exactly defined beginning and end and associated underprocesses. Underprocesses must be defined with inputs, outputs, procedures, performance and accountability.

Decisive factors for the successful management processes are quality systems. Every manager needs to know the company structure, the perpetrators and how the coordinate with processes. The assumption for this is the existence of quality systems in the company and its continuous improvement. Quality involves itself in a number of subsystems, such as:
- Technology of quality management,
- Metrology network of accredited laboratories,
- Quality control of products and processes,
- Quality assurance in after sale period, and
- Collection, recycling, disposal and destruction of waste during the production, exploitation, and after using the product.

Not going into the very essence of quality system standards ISO 9000 and ISO 14000 it is important to know that the main driving force for the implementation is their professional staff the company. Quality is a real reflection of the presence of certain specific company, such as:
- Level of expertise and management skills,
- Level of the organizational culture of employees,
- Level of social satisfaction of employees, and
- Political and economic autonomy in relation to the environment.

For this reason, the introduction and continuous improvement of quality in the national companies practically facing is a major obstacle in terms of:
- Understanding and accepting needs and ways for the establishment and development of quality systems, and
- Staff and securing adequate personal and financial resources for the establishment and development of quality systems.

To eliminate such of problems in companies appropriately, it is necessary to ensure precise explanations to all personal about structures and importance of the quality system for the company. This is because practically all employees in the company, in accordance with their formal and unformal roles, participate in the acceptance, establishment and improvement of the quality system. Of course, in performing such work is primarily important preparation of management and the directions from the top to down. If the management of the authoritative level agree to accept the need for establishing quality system, then it will be much easier to involve and other personnel in companies.

5.CONCLUSION

Qualitative redesigning business processes in the function of maximum customer satisfaction with the quality of selected segments of the global world market, the only essential and lasting responses to micro-economic difficulties of adjusting to changes in our company in national and global socio-economic environment. In this regard it is important to form business relations with foreign strategic partners. The main role of such partnerships is to facilitate cooperation of internal resources providing additional and to provide additional distribution channels and commercial technical development for adaptation of existing production requirements of target segments of the global market. In the initial phase of development of strategic partnership, which must coincide with the business processes reengineering and staff revitalization, the emphasis must be on forms of cooperation in which capital inflow is in the foreground.

Business process reengineering and revitalization of staff in companies, are processes which there are no strict rules. Each company must find its own solutions for solving the specific situation and the applicable general principles for adaptation.

Management and professional staff must be leaders in process of the transformation whose basis stated in the appointment and the implementation of quality assurance. The concept of such a system should be, in as much as possible a greater degree connection with the principles of TQM philosophy because it will also provide the possibility of achieving permanent development.

For all forward putted in the issue about realization, the initial basis should be the organizational structure of company, in which exists a network of autonomous, flexible compatible market, technological and informational parts with economic status mostly winning, and if necessary necessary, and cost centers, which are individually prepared to be caught with all forms of business problems and competition. Structuring and internal organization of such components should comply with the internal information infrastructure, the principles of teamwork, the need for clearly defined objectives and flows and the rules by which they are implemented and that the level of customer satisfaction, is the main barometer of quality.

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THE CHARACHTERISTICS OF THE ROBUST QUALITY MANAGEMENT SYSTEM

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Summary: *The Robust Quality Management System has to be capable to perform and produce the desired product or service under a wide range of different conditions and to successfully transform input into the output of the system. The main idea of this article is to emphasize the most important characteristics of the robust Quality Management Systems and to present the key relationships among them. However, the necessary associations with the ISO 9001 Standard requirements have been made due to the fact that it provides a set of standardized requirements that are the result of the good quality management practices. Therefore the central purpose of this article is to highlight the necessary elements of the Quality Management System that would create a strong foundation of the Quality Management System to be able to deliver the expected results.*

Key Words: *Quality Management System, Effectiveness, Effectivity, Adaptability*

1. INTRODUCTION

Every organization tends to establish the Quality Management System that would be capable of delivering product or service that would meet or exceed the customers' expectations. In practice, sometimes it's very difficult to pay attention to key characteristics, which determine the overall performance of the system. This article has intention to highlight those, the most important characteristics that can influence and create the robust Quality Management System, which is insensitive on the different variations that may impact the performance of the organization and be capable of performing properly under a wide range of different conditions. As a basis, ISO 9001 has been used to describe the logic behind the standard, the key characteristics and the pillars of the robust Quality Management System.

2. ISO 9001 STANDARD MODEL

ISO 9001 Standard has been based on continual loop PLAN-DO-CHECK-ACT (PDCA). This process approach represents the conceptual model of the entire standard and its requirements. The delivered quality is measured as a degree how the organization successfully transforms inputs (customer requirements) into outputs (customer satisfaction). ISO 9001 Standard has recognized that the customers play a significant role in defining the requirements as inputs to the system, and monitoring of their satisfaction as outputs from the system as necessary action to evaluate and validate whether the defined specifications and product/service conformity have been met.

ISO 9001 Standard provides a tried and tested framework for taking a systematic approach to managing the organization's processes so they can consistently deliver the expected results. That framework establishes the requirements that certain Quality System must meet, but does not dictate nor address the way how they should be met in any particular organization, so the standard itself allows diversity and leaves to the organizations how they would execute the necessary requirements. This leaves a great room, latitude and flexibility for implementation in different organizations regardless of business areas and business cultures.

The main process based model that ISO 9001 Standard encompasses represents the systematic way to consistently achieve continual improvements. This operational form is graphically represented to demonstrate functional relationships between the various parts of Quality Management System:

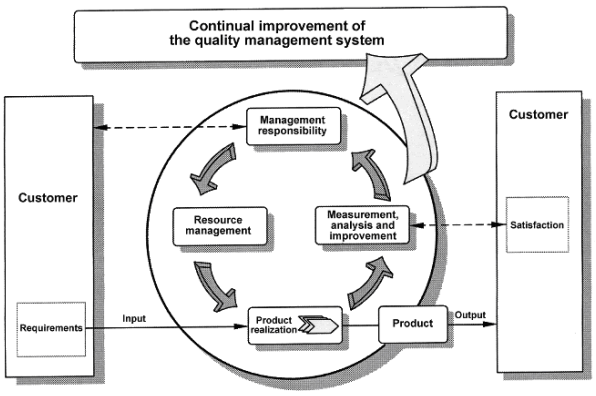

Figure 1. Macro model of a Process-based Quality Management System

The model of a process-based quality management system shown in Figure 1 illustrates the process linkages presented in ISO 9001 Standard Clauses 4 to 8. This illustration shows that customers play a significant role in defining requirements as inputs. Monitoring of customer satisfaction requires the evaluation of information relating to customer perception as to whether the organization has met the customer requirements. The model shown in Figure 1 covers all the requirements of this International Standard, but does not show processes at a detailed level. This model is also known as a macro model of the Quality Management System.

The micro model of the Quality Management System has been deployed from the macro model but it has been translated and adjusted to fit into the operational level. Every process, even though it's not requirement of ISO 9001, has to be documented, in written or unwritten form. The procedure, which usually explains what certain process has to accomplish, represents an explicitly ordered set of tasks for performing some action with predetermined responsibilities.

Execution of the process has to be done in accordance with the existing procedure, written or unwritten, in the same manner, all the time, with the minimum deviations. The same routine in the completing of the certain process can be achieved with assured level of competence, knowledge and experience, which the organization has to assure in order to produce the same level of quality.

The result of the performed process should be in compliance with the procedure, and the records which bear the data, should prove that the final results of the process has been accomplished as desired.

Over the time, every process can be improved by reducing the variation or introducing the better methodologies, which can execute the process in more efficient and effective manner. All those improvements have to be incorporated into the procedure that documents the existing process and it's subject to constant change under the configuration management rules and conditions.

All these steps are creating continual loop on the micro level, for improvement of the process and constantly better transform given inputs into desired outputs.

This micro model can be graphically presented on the following figure:

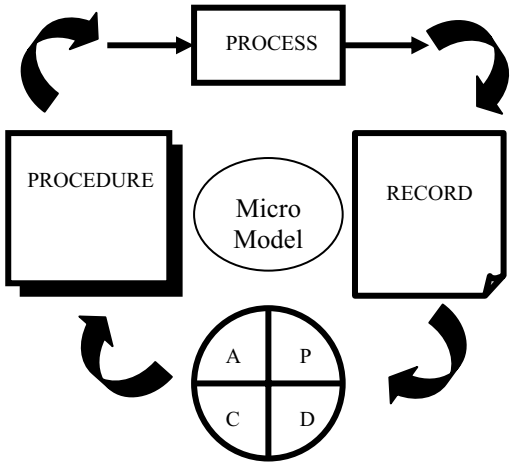

Figure 2. Micro model of a process-based Quality Management System

3. EFFECTIVENESS, EFFICIENCY AND ADAPTABILITY

Effectiveness, Efficiency and Adaptability are three key characteristics of every robust Quality Management System as shown on the following figure:

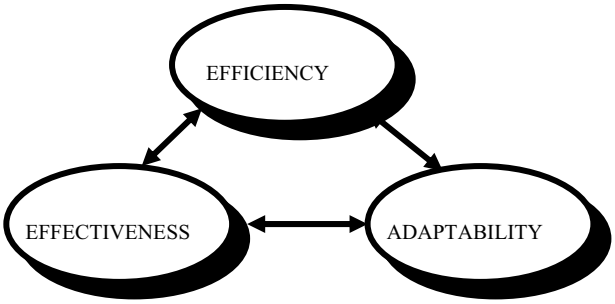

Figure 3. The key characteristics of the robust Quality Management System

Effectiveness can be viewed as the ability of the Quality Management System to deliver the expected results. Effectiveness is defined in ISO 9000 as the "extend to which planned activities are realized and planned results achieved". Effectiveness is actually the state of the system of having produced or caused a desired, expected, predicted or intended effect of an action being taken as is proposed. Effectiveness involves achieving the organizational worthwhile goals that support its vision, mission and objectives.

System effectiveness must be evident all the time as the organizational performance data are regularly gathered, analyzed, disseminated and shared among all relevant subjects within the system.
The effectiveness of the system is measured by comparing the key performance indicators of the vital processes to the organizational objectives. The effectiveness requires the constant aligning of the processes to the defined procedures and their continual improvement. An aware and empowered organization should be able to clearly distinguish between the deviations in the system and to react quickly to resolve those issues by keeping the big picture in mind and to convey the trend of the performance measures most important to the business success. Planning, measuring and analysis are the critical elements to ensure conformity of the Quality Management System and to continually improve its effectiveness.
Effectiveness in its core belongs to strategic aspects of the business and shows that the organization is doing "the right things".
The second key characteristic of the robust Quality Management System is Efficiency. Efficiency represents a term indicating the relationship between the outputs and the inputs in one process or system. Efficiency increases by generating higher outputs as related to inputs. It is usually associated with the productivity of the system and expressed with the other words, the better efficiency means enhancing productivity - less rework, less errors and optimal use of resources. Efficiency usually denotes the optimization of productivity of observed system. It is measured as a ratio of delivered versus invested resources and it can be expressed in percentage scale. System being efficient means producing the results with a less wasted effort and with an optimal way. To improve Efficiency, the organization has to become familiar with the behavior of its systems and processes and to constantly improve them. Efficiency represents how system successfully transforms the input into the output of the certain processes. Sometimes simply by reducing the variability of the system, the organization injects more efficiency into its operations. Efficiency belongs to operational aspects of the business and shows that the organization is doing things "on the proper way".
The third key characteristic of the robust Quality Management System is Adaptability. Adaptability is to be understood as the ability of the Quality Management System to adapt itself effectivelly and efficiently to changed circumstances. An adaptive Quality Management System is therefore an open system that is able to fit its behaviour according to changes in its environment or in parts of the system itself.
It seems so obvious as not to need mention, but speed, the rate of change and all its consequences, is only going to accelerate in today's world. Though not called out as one of the key forces on its own, speed and its impacts are embodied in the list of forces that surface at the top. But whatever view has been taken, the speed is propelling the organizations at ever-higher rates. Speed requires rates of adaptability that is sometimes very difficult for the organizations to manage. Adaptability of the Quality Management Systems simply means to keep the same level of effectiveness and efficiency regardless of the changes occurred inside or outside of the organization.
Adaptability is therefore the preference of the system to "quickly adapts itself" to the new circumstances despite that they have come from inside or outside environment.

4. PILLARS OF THE ROBUST QUALITY MANAGEMENT SYSTEM

The ISO 9001 standard imposes the certain actions in order to comply with its requirements. Among them, there are three very important aspects, which are the main mechanism of the continual improvements in the organization, and they basically represent the pillars of the robust Quality Management System. They are Management Review Meetings, Internal Audits and Corrective Actions as presented on the following figure:

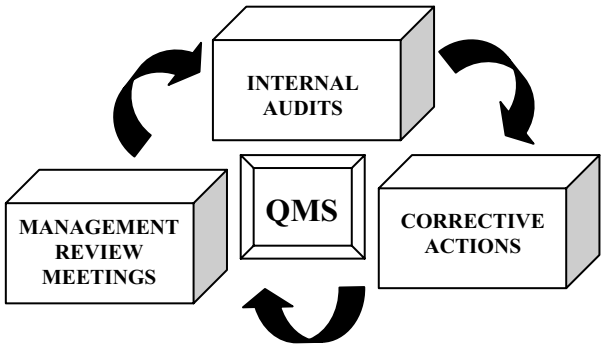

Figure 4. The pillars of the robust Quality Management System

Why these three aspects of the Quality Management System are the pillars? They are pillars simply because they trigger the main continual improvement loop within the organization. On the regular Management Review Meetings, the top Management of the organization decides which actions to take in order to continually improve the organization's system on the process level. The comprehensive and regular Internal Audits are supposed to provide the feedback of the overall level of compliance of the organization's system to the top Management, and based on those results, the top Management is supposed to implement integral corrective actions in order to eliminate the root cause(s) of the existing problems and by taking those actions to continually improve the

characteristics of the organization's Quality Management System.

Management Review Meetings are extremely important parts of the success of the Quality Management System and the significant source for improvements. And as stated in ISO 9004, "Top management should develop the management review activity beyond verification of the effectiveness and efficiency of the Quality Management System into a process that extends to the whole organization, and which also evaluates the efficiency of the system. Management reviews should be platforms for the exchange of new ideas, with open discussion and evaluation of the inputs being stimulated by the leadership of top management. To add value to the organization from management review, top management should control the performance of realization and support processes by systematic review based on the quality management principles".

Internal Audit is an activity involved in helping organizations to achieve their stated objectives. It does this by using a systematic methodology for analyzing business processes, procedures and activities with the goal of highlighting organizational problems and recommending solutions.

As defined by ISO 9004: "Top management should ensure the establishment of an effective and efficient internal audit process to assess the strengths and weaknesses of the quality management system. The internal audit process acts as a management tool for independent assessment of any designated process or activity. The internal audit process provides an independent tool for use in obtaining objective evidence that the existing requirements have been met, since the internal audit evaluates the effectiveness and efficiency of the organization. It is important that management ensure improvement actions are taken in response to internal audit results. Planning for internal audits should be flexible in order to permit changes in emphasis based on findings and objective evidence obtained during the audit. Relevant input from the area to be audited, as well as from other interested parties, should be considered in the development of internal audit plans".

A corrective action is a change implemented to address a weakness identified in the Quality Management System or a solution meant to reduce or eliminate an identified problem.

As stated in ISO 9004: "Top management should ensure that corrective action is used as a tool for improvement. Corrective action planning should include evaluation of the significance of problems, and should be in terms of the potential impact on such aspects as operating costs, costs of nonconformity, product performance, dependability and the safety and satisfaction of customers and other interested parties. People from appropriate disciplines should participate in the corrective action process. Also, the effectiveness and efficiency of processes should be emphasized when actions are taken and the actions should be monitored to ensure that desired goals are met. Corrective actions should be considered for inclusion in management review. In pursuing corrective action, the organization should identify sources of information, and collect information to define the necessary corrective actions. The defined corrective action should be focused on eliminating causes of nonconfotmities in order to avoid recurrence".

5. CONCLUSION

To achieve the robust Quality Management System is not easy. It requires disciplined process which sometimes takes long period of time and lots of efforts. In this paper some of the key characteristics have been presented on which every organization, which strives to produce a high level of quality, needs to pay special attention and to continually monitor and improve them.

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MEASURING THE EFFECTIVENESS OF QUALITY MANAGEMENT SYSTEM

Branislav Tomic, Bombardier Aerospace, Toronto, Canada

Summary: *The conformance to standard requirements can be done through regular internal audits to show that the organization is capable of meeting those requirements. Moreover, the effectiveness of the Quality Management System can be done through systematic process, which is called Quality Performance Evaluation in order to measure the Effectiveness of the Quality Management System through Quality Performance Indicators. This article has intent to highlight the most important steps to well-organized and systematic way of performing Quality Performance Evaluation.*

Key Words: *Quality Management System, Effectiveness, Quality Performance Evaluation*

1. INTRODUCTION

In all aspects of ISO 9001:2008 standard the word "effectiveness" has been constantly mentioned. The importance of the word effectiveness comes from the fact that effectiveness is the ability of the Quality Management System to deliver the expected results through its processes. Effectiveness is defined in ISO 9000 as the "extend to which planned activities are realized and planned results achieved". Effectiveness is actually the state of the system of having produced or caused a desired, expected, predicted or intended effect of an action being taken as is proposed. Effectiveness involves achieving the organizational worthwhile goals that support its vision, mission and objectives. How than the effectiveness can be measured?
For management to be able to assess the suitability and effectiveness of its QMS, both conformity to the standard and QMS performance in meeting the needs of the organization must be determined. Quality Performance Evaluation is proposed as the means to provide this capability to management to measure the organizational effectiveness and to deploy it to the process level.

2. QUALITY PERFORMANCE EVALUATION

Quality Performance Evaluation can be simply defined as an evaluation of Quality Performance, as review of an organization's quality aspects to determine whether objectives have been met. Quality aspects can be defined generally to include any elements of the organization's activities, services, and products that can interact with the quality of the final outcome that organization delivers to its customers or end-users. Quality Performance Evaluation is intended therefore to be a management aid or tool to help an organization to focus on and improve its quality performance. The Quality Performance Evaluation process uses specifically defined Quality Performance Indicators defined by management, as a measure of the performance achieved by implementation of the organization's Quality Management System. As a management process, Quality Performance Evaluation embodies fundamental characteristics consistent with sound management practices.

In principle, the Quality Performance Evaluation process should:

- have the full top and senior management commitment,
- be compatible with existing business systems and processes,
- be based on accurate, objective, and verifiable data,
- generate understandable and reliable information,
- appropriately consider customers and suppliers concerns and expectations and
- trigger the continual improvement loop.

Quality Performance Evaluation is an internal process and management tool designed to provide management with reliable and verifiable information

on an ongoing basis to determine whether an organization's quality performance is meeting the criteria set by the management of the organization. An organization with a Quality Management System in place may evaluate its quality performance against its quality policy, objectives, targets and other quality performance (including product and other significant) criteria. Quality Performance Evaluation and Quality Audits help the management of an organization to assess the status of its quality performance, the suitability and effectiveness of the Quality Management System, and identify areas for improvement as needed. Quality Performance Evaluation is an ongoing process of collection and assessment of data and information to provide a current evaluation of performance, as well as trends over time.
The Quality Performance Evaluation process is supposed to have three primary steps:

1. Planning for Quality Performance Evaluation:
- management considerations
- defining the scope of the organization's Quality Performance Evaluation process
- collecting information needed for Quality Performance Evaluation planning
- developing Quality Performance Indicators
- selecting Quality Performance Indicators

2. Implementing Quality Performance Evaluation:
- collecting data
- analyzing data
- evaluating Quality Performance Evaluation information
- reporting and communicating quality performance

3. Improving Quality Performance Evaluation:
- improving the Quality Performance Evaluation process
- contributing to the Quality Management System
- improving quality performance

Quality Performance Evaluation is a planned process, appropriate to the size and type of organization, its products and/or services, and its needs and priorities. Quality Performance Evaluation should be a cost-effective part of the regular business functions and activities of an organization. Management commitment to evaluate quality performance is essential. The information generated by Quality Performance Evaluation may assist an organization to:

- determine any necessary actions to achieve its quality performance criteria,
- identify opportunities for better management of its quality aspects,
- track changes in its quality performance (including product/service quality trends),
- increase business efficiency and effectiveness and
- recognize strategic business opportunities.

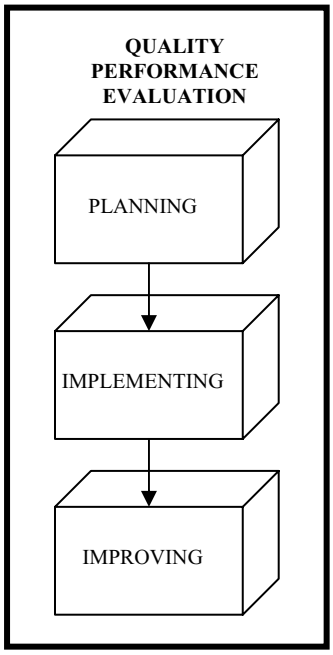

Figure 1. Quality Performance Evaluation Steps

2.1. Planning for Quality Performance Evaluation

An organization should base its planning of Quality Performance Evaluation and selection of indicators for Quality Performance Evaluation on:

- consideration of the full range of the organization's activities, products, and services,
- the significant quality aspects that it can control and over which it can be expected to have an influence,
- its quality policy,
- its quality performance criteria,
- information needed to meet contractual, and other requirements, as well as customer expectations and
- an understanding of the views of potential customers.

The identification of an organization's quality aspects is an important input in planning Quality Performance Evaluation. This information typically is developed in the context of a Quality Management System. An organization with a Quality Management System in place should evaluate its quality performance against its quality policy, objectives, targets and other quality performance criteria taking into consideration customer and

contractual requirements. For most organizations, the review of quality aspects will focus on the organization's operations. An organization should plan Quality Performance Evaluation in conjunction with setting its quality performance criteria so that the selected indicators for Quality Performance Evaluation will relate to and be appropriate for measuring or describing the organization's quality performance against the selected criteria. Some examples of sources from which quality performance criteria could be derived include:

- past performance,
- customer requirements (including complaints),
- best practices,
- performance data developed by industry and other sector organizations,
- management reviews and audits and
- the views of potential customers.

In planning for Quality Performance Evaluation, management should also consider its organizational structure, overall business strategy, and quality costs and benefits. Over time, the scope of Quality Performance Evaluation can be changed to address other elements of an organization's activities, products and services that may impact the quality performance, as the organization changes to satisfy its evolving mission.

Indicators for Quality Performance Evaluation help to condense relevant data into concise and useful information about management's efforts, the quality performance of the organization's system, processes and operations. An organization should select a sufficient number of relevant, significant, and understandable indicators to evaluate its quality performance. The number of selected indicators for Quality Performance Evaluation should reflect the nature and scale of the organization's operations. The choice of indicators for Quality Performance Evaluation will determine which data should be collected or which available data should be used. Indicators for Quality Performance Evaluation are selected by organizations as a means of presenting quantitative or qualitative raw data or information in a more understandable and useful form. There should be a clear understanding of assumptions made in the handling of data and the transformation of it into information and indicators for Quality Performance Evaluation. Moreover, any direct measurements of indicators must be supported by a sufficient and adequate system of quality control and quality assurance in order to assure that the indicator values are usable for Quality Performance Evaluation. There are many processes an organization may employ to select indicators for Quality Performance Evaluation, and several approaches that an organization may consider to select its Quality Performance Indicators. Some quality aspects may be complex, and it may be beneficial to select a combination of Quality Performance Indicators to provide a comprehensive evaluation. Indicators for Quality Performance Evaluation should be selected so that management has sufficient information to evaluate the effect of progress toward achieving the quality performance criterion in one area has on performance in other areas of concern.

2.2. Implementing Quality Performance Evaluation

An organization should collect data regularly to provide input for calculating values for selected indicators for Quality Performance Evaluation. Data should be collected systematically from appropriate sources at frequencies consistent with Quality Performance Evaluation planning. Data collection procedures should ensure data reliability and usability. This depends on factors such as availability, adequacy, scientific and statistical validity and verifiability. Data collection should be supported by quality control and quality assurance practices that ensure the data obtained are of the type and quality needed for Quality Performance Evaluation use. Data collection procedures should include the appropriate identification, filing, storage, retrieval, and disposition of data and information. Such provisions help to ensure the credibility and relevance of Quality Performance Evaluation to operations. An organization may use its own data or data from other sources. For example, data may be collected from monitoring and measuring; interviews and observations; customer complaints; inventory and production records; financial and accounting records; quality review, audit, or assessment reports; quality training records; scientific/technical reports and studies; government agencies, academic institutions and nongovernmental organizations; suppliers and subcontractors; and customer and consumer surveys.

Data analysis converts collected data into information describing the organization's quality performance, expressed as indicators for Quality Performance Evaluation, which are useful for the organization's intended purpose. Data analysis may include consideration of the data quality, validity, adequacy, and completeness necessary to produce reliable information. Such information describing the organization's quality performance may be developed using calculations, best estimates, statistical methods, graphical techniques, or by indexing, aggregating or weighting. Quality Performance Evaluation is intended to provide useful information on the management efforts of the organization and its operations as a basis for appropriate management actions. The information, expressed in terms of Quality Performance Indicators, should be compared with the organization's quality performance criteria. This

comparison may indicate progress or deficiencies in quality performance. The results of this comparison may be useful in understanding why the quality performance criteria have, or have not, been met. The information describing the organization's quality performance and the results of the comparison, should be reported to management, to support appropriate management actions to improve quality performance. Quality reporting is a tool for providing information describing an organization's quality performance to external as well as internal interested parties, based on management's assessment of needs and its audiences. Internal interested parties may include other divisions, process lines, internal suppliers, and internal users of the product or service. External interested parties may include past, current, and potential future customers. Benefits of reporting and communicating Quality Performance Evaluation results may include:

- facilitating the organization's achievement of its quality performance criteria,
- increasing awareness and dialogue about the organization's quality policies, objectives, targets and other quality performance criteria
- demonstrating the organization's commitment and efforts to improve quality performance and product/ service quality and
- responding to concerns and questions about the organization's quality aspects and product quality.

Management should ensure that appropriate and necessary information describing the organization's quality performance is communicated throughout the organization on a timely basis. This may assist employees, contractors, and others related to the organization to fulfill their responsibilities, and the organization to meet its quality performance criteria.

Examples of information describing the organization's quality performance may include:

- status of and trends in the organization's quality performance and product quality,
- status of the organization's conformance with other requirements to which it subscribes,
- cost savings or other financial results and
- opportunities or recommendations to improve an organization's quality performance.

An organization may choose or may be required as part of contractual obligations to issue quality reports or statements providing information describing its quality performance to external interested parties, such as potential customers. Quality Performance Evaluation provides information which an organization may wish to include in its quality reports or in other communications to external audiences. A number of factors may influence an organization's decision to voluntarily report information describing its quality performance. These factors may include an organization's interest in improving its business position and relations with customers or a consumer market group, and in communicating with the business sectors in which it operates.

2.3. Improving Quality Performance Evaluation

An organization's Quality Performance Evaluation process and results should be reviewed periodically to identify opportunities for improvement. Such a review may lead to management actions to improve the quality performance of the organization and may result in improvements in product and service quality. The success of the Quality Performance Evaluation process will be determined by the timeliness and effectiveness of the actions taken by management. Quality Performance Evaluation is a management tool. Unless it is used in a constructive manner, it will not yield effective results. Management may also determine that the Quality Performance Evaluation process itself may need adjustment from time to time in order to keep the process current with other management and operational changes to the organization. Such adjustments will help to assure its continued effectiveness.

3. CONCLUSION

The concept of going beyond conformance to a management system standard has been realized and developed to extend that Quality Performance Evaluation provides management with a powerful tool to determine the suitability and effectiveness of an Quality Management System. While quality audit practices provide the means of confirming the conformance of the Quality Management System to the quality standard, like ISO 9001, Quality Performance Evaluation provides management with the means to assure that the Quality Management System meets the performance needs of the organization.

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SIX SIGMA, LEAN MANUFACTURING AND LEAN SIX SIGMA

Branislav Tomic, Bombardier Aerospace, Toronto, Canada

Summary: *Six Sigma and Lean Manufacturing methodologies have been developed in order to enhance the final output from the organization. Six Sigma methodology reduces the variations from different processes and therefore by producing the better quality saves the money to the companies; Lean Manufacturing methodology aims elimination of any type of waste and creates continuous production flow and optimizes organization's processes. By integrating Six Sigma and Lean Manufacturing many synergic effects could be reached. Together, these two methodologies create a new way of working that is more powerful and effective than any of the two concepts individually. This article has intention to highlight the most important facts from each methodology, their comparison, to discuss about strengths and weaknesses of the both methodologies and strategies for their integration. The article presents how elements of both methodologies can be effectively integrated to create an effective Lean Six Sigma production system.*

Key Words: *Six Sigma, Lean Manufacturing, Integration*

1. INTRODUCTION

Today, Six Sigma and Lean Manufacturing are the two most used methodologies for continuous improvements and process development. Most major companies are using at least one of them. More and more companies are using both. In some companies, this results in two separate programs; one program for Six Sigma and one for Lean Manufacturing. This is not usually successful. Many of the possible synergic effects between the two methodologies have been missed and often conflicts arise between the two programs. Due to the fact that both methodologies work toward improvements in the companies but having different goals, there is a dilemma how to optimize both methodologies to work together or simply how to integrate Six Sigma and Lean Manufacturing successfully? This article is trying to describe the important facts for the successful integration of Six Sigma and Lean Manufacturing based on the previously done studies and practical experience.

2. SIX SIGMA METHODOLOGY

Six Sigma represents the quality methodology which aims to improve the quality of process outputs by identifying and removing the root causes of the problems and to reduce the variability in organization's processes. It uses a set of quality management tools and methods and follows a predefined sequence of steps how to achieve the certain projects. Every six sigma project has to have quantified financial targets either in cost reduction or profit increase. Six Sigma methodology emphasizes:

- continual efforts to achieve stable and predictable process results by reducing the process variation,
- that processes have characteristics that can be defined, measured, analyzed, improved / designed and controlled / verified and
- Achievemant of sustained quality improvement that requires commitment from the entire organization, particularly from top-level management including financial results.

Six Sigma projects follow two project methodologies inspired by Deming's Plan-Do-Check-Act Cycle. These methodologies, comprising five phases each, bear the acronyms DMAIC and DMADV:

- DMAIC is used for projects aimed at improving an existing business process and
- DMADV is used for projects aimed at creating new product or process designs.

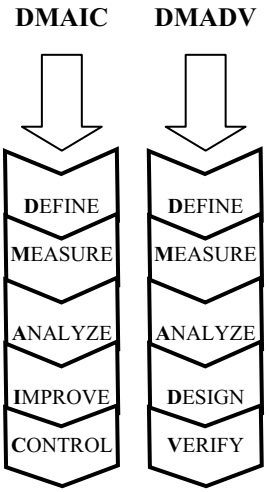

Figure 1. DMAIC and DMADV Models in Six Sigma Methodology

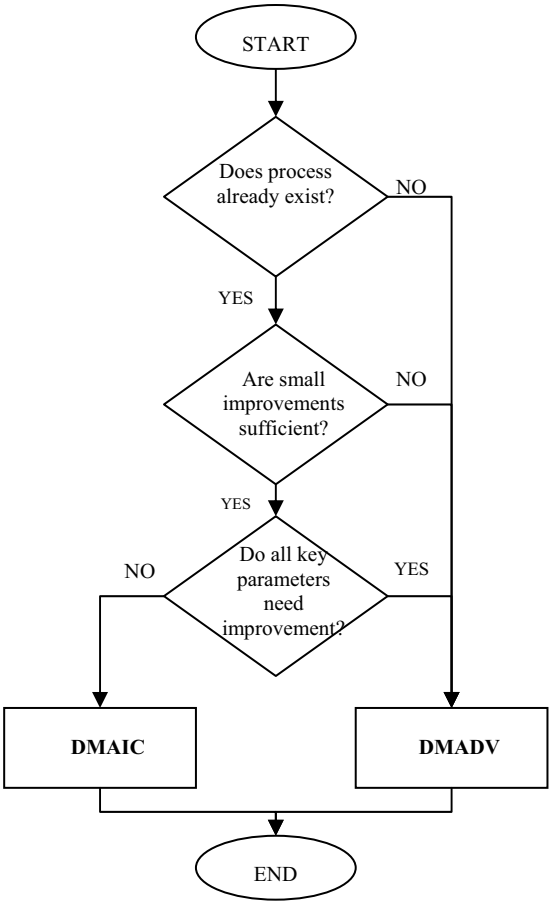

Figure 2. Algorithm when to apply DMAIC or DMADV Model in Six Sigma Methodology

The DMAIC methodology, instead of the DMADV methodology, should be used when a product or process is in existence in the organization but is not meeting customer specification or is not performing adequately.

The DMADV methodology, instead of the DMAIC methodology, should be used when a product or process is not in existence in the organization and one needs to be developed or the existing product or process exists and has been optimized (using either DMAIC or not) and still doesn't meet the level of customer specification or six sigma level.

3. LEAN MANUFACTURING

Lean manufacturing is a methodology or production practice that considers the use of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. Working from the perspective of the customer who consumes a product or service, "value" is defined as any action or process that a customer would be willing to pay for. Basically, lean is centered around creating more value with less work.

Lean manufacturing is a concept based on optimizing flow.Lean Manufacturing utilizes the set of tools that assist in the identification and constantly elimination of waste. As waste is eliminated quality improves while production time and cost are reduced. Examples of such tools are Value Stream Mapping, 5S, Kanban or Pull System, and Poka-Yoke (Error-Proofing).

Lean implementation is therefore focused on getting the right things to the right place at the right time in the right quantity to achieve perfect work flow, while minimizing waste and being flexible and able to change. More importantly, all of these concepts have to be understood, appreciated, and embraced by the actual employees who build the products and therefore own the processes that deliver the value.

The original seven wastes are defined as:

- Over-production
- Waiting time
- Transportation
- Processing
- Inventory
- Motion
- Scrap in manufactured products or any type of business.

Later an eighth waste was defined by Womack as manufacturing goods or services that do not meet customer demand or specifications. Many others have added the "waste of unused human talent" to the original seven wastes.

Lean Manufacturing is therefore the methodology that is about more than just cutting costs in the factory but to provide the real value to the customer / end user.

4. LEAN SIX SIGMA

There are many similarities between Six Sigma and Lean Manufacturing. At first glance, they can look rather different, but once one understands the two concepts more deeply, the similarities become clear. They both have a strong focus on quality and continuous improvement. Management commitment and understanding are central. The work is based on the deep knowledge and understanding of the companies' customers and processes. People are trained and involved; often even suppliers and customers are involved.

Many of the more immediately prominent differences between Six Sigma and Lean Manufacturing could be explained as a result of cultural differences between the western world and Japan. Six Sigma was founded within Motorola and further developed in companies like General Electric and Ford. In the west, organizational structure, responsibilities, and facts and measures are of the utmost importance. Lean Manufacturing on the other hand, is based on Toyota's very successful production system. In the Japanese culture, principles, philosophies, general structures, and behavior are more central. This is probably a major reason why Six Sigma has more structures, roles with clear responsibilities, two common models (DMAIC and DMADV), and many of systematic tools; while Lean Manufacturing is based on principles, change of behavior, and company culture. Once one understanding the concepts, it becomes clear that the underlying meaning is very similar despite those cultural differences. The most important difference between Six Sigma and Lean Manufacturing has to do with purpose. Six Sigma is a program intended for running continuous systematic improvements in an organization. Lean Manufacturing focuses on building a production system for the entire business; which means transforming the organization and its processes into a completely new way of doing the work. A production system created out of the Lean Manufacturing principles is also based on continuous improvements, but using fewer tools and structures than Six Sigma. A total Lean Manufacturing transformation is a much bigger challenge than the implementation of a Six Sigma program, as it means a totally new way of running the business. Lean Manufacturing is more like a total paradigm shift. Compared to Toyota's success with their production system, very few companies have succeeded in really implementing Lean Manufacturing. One reason is perhaps that a Lean Manufacturing transformation takes a significant amount of time to implement, and western management and stockowners don't have the maturity or patience needed. With Six Sigma it is often easier to succeed, as Six Sigma is a separate program. A Six Sigma program provides visual results rather quickly, as it is based on running many improvement projects simultaneously and that those results are measured financially. This usually makes it easy to motivate top management to become personally committed and to enlarge the Six Sigma initiative.

When comparing Six Sigma and Lean Manufacturing, it is possible to identify both the strong and weak qualities of each concept. Six Sigma has a stronger focus on results, clear roles and responsibilities, and has numerous effective problem solving tools; while Lean Manufacturing focuses more on the full perspective and the total transformation of the work approach, has a stronger focus on involving all employees, and aims at a total change of the company culture. By integrating Six Sigma and Lean Manufacturing, it is created the possibility to take advantage of most strong areas while avoiding weak ones.

Lean Manufacturing	Six Sigma
• Flow and process development • Employee participation • Cultural change • Strong philosophy with resolute principles • Focus on quality • Local improvement teams	• Problem solving • Distinct leadership • Strategic result focus • Clear role structure, common methodology and many tools • Financial focus • Cross-functional improvements

Table 1. Characteristics of Lean Manufacturing and Six Sigma Methodology

Also, there is comparison of the key characteristics of both approaches:

Characteristics	Six Sigma	Lean Manufacturing
Improvements	*Reduction of Variation*	*Elimination of Waste*
Results	*3.4 defects per million chances*	*Smooth flow*
Cost Reduction	*Cost of poor Quality*	*Operational Costs*
Learning Process	*Long*	*Short*
Project Selection	*Different Approaches*	*Based on Optimal Flow*
Length of Project	*Up to 6 months*	*Up to 3 months*
Initiator	*Data*	*Demands*
Complexity	*High*	*Moderate*

Table 2. Comparison of the Key Characteristics between Lean Manufacturing and Six Sigma Methodology

Six Sigma and Lean can be integrated in two directions. Selected Lean tools can either be integrated into a Six Sigma improvement program,

or improvement methodology and selected tools within Six Sigma can be integrated into a Lean production system. The results will be distinct. If Lean tools are integrated into Six Sigma, better improvement and problem solving concepts will be created, which are flexible enough to handle many different situations. If Six Sigma tools are integrated into a Lean production system, a more effective production system is created, which enables much better improvement capabilities.

By integrating selected Lean tools into Six Sigma, a wider and more effective improvement program is created. By complementing the traditional statistical methods within Six Sigma with tools like Value Stream Mapping, Poka Yoke, Cycle Time Reduction, Standard Work, and Theory of Constraints, it is possible to handle and solve a wider range of problems. Six Sigma becomes a complete problem solving and improvement program that can handle any problem; from elimination of variations, to making flows and processes more effective.

The integration of Six Sigma into a Lean production system is much less common than integrating Lean tools into Six Sigma. It seems that people working with Six Sigma have understood and accepted the advantages of bringing Lean tools into Six Sigma more than people working with Lean have accepted and understood Six Sigma. In any case, it is of great importance to change this and create an extended version of a Lean production system that uses Six Sigma as a structure and methodology for improvements and development.

Many companies have tried to work with Lean Manufacturing and Six Sigma as two parallel concepts within their organizations. This has often been more instrumental in creating misunderstanding, cultural clashes, and building barriers between the two sides. An integration of the two concepts is important. Some companies try to do this by putting one concept on top of the other. Often, this becomes unclear and difficult to understand. The structures and packages of Lean Manufacturing and Six Sigma are too different to make this practically useful. A successful integration has to be much deeper. Tools, working methodologies, and techniques have to be integrated with each other. A common way of working with all the tools and techniques learned from Lean Manufacturing and Six Sigma has to be found. Succeeding with integration has a lot to do with building a common cross-functional competence between the two concepts. By getting the same people to learn both Lean Manufacturing and Six Sigma in detail, deep understanding can be reached. Thus, when the situation requires it, the knowledge to combine the best techniques and tools from each concept can be used. A person can then fully understand both concepts since many of the barriers and misunderstandings automatically disappear. To succeed, it is of great importance to have a strong result focus and get rid of method focus and fundamentalism. It is important to stop looking at Lean Manufacturing and Six Sigma as pre-defined methodologies that should be run in a pre-determined fashion. They should be treated as competence packages with high flexibility that can be combined in the best possible ways. Other important consequences are that the total scoop increases, and the number of tools and techniques increase dramatically. The new integrated concept becomes more and more complete, and has the ability to handle progressively more different situations. This is of course very positive, and results in a much better improvement program. On the other hand, the methodology simultaneously becomes more vague and undefined. The specific way of working and solving problems becomes more and more situation-specific. This is something that has to be accepted. What is of the highest importance is to treat this as a competence and power to problem solve, develop processes, and run improvements rather than as a pre-defined methodology that should be followed in a specific way.

5. CONCLUSION

Six Sigma and Lean Manufacturing have much to offer each other. There are many similarities, but also differences. By integrating the best parts from each concept, a new and much better concept could be created. This has both to do with the tools and techniques that are associated with each concept and with the working methodology advocated by them. It is very important to integrate Lean Manufacturing and Six Sigma on a very deep level. Putting them on top on each other is usually not successful. In some situations it can become worse; with conflicts arising between them. Instead, Lean Manufacturing as Six Sigma have to be integrated into a common competence where tools, techniques, and working methodologies are combined and mixed in the best possible way.

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SESSION C – DECISION MAKING AND CONTROL IN IE

4th INTERNATIONAL SYMPOSIUM OF INDUSTRIAL ENGINEERING

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INDUSTRIAL ENGINEERING DEPARTMENT, FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF BELGRADE, SERBIA & STEINBEIS ADVANCED RISK TECHNOLOGIES, STUTTGART, GERMANY

THE AHP APPLIED IN MACHINE CRITICALITY DETERMINATION FOR MAINTENANCE STRATEGY SELECTION

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Abstract. *The paper presents the decision making model for determining machine criticality level, so as to select the best maintenance strategy. Initial model development involved the generation of the hierarchy containing 8 criteria at the first level and 6 criteria at the second level, and 5 alternatives. The procedure of alternatives ranking, i.e. machines in a concrete case, is presented in view of determining the criticality level for selecting the suitable maintenance strategy. Thereafter, a simplified decision making model was developed to determine machine criticality level regarding maintenance strategy, where a set of criteria involved the "Risk category". Comparison of obtained results was performed by applying two models and it was pointed to facilitated alternatives ranking in determining machine criticality level from maintenance aspect by using the risk category.*

Key words: *AHP, maintenance, strategy selection.*

1. INTRODUCTION

Selection of suitable maintenance strategy is made for each part of equipment or system, depending on defined criteria and constraints related to the observed system. The selection of the best combination: corrective, preventive, opportunistic, condition-based and predictive maintenance strategies is a complex task having in mind setting the conditions for system maximum availability with maintenance cost rationalization and failure risk reduction in the observed equipment.

According to Bevilacqua and Braglia (2000) maintenance manager wants to recognize the most critical machines for a reallocation of the budget maintenance resources. According to them this selection involves several aspects such as the investment required, safety and environmental problems, failure costs, reliability of the policy, Mean Time To Repair (MTTR), Mean Time Between Failure (MTBF), etc. and some of them is hard to evaluate because of complex nature

Triantaphyllou et all. (1997) research this problem and suggest AHP application in consideration only for criteria: cost, repairability, reliability and availability. The Reliability Centered Maintenance (RCM) methodology is widely used technique which represent a method for preserving functional integrity and is designed to minimize maintenance costs by balancing the higher cost of corrective maintenance against the cost of preventive maintenance, taking into account the loss of potential life of the unit in question (Crocker, Kumar, 2000). Failure Mode Effect and Criticality Analysis (FMECA) techniques is one of the very frequently adopted by the companies to categorize the machines in several groups of risk.

Belivacqua and Braglia (2000) suggest use of multi-attribute decision method based on AHP approach to select the most appropriate maintenance strategy for each machine group.

2. METHOD

The analytic hierarchy process (AHP), developed by Tomas Saaty in 1980s, is a tool for decision making analysis, created to assist decision makers in complex problem solving with a larger number of decision makers, a larger number of criteria and in multi-stage periods.

The axioms of AHP method are as follows (Vargas, 1990):

Axiom 1. Let pairwise alternatives and/or optimality criteria be given. Decision maker can compare their values, so that they are reciprocal.

Axiom 2. When values of pairwise alternatives or optimality criteria are compared, decision maker never assesses whether one alternative or optimality criterion is infinitely better than another alternative (optimality criterion).

Axiom 3. Decision making problem can be defined as hierarchical.

Axiom 4. When the decision making problem is defined, the next step is prioritization and assigning of optimality criteria weights respectively.

The analytical hierarchical process is based on the concept of balance used to determine overall relative weight of a set of attributes, activities or criteria, and are related to the analyzed decision making problem. This can be achieved by structuring any complex decision making problem which involves a few persons, a few criteria and a few periods in a larger number of hierarchy levels, assigning weights in the form of a series of pairwise matrices, and thereafter by using decision support system to determine normalized weights that will be deployed for evaluation of attributes at the lowest level of the overall hierarchy. The thus taken modeling process requires four phases:

1. Problem structuring
2. Data collection
3. Evaluation of relative weights
4. Determination of problem solution

The first phase consists of decomposing any complex decision making problem to a series of hierarchies, where each level represents a lower number of manageable attributes. They are then decomposed into a second set of elements corresponding to the next level etc. Such hierarchical structuring is an efficient way of facing the complexity of real problems and identifying significant attributes to achieve the overall goal of the problem. Hence the AHP method possesses and provides outstanding flexibility in assisting the decision making management processes and makes possible decomposing of the dependent – independent relations between attributes into hierarchy levels.

The second phase begins with data collecting and (their) weighting. The assessor and evaluator will then assign relative scores to pairwise attribute of a single hierarchy level, then to those for the next upper hierarchy level. The same process is repetitive for all levels of the overall hierarchy.

Following this ranking method, the assessor will assign weights to each pair separately, as a measure of how much one pair is more significant than another. If objective data are available, the assessor can utilize his own beliefs, assessments or data in assigning the weights. On completing the process, the corresponding pairwise comparison matrix is obtained, matching each hierarchy level.

The third phase consists of relative weights evaluation. As above mentioned, the pairwise comparison matrices will be translated into the problems of eigenvalues determination in order to obtain normalized and unique weight eigenvectors for all attributes at each hierarchy level. Let it be assumed that a given hierarchy level possesses n attributes A_1, A_2,…A_n with weight vector $t = (t_1, t_2, \ldots t_n)$. It is necessary to find t to determine relative weight for A_1, A_2, …A_n. If the assessor of weights compares each pair A_i and A_j of all attributes as a level whereby A_i is dominating A_j (i.e. t_i/t_j), then the pairwise matrix can be built:

$$A = (a_{ij}) = \begin{array}{c} \begin{matrix} A_1 & A_2 & & A_j & & A_n \end{matrix} \\ \begin{bmatrix} t_1/t_1 & t_1/t_2 & \ldots & t_1/t_j & \ldots & t_1/t_n \\ t_2/t_1 & t_2/t_2 & \ldots & t_2/t_j & \ldots & t_2/t_n \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\ t_i/t_1 & t_i/t_2 & \ldots & t_i/t_j & \ldots & t_i/t_j \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\ t_n/t_1 & t_n/t_2 & \ldots & t_n/t_j & \ldots & t_n/t_n \end{bmatrix} \end{array}$$

Then the normalized vector of weights $t = (t_1, t_2, \ldots t_n)$ can be found by solving the corresponding problem of the largest eigenvalue:

$$At = nt$$

Let A be reciprocal, i.e. the matrix with the property: $A_{ji} = 1/a_{ij}$ and $a_{ij} = 1$ for all I, j = 1, …, n

If diagonal elements of the matrix A are equal to 1 ($a_{ij} = 1$) and if A is the regular matrix ($\det A \neq 0$), then small changes in values for a_{ij} retain the largest eigenvalues for let's say λ_{max} ,the other eigenvalues being approximately equal to zero. In this way, finding the value of vector t by solving the expression At = nt is equivalent to:

$$At = \lambda_{max}\, t$$

In general, the vector obtained by solving this expression is not the normalized vector. Defining $\alpha = \Sigma t_i$ and substituting t with t/α it can be obtained the normalized vector for determining relative weights of attributes A_1, A_2, …A_n..(Saaty, 1972).

Index of consistency (IC), as a measure of consistency in deviation n from λ_{max} can be calculated from the following expression

$$IC = \frac{\lambda max - n}{n - 1}$$

The value of IC <0.10 is considered, in general, the satisfactory measure indicating that estimates (for a_{ij}) are consistent and that due to this a certain value for λ_{max} is approximately equal to the ideal value the assessor wants to assess.

The fourth phase is the last phase of the AHP method which implies finding so called composite normalized vector.

3. MODEL DESIGN

The first step in selecting the maintenance strategy for a certain machine/part of some technical equipment/installation/plant is the determination of its criticality level. For machine equipment where a high criticality level has been established for safety (of personnel, environment, factory etc); importance for the manufacturing process; high percent in the overall maintenance costs;; deficiency of spare parts; greater attention should be given to preventive maintenance when selecting the maintenance strategy.

In determining machine criticality level the following criteria were defined:

1. Damage in the event of failure: product damage, people damage, image damage, plant damage, environmental damage and production loss.
2. Machine importance for the process. Significance machine for correct operation of the plant.
3. Spare parts availability. Machines that do not have spare parts available are the most critical.
4. Maintenance cost. Maintenance costs embrace costs of spare parts procurement, invested labor.
5. Access difficulty.
6. Failure frequency.
7. Downtime length.
8. Operating conditions.

On the basis of defined criteria, a hierarchy was generated for decision making model of machine criticality level for selecting maintenance strategy, as shown in Fig. 1. The generated hierarchy has two criteria levels and a set of alternatives constituted of 5 machines in this example. The AHP method was used to evaluate relative weight coefficients for the first- and second-level criteria. To evaluate the criteria at the first level, a 5-point verbal scale for significance level was used. The same scale was deployed to determine relative significance of criteria at the second level against the criterion "Damage" at the first level. To determine relative significance of alternatives in the criterion "Failure frequency", a numerical scale "percent'' was used. To determine relative significance of alternatives in the criterion "Downtime length" a new numerical scale was introduced with real values from the previous period for individual machines of mean time in downtime.

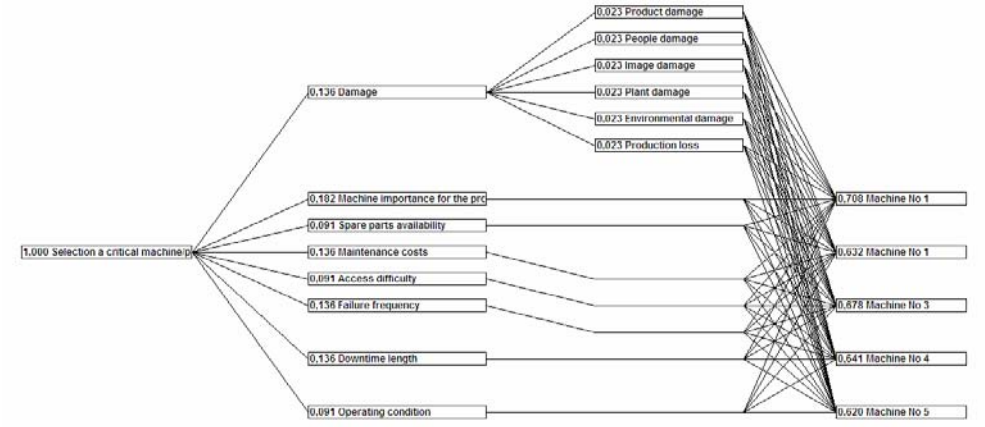

Fig. 1 AHP hierarchy for determination of machine criticality

Using the decision making support system which supports hierarchy generation and calculations based on the AHP method, data were obtained, which are presented in Fig. 2. Based on the obtained results, ranking of alternatives can be performed according to criticality level for the manufacturing process continuity, safety for personnel, environment, production losses, company's image, etc, which all affects the selection of the suitable maintenance strategy. The results indicate that machines No 1 (0.708) and machines No 3 (0.678) are the most critical from the maintainer's aspect.

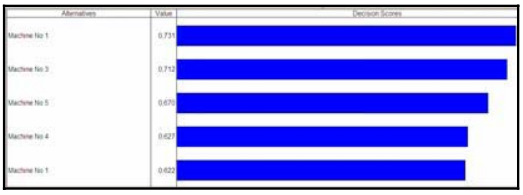

Fig. 2 Decision score

Fig. 3 shows the percent of individual criteria at the first level in the overall result. For example, the highest relative percent for the criterion "Machine importance for the process" is evident for machine No 3, however, due to low relative percent of the criterion "Maintenance cost" in total maintenance cost, this machine is ranked second in the final rank of the observed machines with respect to the maintenance criticality level.

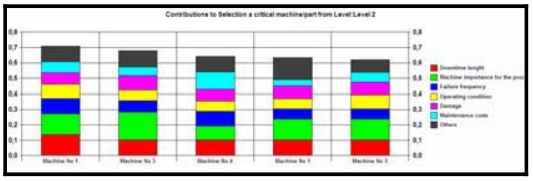

Fig. 3 Contribution level

Considering that the risk of machine failure is calculated as the product of failure probability and consequences for personnel, environment, production losses, image etc in the generated hierarchy of criteria at the first level for alternatives ranking with respect to criticality level for maintenance, it is possible to replace the criteria "Damage" and "Failure frequency" with the criterion "Risk category". The generated simplified hierarchy is presented in Fig. 4.

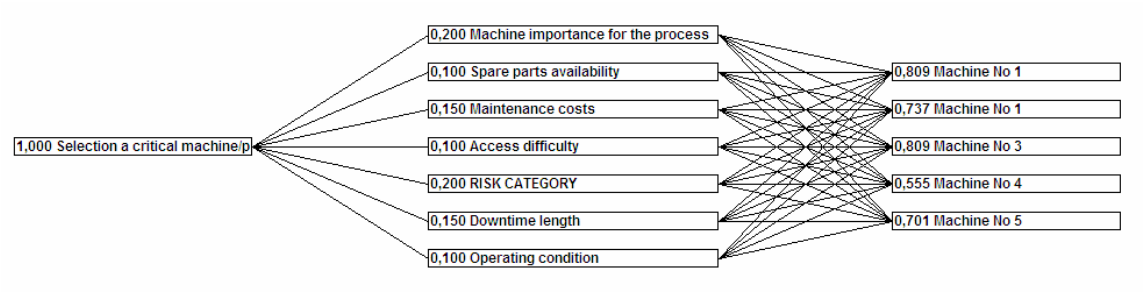

Fig. 4 Simplified Hierarchy

The risk category for some machines is the most common variable, therefore using the mentioned 5-point verbal scale for risk assessment, a simplified decision making hierarchy for determining machine criticality level regarding maintenance is obtained. Fig. 5 shows the obtained results.

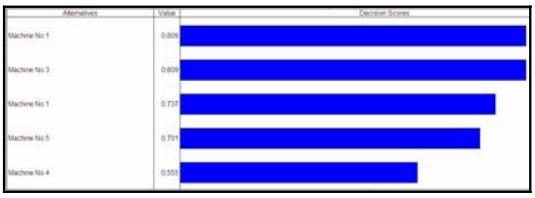

Fig. 5 Decision score

The sequence of alternatives obtained by the simplified model against the initial decision making model is identical, but weight coefficients are different. The difference in weight coefficients in final decision score was caused by change in the overall relative significance of the criterion "Risk category" (0.200) in the simplified model ("Critical" on a 5-point scale of significance) compared to the initial model where the summative percent of the criteria "Damage" (0.136) and "Failure frequency" (0.136) amounts to 0.272. Fig. 6 shows relative percent of individual criteria at the first level in the overall result.

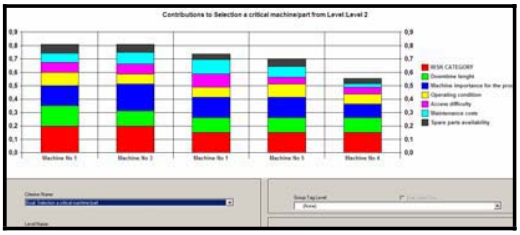

Fig. 6 Contribution to selection of a CM from level 2

Fig. 7 presents alternative weight coefficients against the criterion "Risk category" at the first level. It is noticeable from the Figure that machine No 1 and machine No 3 have the highest assessment level on a 5-point scale for the assessment of risk category, which coincides with the overall Decision score (Fig. 5) for machine criticality level assessment with respect to maintenance.

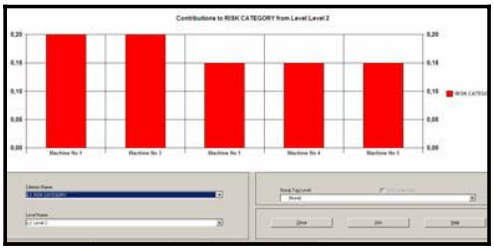

Fig. 7 Contribution to Risk category form Level 2

4. CONCLUSION

The paper displays a decision making model for machine criticality level determination with respect to the selection of the suitable maintenance strategy. The presented model is useful for decision makers of maintenance because it facilitates defining a group of critical machines that need more attention from the maintenance aspect, then according to production concrete needs and requirements makes necessary modifications of the model itself in the sense of changing the significance of some criteria and varies alternative estimates with respect to some criteria depending on real operating conditions. The presented model is also applicable in process and power industries, oil refinery etc.

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IMPLEMENTATION OF DECISION SUPPORT SYSTEM IN THE DESIGN OF THE LUNDBERG MODEL FOR INITIATING ORGANIZATIONAL CHANGES

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Abstract
The paper displays implementation of the decision making support system in the design of the Lundberg model for initiating organizational changes in the company. Using the known decision making variables and alternative solutions as defined by the Lundberg model for the design of initiating organizational changes, a decision making hierarchy was built and verbal scales were defined. Comparative analysis of the results that can be obtained by implementing the original Lundberg model and the model designed in this work pointed out several advantages of the Decision support system.
Key words: decision support system, organizational changes

1. INTRODUCTORY CONSIDERATIONS

The Lundberg model for the design of initiating organizational changes is a process constituted of a series of sequential choices. The model has a series of questions for the manager of organizational changes. Through the answers to the questions, in a certain sequence, it is arrived at the decision on the initiating mode and the issue of organizational changes strategy. Questions are actually rules that determine particular choices, leading to the next choice etc, while the overall path is defined i.e. the mode of initiating organizational changes.

The Lundberg model contains:
- a set of contingency questions – variables X_i, i = 1, 2, …10; where for each X_i the answers can be "yes" or "no";
- a set of points defining the decision making strategy in the organizational changes process Y_j , j = 1, 2, … 7;
- factorization function in the decision tree, which converts condition vectors into a choice of questions, thus defining the organizational changes path i.e. Y = F(X)

Questions constituting the Lundberg model i. e. variables X_i are as follows:
X_1 – Should the project of changes be initiated? (X_1 represents manager's belief that deviation will fade away if it is ignored)
X_2 – Does manager know technically feasible solution or project design? (X_2 does not involve manager's assessment of the project/solution acceptability on the part of his subordinates)
X_3 – Does manager have enough time to solve or to design deviation solutions?
X_4 – Does manager have the authority to solve or to design deviation solutions? (X_4 refers to the manager capable of decision making and does not refer to the manager capable of choosing technically feasible solution – project)
X_5 – Is deviation recurring? (X_5 asks the manager if deviation is likely to recur or it has been registered earlier)
X_6 – Will manager's solution/project of solution be accepted or it has to be negotiated? (Manager's negotiating ability depends on his capacity to identify people who will be affected by the project of changes as well as on his power over them)
X_7 – Can manager transfer deviation to his superior? (X_7 depends on the manager's assessment of his own will and intention to transfer the problem to his superior as well as on the superior's will to accept this)
X_8 – Is there a suitable standing committee and does it have time to answer? (X_8 depends on manager's belief in the standing committee's competence)

X_9 – Is it possible to contract a consultant? (X_9 possibility depends on availability of consultants as well as on whether there are resources to compensate for the consultants' effort)
X_{10} – Is there a serious time limit or dead-end? (X_{10} requires imposition of the solution/project if manager believes that further discussion is useless!)

In the Lundberg model, seven decision making strategies (Y_j) are defined:
Y_1– To undertake nothing
Y_2 – To solve (the manager implements directly his solution to the emerged problem)
Y_3 – The manager transfers the problem directly to the upper level because he thinks that the problem overcomes his authority and can be solved only at the upper level
Y_4 – Forming the ad hoc committee (the committee is defined as a set of the manager's colleagues or subordinates whose task is to propose the problem solution to the manager i.e. they are not authorized to implement it)
Y_5 – To assign a task to the standing committee (its task is to propose the likely solution to the manager; standing committee has been in existence and deals with problems and activities related to a concrete problem being solved by the manager)
Y_6 – Forming the task force (task force is defined as a set of colleagues who are assigned by the manager to propose the problem solutions but to implement them as well)
Y_7 – To contact the consultants (the consultant is a person outside the company which agrees to "supply" the manager with recommendations)

2. IMPLEMENTATION OF DECISION SUPPORT SYSTEM IN MODEL DESIGN FOR INITIATING ORGANIZATIONAL CHANGES

In the design of the model for initiating organizational changes the variables X_i , i = 1, 2, …10; and alternatives Y_j, j = 1, 2, …7; were deployed. The initial model is shown in Fig. 1. The defined variables were utilized as criteria in the generated decision making model, and beforehand defined decision making strategies were taken for alternatives. For each variable in the initial model, a verbal scale with possible "yes" and "no" answers was placed. Linking variables into a series of chained rules is possible owing to the Rule-base editor in DSS.

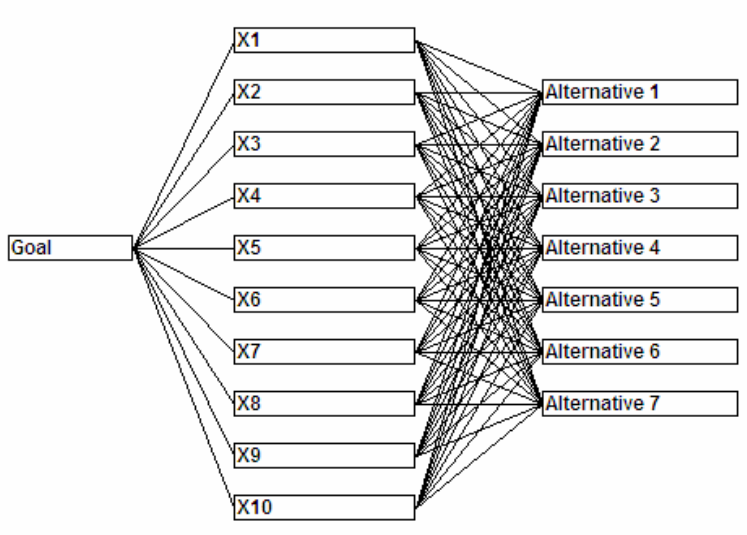

Figure 1. Initial model

In the initial model in DSS preference criteria, i.e. defined variables after Lundberg, are equal so as to obtain the identical original model basically with the idea to sum the results in group decision making and to use average in the final score. Also, in the initial model verbal Yes/No scales were deployed.

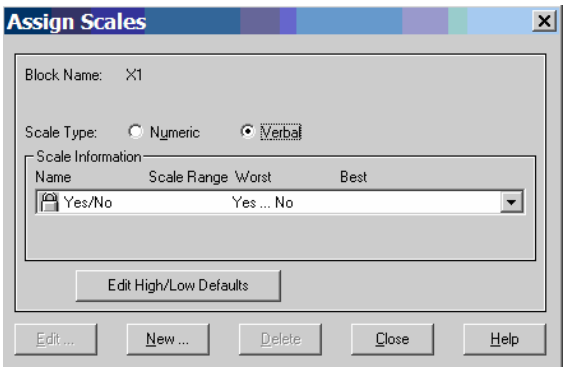

Figure 2. Verbal scale: Yes/No

However, the advantages provided by DSS are that some criteria can be assessed in terms of weight as more significant, and thus we obtain much more complex structure and totally different concept of decision making compared to the original Lundberg model. The initial model was observed a certain number of conflicts, and thus it is formed a new set of criteria, figure 3.

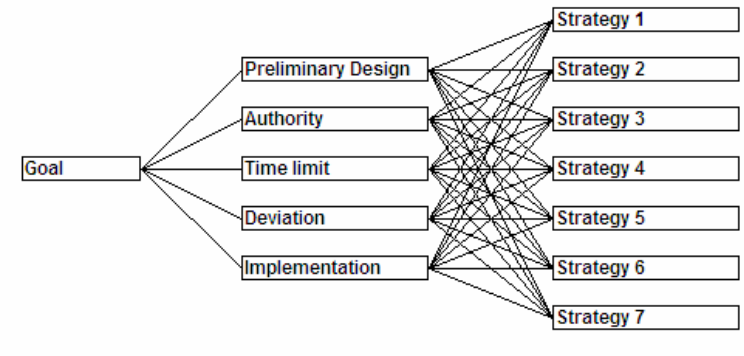

Figure 3. Hierarchy Graph

The following criteria are defined: Preliminary Design, Authority, Time limit, Deviation, Implementation. In the shown model (fig. 3), decision makers have the possibility to define the importance of influential criteria. Figure 4 shows the defining of the verbal scale for the criterion 'Authority'? A 4-level verbal scale of likely answers was constructed: the project of changes should not be initiated; the project of changes may be initiated; it is necessary to initiate the project of changes; it is necessary to initiate the project of changes immediately.

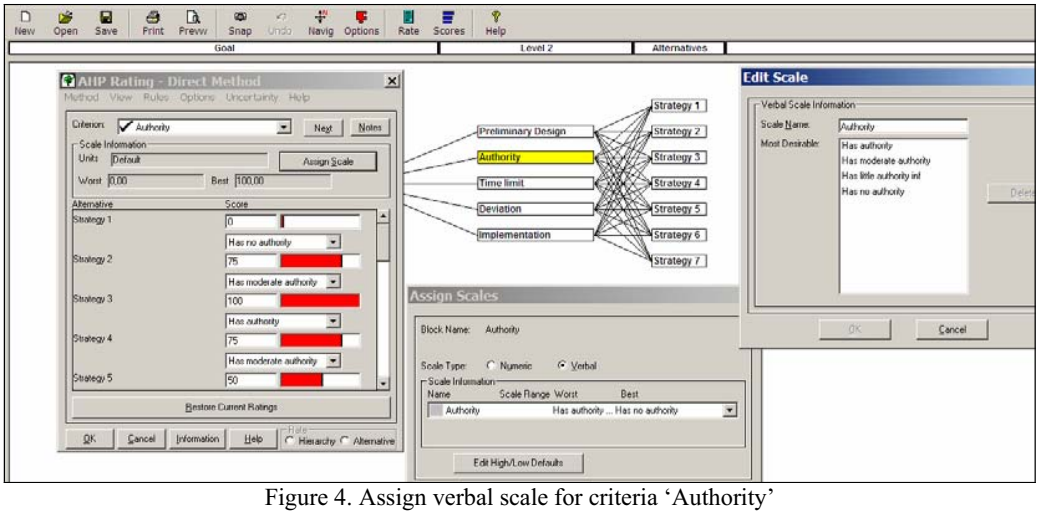

Figure 4. Assign verbal scale for criteria 'Authority'

In the observed problem of ranking strategies for initiating organizational changes it is very useful to perceive the results of sensitivity analysis which demonstrates sensitivity of the proposed solution for likely deviations. Figure 5 presents sensitivity analysis indicating that alternative 6 (Strategy 6) is insensitive to input parameters change, which provides reliability in the choice of decision making strategy.

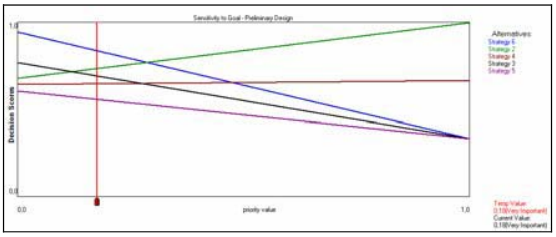

Figure 5. Sensitivity by Weights

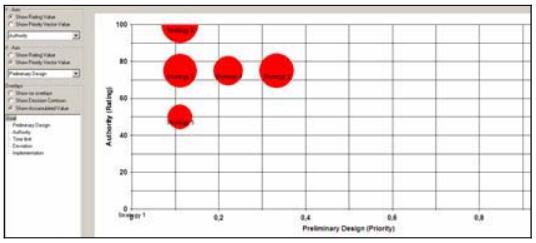

Figure 6. Data Scatter Plot – Accumulated Value

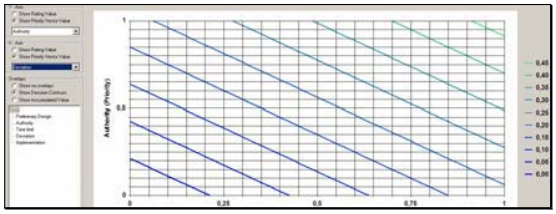

Figure 7. Data Scatter Plot – Decision Contours

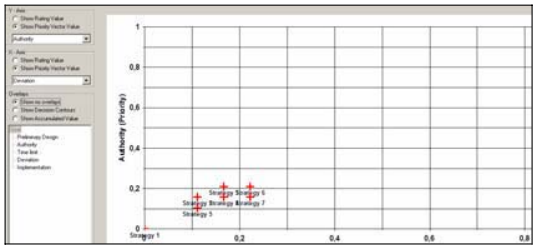

Figure 8. Data Scatter Plot – No overlays

Data Scatter Plot diagrams shown on figures (Figure 6. Accumulated Value), (Figure 7. Decision Contours), (Figure 8. No overlays) gives additional insight into the justification of the chosen solution in decision making model for initiating organizational changes.

The advantages of the designed model in the decision support system compared to the original Lundberg model are as follows:

- possibility of ranking the strategies
- possibility of assigning preferences in influential criteria
- possibility of assigning verbal scores on the n-th-level scales instead of ‘yes” and “no” answers only
- possibility of modeling the preferences
- possibility of adjusting the designed model to the needs of a concrete company

3. CONCLUDING CONSIDERATIONS

The paper presents the decision making model for initiating organizational changes. The model was designed in the decision support system. Unlike the classical Lundberg model for initiating organizational changes, in the presented model it is possible to vary the preferences of influential criteria, use linguistic statements in defining weight coefficients of alternative solutions (i.e. in the concrete case of alternative decision making strategies for the mode of initiating organizational changes in a concrete company) and perform alternative solutions ranking.

Sensitivity analysis enables the perception of decision making strategy sensitivity level against relative changes of influential criteria preferences, as well as of decision making strategy sensitivity in the case of changes in weight coefficients against the posed decision making variables.

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COMPUTER SUPPORT FOR PRODUCTION PRODUCTIVITY MONITORING

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Abstract – *This paper describes the development of the computer programme for monitoring production productivity. The paper presents all significant parameters and calculation elements from the theoretical aspect, as well as the method of computer support in particular steps. In addition to automation of calculation, the paper also describes other significant properties of computer support in this segment, such as linking with the existing databases and, consequently, the automation of obtaining databases, as well as the visual methods for results presentation.*

Key Words *– Production productivity, Computer support*

1.0 INTRODUCTION

The main purpose of monitoring production productivity is the effort to realise the largest possible production scope. On the other hand, there is another equally important effort – the smallest possible work time consumption. These parameters represent the main components for determining productivity in the narrow sense, no matter which work levels and sectors they were measured on.

The very effort to realise the largest possible production scope with the smallest time consumption leads to the fact that quantitative productivity measure is expressed in the form of relation between material goods produced in a particular period of time and time consumed in the course of that production. A detailed procedure for all significant calculations, with examples which illustrate that, is given in reference [7].

The productivity measure gets its true meaning only when it is compared to the equivalent productivity measure from some other time period. That is the reason for defining the basic period as a reference for comparing. The main goal of calculated values is to show, in percentages, the increase or decrease of work productivity in the examined period when compared to the basic period. Productivity indexes are used as measure for expressing this comparison. Productivity can be examined from the aspect of one or several products, one production plant or the entire factory. Therefore, the production indexes can be defined as individual or collective (consolidated) indexes.

The diversity of production and products assortment often represents an obstacle when determining grouped productivity indexes; from that reason, dynamic indexes (variable structure indexes) are defined as well, which is more comprehensively given in reference [11].

The use of computers and computer applications intended for automation of these applications should aim at automatic generation of results on the basis of a large number of necessary parameters for monitoring productivity production. It is important to presents such results in the form of diagrams, i.e. visually, which leads to more practical and vivid insight.

It should also be mentioned that, due to the linking to the existing databases, which are of dynamic nature, the application of computers for this purpose becomes even more significant.

2.0 BASIC ELEMENTS OF CALCULATIONS AND RESULTS PRESENTATION

The basic elements which are necessary for calculating production productivity, as well as some of the most important calculated elements, are given in initial application forms. Figure 1 presents

the form for input of main parameters in the case of monitoring data on flow of articles production scope from one year to another in the company. By defining the equivalent physical production scope, monitoring of their production productivity is also made possible.

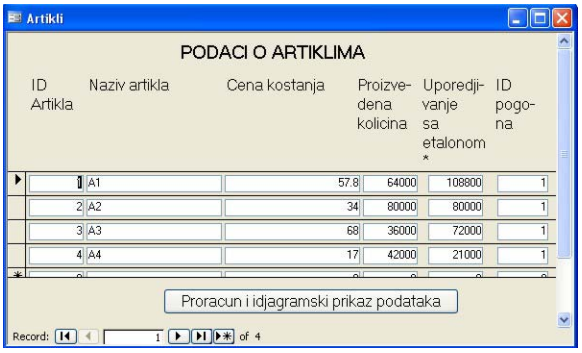

Figure 1. Monitoring of articles production scope

Most often, the most massively produced article is taken as benchmark. The following programme code shows the elementary course of these calculations:

SELECT Sum(Articles.USE) AS SumOfUSE
FROM Articles;
*UPDATE Articles SET Articles.USE = (Articles!CK/Forms![Determining of benchmark]!CK)*Articles!PK;*
...

Presentation of results in the form of diagram is given in figure 2.

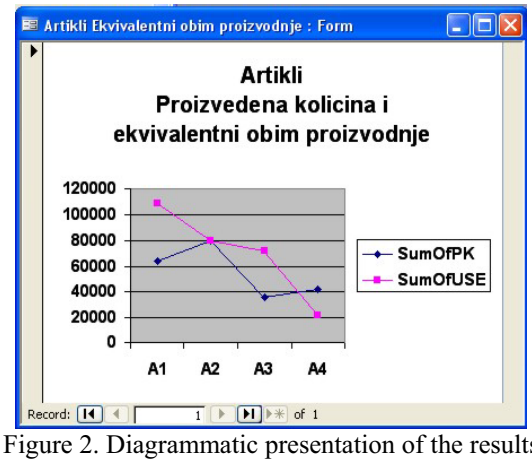

Figure 2. Diagrammatic presentation of the results

The following example shows the examination of a more complex calculation with a large number of parameters. Figure 3 shows input and output parameters (marked with asterisk) of the first compared production plant, while figure 2 gives data on the second one.

Productivity was calculated according to the following basic equation, both in basic (main) and in ongoing (examined) period and represents the relation between production scope and consumed working hours.

$$P_{0,A} = \frac{Q_{0,A}}{T_{1,A}} \quad \ldots$$

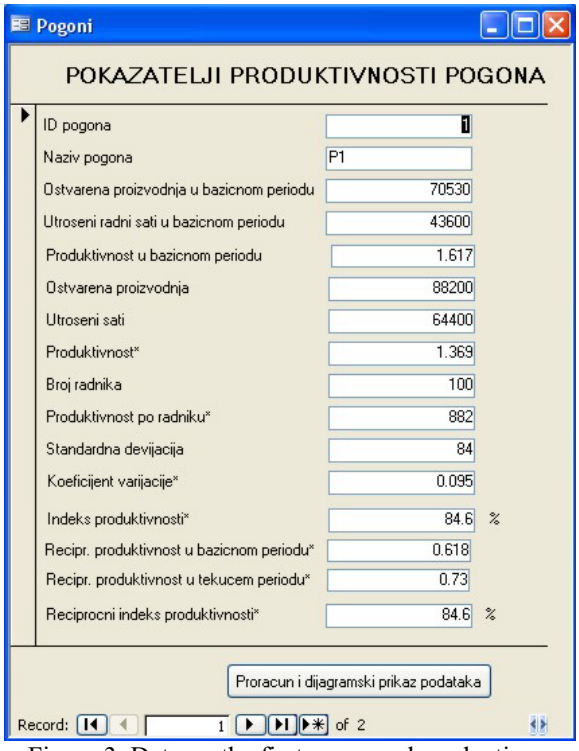

Figure 3. Data on the first compared production plant

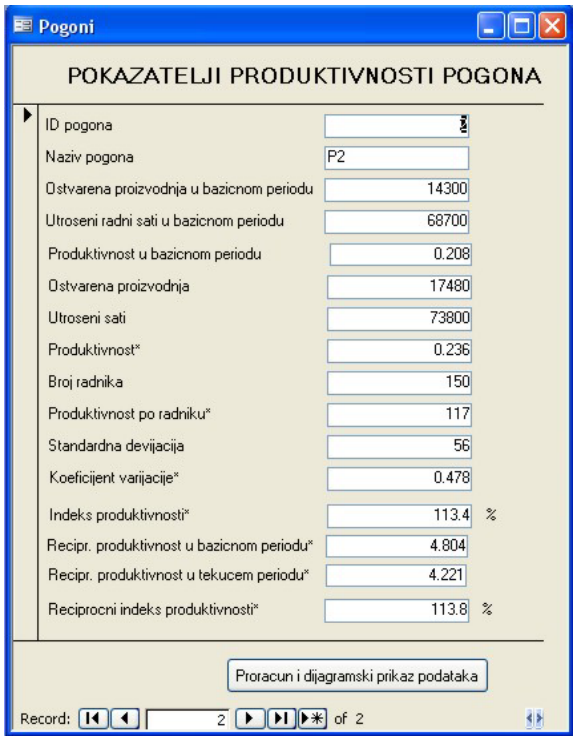

Figure 4. Data on the second compared production plant

Productivity index is shown as a relation between productivity in ongoing and main period:

$$IP_{q,A} = \frac{P_1}{P_0} \cdot 100 \ [\%]$$

Variation coefficient (relation between standard deviation and average productivity per worker) gives insight into variability of production plant productivity.

$$V_A = \frac{\sigma_A}{X} \ ...$$

Programme interpretation is given in the following way.

```
UPDATE Plants SET Plants.PBP =
Plants!OPBP/Plants!URSBP, Plants.P =
Plants!OP/Plants!URS, Plants.RPBP =
Plants!URSBP/Plants!OPBP, Plants.RPTP =
Plants!URS/Plants!OP;
UPDATE Plants SET Plants.PPR = Plants!OP/Plants!BR;
UPDATE Plants SET Plants.KV = Plants!SD/Plants!PPR;
```

It would be interesting to mention the calculation of the complex productivity index (on the basis of reference [1]) for numerous diverse groups of products, which represents the sum of products of consumed time and productivity in the examined and basic period (form for results presentation is given in Figure 5.

$$IP_q = \frac{\sum T_1 P_1}{\sum T_1 P_0} \ ...$$

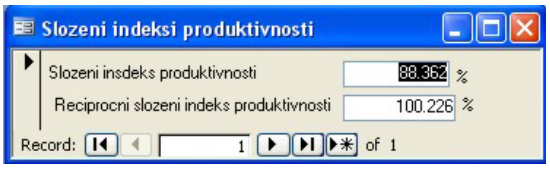

Figure 5. The results of complex productivity index

As shown in the figure, on the basis of obtained results, the examined company would have the decrease of productivity of about 0.12% according to the complex productivity index.

Figure 6 shows some of numerous parameters which can be monitored visually. Such a convenience facilitates perception of parameters change to a large extent, which is very important in this area. Only after this part is realised, do the accurate numerical values of parameters become significant.

Graphic presentation makes it possible to observe not only the ongoing condition of examined values in particular production plants, but also their comparison. Diagrams represent the results of only the elementary example with two production plants. With the increase of production plants number, such a comparative diagrammatic presentation becomes much more valuable in practice.

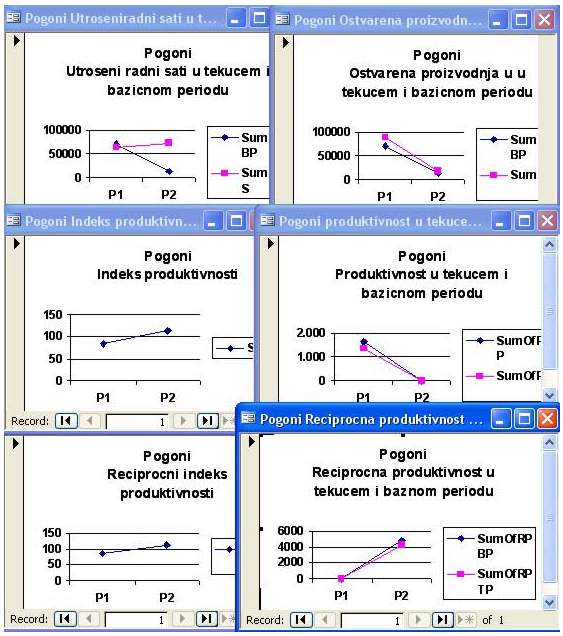

Figure 6. Parameters and results shown visually

3.0 SOME PROPERTIES OF PROGRAMME SOLUTION

One of the significant properties that could be emphasised when using such a programme solution is, first of all, generalisation of its application. Mathematical model of calculating the examined parameters represents the general model, which can be applied in practice regardless of the type of production and other company properties. On the basis of input values, all necessary calculated values are obtained.

The application has been implemented in the tool MS Access, due to which it can function independently and in a smaller network, if practical needs of the company require that. Linking with the large system base, such as, for example, MS SQL Server, makes possible the use of centralised data of the big company. In this case, in addition to simple implementing by ODBC technology, this tool also becomes excellent user's interface for using shared data. The significance of linking with the central base enables the use of the information system. In this way, the application uses and becomes a part of the general information system of a large company. Thereat, it is not necessary to input data additionally; the programme is only allowed to analyse them.
Figure 7 shows some of the most important fields of one of the database tables used by the programme. By linking tables of the SQL Server,

the programme can simply use other external databases.

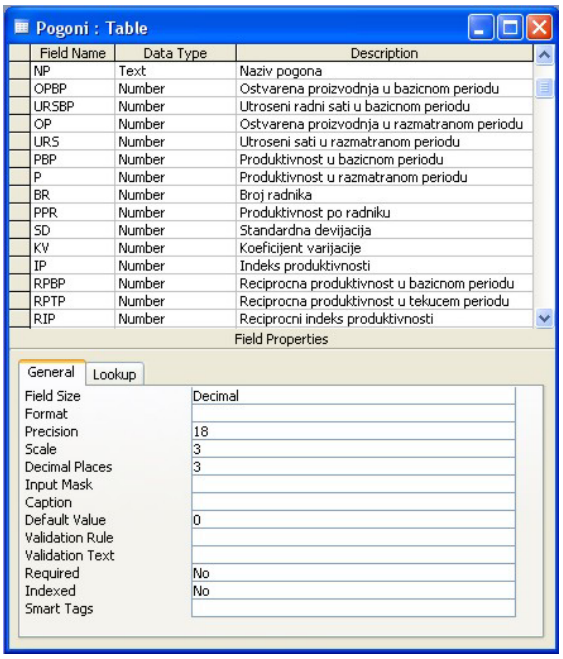

Figure 7. One of database tables

The entire mathematical model of calculation in this application has been defined by SQL language, which represents the universal language for accessing databases. In that way, already developed programme code (with minor changes) can be used in other tools, when developing application for this purpose.

4. CONCLUSION

On the basis of everything previously said, it could be concluded that computer support significantly enhances calculation methods in the discussed area. The user does not have to spend a lot of time dealing with theoretical postulates of calculations and mathematical models; instead, the user can observe them in the form of ready results and diagrammatic presentations.

The paper shows one elementary example of comparing the results of two production plants, which could be much more complex in practice. That is the exact case where the functionality of presented solution shows its extreme importance. Due to automation of calculations and possible obtaining of input data from the existing information system, the user is only allowed to monitor the condition of production system and its productivity.

It is especially important to emphasise the universality of this application use in any production organisation or entity.

In the course of developing this programme solution, particular attention was given to the fact that the entire calculation should be expressed by universal language for accessing databases, so that it could also be used when developing applications in other tools. This point exactly could be the basis for further improvement of such computer support.

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IMPROVEMENT OF AN ADAPTATION OF A HURWITZ APPROACH FOR THE BEST PRODUCTION SOLUTION TRIBOMETER SELECTION

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Abstract . This paper considers selection of the project solution of tribometers with respect to all treated criteria, simultaneously, taking into account the type of each criterion and its relative importance. The considered problem has a critical effect on the competitive advantage of small firms in which tribometers are being manufactured. The criteria present project solution performances and they are defined by Management Team. The relative importance of treated criteria is different and it is assigned according to relative importance relationship of each treated criteria pair. Criteria values for each project solution can be obtained either analytically or they are linguistic subjective judgments defined by discrete fuzzy numbers. In order to rank and choose the best project solution, a new procedure is developed and applied.

Key words. Project solution of tribometer selection, fuzzy set, multi-criteria analysis, fuzzy analytic hierarchy process

1. 0 INTRODUCTION

Technological, political, economic and other environmental changes in the business world demands from managers of all industrial organizations, especially small firms in which special measuring equipment such as tribometers is being produced, to develop new strategies which should lead to the increase of their competitive advantages which is basically achieved through [2]: high quality products, lower cost and higher customer satisfaction. Some of the possible strategies are modification of existing products and/or introducing new products which have the same technological base..

Tribometer is contemporary highly sophisticated measuring machine used for testing the interaction of contact surface during the relative movements of nano and micro levels to the levels of national economy. Tribometers are used in almost all industrial organizations with various productions such as: production of rolling-element bearings and sliding bearings, production of gears and screw pairs, production of various materials (steel, plastic, non-ferrous metals, et al), thermal treatment and harden materials, production and processing of plastic mass, production of oils and lubricants et al. It should be mentioned that quality testing of large number of various products in order to get the quality certificates of considered products, is realized on tribometers

Nowadays, there are a lot of small firms, mainly in India and which produce different kinds of tribometers, whose annual profit is few million euros. Based on data from file depending on type, unit market price of tribometer is within the price range of 30 thousand to one million euros. The price of 1 kilo of manufactured material built-in tribometar is over 1000 thousand euro, while for example in the latest cars the kilo of the manufactured material is being sold for nearly 50 euros. From the aspect of price,, tribometer is 20 times more current product than a car.

One of the principal decision making problems which for managers of small firms in which tribometers are being projected and manufactured, is how to choose the best project solution from the group of available project solutions in order to gain the highest profit. The considered problem can be characterized as dynamic and unstructured. Situations are changing rapidly or are uncertain,

and values of some criteria are difficult or impossible to quantify.

According to voluminous review of literature shown in [8] we can conclude that it is necessary to make more effort towards combining both qualitative and quantitative criteria affecting the selection process in a rational and systematic way.

Considered problem can be stated as multi-criteria optimization task. Solutions of this problem can be obtained by applying in the different ways. In this paper, solution of the considered problem is given by applying integrated approach. The developed procedure combines elements of the analytic hiearchy process-AHP [7] , fuzzy set theory ([6], [9], [11]), and adapted Hurwitz approach [5].

Values of uncertain demand can be adequately described by vague linguistic expressions. In this paper, it is shown that uncertain demand is better represented by the notation of fuzziness than that of chance and probability [4].

Fuzzy approach in treating uncertainties in real-word applications has numerous advantages in regard to other approaches such as applying probability theory, applying rough set theory, etc. These advantages could be expressed as following [10]:

- Fuzzy system models are conceptually easy to understand.
- Fuzzy system models are flexible, and with any given system, it is easy to manage it with fuzzy system models.
- Fuzzy system models can capture most nonlinear functions of arbitrary complexity.
- Fuzzy system models are tolerant of imprecise data.
- Fuzzy system models are built on the expertise of experts.
- Fuzzy system models ban be blended with conventional control techniques.
- Fuzzy system models are based on natural languages.
- Fuzzy system models provide better communication between experts and managers.

The objective of this paper is model a number of possible projects solutions in the case where customer demand is uncertain and described by fuzzy sets ([6], [9], [11]), and to choose one among them.

Choosing the best project solution among possible project solutions has to be made by taking into account a number of criteria, representing many aspects that enter into the evaluation of each project solution. The values of each criterion are either cardinal or linguistic expressions.

The paper is organized as follows: in Section 2 a multicriteria approach for selecting the best project solution is given. In Section 3, modeling of uncertainties which exist in models, are described. In Section 4 a new fuzzy model for the selection of the compromised best project solution with respect to numerous criteria, simultaneously, is described.

2.0 PROBLEM STATEMENT

2.1 Basic assumptions

Assumptions, under which a model for selecting the best possible supplier for one kind of raw material with respect to more different criteria such as their importance is developed, are:

-Management Team defines the set of possible project solution tribometers.

-Management Team based on its knowledge and experience defines the set of criteria according to which each possible project solution is being evaluated. In this paper, the following criteria are treated:
1. Unit price of project solution, monetary unit
2. The total production costs (costs of special parts production, installation costs and testing costs), monetary unit
3. The total price of finished components whish are built into tribometer, monetary unit,
4. Forecasting demand in year, item

-To each defined criterion an organized pair (relative importance, value joined) is associated.
-Relative importance of treated criteria does not depend on project solutions, and is in most cases hardly changes. Generally, the relative importance of criteria is different and determined according to knowledge and experience of Management Team. In this paper relative importance of treated criteria is assigned according to a matrix of pair comparison which is positive and reciprocal.
-Values of defined criteria are determined for each project solution separately. In this problem, these values can be crisp and/or uncertain. The uncertain values are modeled by applying the fuzzy set theory.

The values of first three considered criteria for each possible project solution can be obtained analytically. These criteria are cost-type. The value of customer demand is a subjective judgment described by a linguistic expressions. This criterion is benefit-type.

2.2 Notation

p-project solution, p=1,..,P,
k-criterion, k=1,..,K,
P,-total number of project solutions,
K'-total number of crisp criteria,
K-total number of considered criteria,
w_k-the relative importance of criterion k, k=1,..,K,
f_{pk}-parameter of crisp criterion k for project solution p, k=1,.., K'; p=1,..,P,
f_{sk}^n-normalized value of f_{sk}, k=1,.., K'; p=1,..,P,
$\tilde{f}_{pk}$- parameter of uncertain criterion k for project solution p, k= $K'+1$,..,K; p=1,..,P,
$\tilde{f}_{pk}^m$-mapping value of $\tilde{f}_{pk}$, k= $K'+1$,..,K; p=1,..,P
d_{pk}-transformed value of f_{sk}^n of with respect to relative importance criterion k, k=1,.., K'; p=1,.,P,
$\tilde{d}_{pk}$-transformed values of $\tilde{f}_{pk}^m$ with respect to relative importance criterion k, k= $K'+1$,.., K; p=1,.,P,
$\tilde{D}$-decision matrix PxK which inputs are d_{pk} and $\tilde{d}_{pk}$, k=1,.., K; p=1,.,P,
p^*-the best project solution.

3.0 MODELING OF UNCERTAITIES

In this Section, the procedure of modeling the uncertainties which exist in developed model is described.

3.1 Relative importance of criteria

In this paper, comparison pair matrix of relative importance of each considered criteria is constructed. The elements of this matrix, W_j are defined in the following way as: importance of the criterion k to criterion $k', k, k' = 1,..,K; k \neq k'$. Values W_j are defined into interval [1,9] according to Satty's measure scale [7].

Comparison pair matrix of relative importance criteria has the following characteristics:

- It is squared ,dimension KxK
- Elements on the main diagonal are not defined and,
- Elements in relation to the main diagonal are reciprocal.

By applying Satty's eigenvector methods we can get relative importance of each considered criterion.

3.2 Values of customer demand

The value of customer demand in the considered problem according to author's opinions can be adequately described by vague linguistic phrase "annual demand is much larger than d_L", or "demand in the next period will be in the interval $[f_L, f_U]$ with a high degree of possibility that demand will be zero" and it is described by discrete fuzzy number $\tilde{f}_{pk}$. f_L, f_U are the lowest, that is the highest expected value of customer demand into domain of discrete fuzzy number $\tilde{f}_{pk}$. These values are judgments by Management Team. It is assumed that the discretization step of domain of discrete fuzzy numbers $\tilde{f}_{pk}$ is ten items. The discretization step is performed according to the nature of product which is being considered in this paper. Membership function of each discrete fuzzy number $\tilde{f}_{pk}$ is given by copying the probability distribution into possibility distribution [1]. Probability distribution can be calculated by results of DELFI method. Of course, many linguistic expressions about customer demand can be interpreted by appropriate fuzzy sets.

4.0 ALGORITHM FOR THE SELECTION OF THE BEST SUPPLIER

In this Section, the algorithm on which is based the selection of the best project solution, is shown. The algorithm development is realized through the following steps:

Step 1. We determine the comparison pair matrix of relative criteria importance.
Step 2. Transform all the cardinal criteria values, f_{pk} into f_{pk}^n defined on a common scale [0,1] by applying linear normalization:

$$f_{pk}^n = 1 - \frac{f_{pk} - f^{min}}{f^{max}}, \quad p=1,...,P;\ k=1,..,K'$$

Where:

$$f^{min} = \min_{p=1,..,P} f_{pk}, \quad f^{max} = \max_{p=1,..,P} f_{pk},$$

$$p = 1,.., P; k = 1,.., K'$$

Step 3. Let us copy all uncertain criteria values $\tilde{f}_{pk}$ into $\tilde{f}^{m}_{pk}$. Values in the domain of discrete fuzzy numbers $\tilde{f}^{m}_{pk}$, v^{m}_{pk} are given by applying the following expression:

$$v^{m}_{pk} = \frac{v_{pk}}{v^{max}}$$

Where $v^{max} = \max_{p=1,..,P} v_{pk}$

Step 4. Calculating the elements of matrix $\tilde{D}$ which inputs represent value of criterion k, k=1,,..,K for project solution p, p=1,..,P with respect to relative importance of criterion k, k=1,..,K. These values are determined:

$d_{pk} = w_k \cdot f^{n}_{pk}$ for all columns k, $k=1,.., K'$ which correspond to the cardinal criteria,

$\tilde{d}_{pk} = w_k \cdot \tilde{f}_{pk}$ for all columns k, $k= K' + 1,..., K$ which correspond to the linguistic criteria.

Step 5. The best project solution with respect to all criteria, simultaneously, taking into account the type of each criterion and its relative importance is obtained by applying the adapted Hurwitz approach for selecting a combined optimistic-pessimistic solution [3]:

$$\max_{p=1,..,P} \left\{ \min_{k=1,..,K'} d_{pk}, \min_{k=K'+1,..,K} \tilde{d}_{pk} \right\}$$

5. CONCLUSION

It is shown how the combined use of multi-criteria approach, description of uncertainties by fuzzy sets can effectively lead to identifying the best project solution that maximizes Management Team satisfaction.

The following conclusion is made:

1. It is possible to describe the problem to determine the best project solution by formal language that enables to look for the solution by exact method.
2. The uncertainties which exist in the model can be described by discrete fuzzy numbers.
3. All the changes, as the changes in the number of criteria or its relative importance, or number of project solutions, can be easily incorporated into the model.
4. The best project solution with respect to all criteria, simultaneously, taking into account the type of each criterion and its relative importance is determined by applying a new fuzzy algorithm which is based on Hurwitz approach for selecting a combined optimistic-pessimistic solution.

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IDENTIFICATION OF FACTORIAL EFFECTS IN 2^K FACTORIAL DESIGNS

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Summary
Paper present a method for allocation of effects in open (traditional approach) and closed (Taguchi's approach) 2^k full factorial designs, where $k \to \infty$. Factorial effects and number of column for them are connected via adequate formulas for their allocation in design. Method is applied on development of alias structure for fractional factorial designs.

Keywords: *allocation of main effect in basic columns, allocation of effect in nonbasic columns, full factorial design, fractional factorial design, generators (words), alias structure*

INTRODUCTION

Most statisticians consider that Taguchi's techniques had a role of accepting application of DOE methods in industrial and scientific research and quality improvement (Montgomery, 2001). There is controversy to approach to Taguchi's methods, especially from the point of experimental design which is ongoing up this day (Parks 2001, Woodal et.al. 2003).

Notwithstanding engineers widely use Taguchi's methods especially orthogonal arrays with mostly with 3, 4 and 5 levels (Cooke et.al. 2007, Tsoukalas, 2008, Tanyildizi, Coskun, 2008, Wang et.al., 2008, Safarzadeh et.al., 2008), with or without application of S/N ratio in analysis of data results.

Recently even criticists of Taguchi methods begin to accept the method (Montgomery, 2008), since for engineers advantages for use of Taguchi method are: clearly defined procedures, uniform tables for all types of designs, regardles of the level, linear graphs, as a starting point for experimental set-up, exact outcome of experiment by obtaining combination of factor levels, additional optimisation of the experiment via S/N ratio (Veljković, 2005).

This paper present an alternative methodology for identification factorial effects in 2^k full factorial designs and adequate Taguchi's orthogonal arrays and its application for defining alias structure in fractional factorial designs. Method is the same for both approaches (Veljkovic, 2005, Veljkovic et.al. 2008).

I. ALLOCATION OF MAIN EFFECTS

Let 2^k be full factorial design, with dimensions $2^k \times \left(2^k - 1\right)$. Further, let the main effects in design be allocated in classical order:

A, B, AB, C, AC, BC, ABC, D, ...

and, let every effect also be defined by number of column. That led to factor allocation presented in Table I.1.
Main factor effects are placed in basic columns. Their allocation is pointed at the Table I.1.

Therefore, basic columns are:

1, 2, 4, 8, 16, 32, 64, ...

for factors:

A, B, C, D, E, F, G, ...

Since basic columns represent designs for two level factors, numbers of basic column could be described by (mod 2). Therefore order of the basic columns is:

2^0, 2^1, 2^2, 2^3, 2^4, 2^5, 2^6, ...

A 1	***B*** 2	***AB*** 3	***C*** 4	***AC*** 5	***BC*** 6	***ABC*** 7	***D*** 8	***AD*** 9	***BD*** 10
ABD 11	***CD*** 12	***ACD*** 13	***BCD*** 14	***ABCD*** 15	***E*** 16	***AE*** 17	***BE*** 18	***ABE*** 19	***CE*** 20
ACE 21	***BCE*** 22	***ABCE*** 23	***DE*** 24	***ADE*** 25	***BDE*** 26	***ABDE*** 27	***CDE*** 28	***ACDE*** 29	***BCDE*** 30
ABCDE 31	***F*** 32	***AF*** 33	***BF*** 34	***ABF*** 35	***CF*** 36	***ACF*** 37	***BCF*** 38	***ABCF*** 39	***DF*** 40
ADF 41	***BDF*** 42	***ABDF*** 43	***CDF*** 44	***ACDF*** 45	***BCDF*** 46	***ABCDF*** 47	***EF*** 48	***AEF*** 49	***BEF*** 50
ABEF 51	***CEF*** 52	***ACEF*** 53	***BCEF*** 54	***ABCEF*** 55	***DEF*** 56	***ADEF*** 57	***BDEF*** 58	***ABDEF*** 59	***CDEF*** 60
ACDEF 61	***BCDEF*** 62	***ABCDEF*** 63	***G*** 64	***AG*** 65	***BG*** 66	***ABG*** 67	***CG*** 68	***ACG*** 69	***...*** ***...***

Table I.1. *Allocation of factorial effects in 2^k full factorial designs*

This leads to general formula for columns for main factor design in full factorials:

$$x_b = 2^{i-1}, i = 1, \ldots, k \qquad \text{(I.1)}$$

II. ALLOCATION OF INTERACTIONS

In this part allocation of interaction columns in 2^k full factorial designs in terms of equation (I.1) is described. For 2^k designs, interaction columns are placed in only one interaction column for any interaction in 2^k designs. Column number for any interaction could be obtained by summation of all number of basic columns for main effect factors in interaction. For example, interaction *ACDFG* is in the column

$$ACDFG \rightarrow 1 + 4 + 8 + 32 + 64 = 109 \qquad \text{(I.2)}$$

with smaller full factorial for this interaction 2^8.

Expressed in the terms of equation (I.1) number of interaction column could be defined as

$$x_i = \sum_{j=1}^{i} 2^{m_j} , \qquad \text{(I.3)}$$

where:
i - represent number of factors in interaction,
j - factor in interaction, and
$m_i = (k-1), \ldots, (i-1), m_j = (i-j), \ldots, (m_{j-1} - 1)$,
$i \in \mathbf{P}(1, .., k), j = 2, \ldots, i$, $\mathbf{P}$ is
partition set.

In case that j=1, interaction column is basic column for factor in design, i.e.

$$x_i = x_b . \qquad \text{(I.4)}$$

Expressed in those terms, column for interaction *ACDFG* (I.2) could be expressed as

$$x_4 = x_{ACDFG} = 2^0 + 2^2 + 2^3 + 2^5 + 2^6 . \qquad \text{(I.5)}$$

III. INTERACTIONS IDENTFICATION BY COLUMN NUMBER

This approach can be used for interactive algorithm for identification of interaction in the certain column. Let x be the column from full factorial design, eider basic or nonbasic. Interactive procedure (I.6) repeats until $p_j = 0$.

$$\begin{aligned} &p_0 = x \\ &p_j = p_{j-1} - m, j = 1, 2, ... \\ &m_j = \max_{m_j \le p_j} \left\{ 2^{i-1}, i \in \mathbf{P}(1, 2, ...) \right\} \end{aligned} \qquad \text{(I.6)}$$

where:
p_i - is indicator of change,
m_j - is main effect of factor in interaction,
j - defines number of factors in interaction and
2^{i-1} - is the main effect of full factorial design.

To identify interaction in column 263, procedure (I.6) is

1. $p_0 = 263$

2. $m_1 = 2^{i_1}$ *such us* $2^{i_1} = \max\left\{2^0, 2^1, ...\right\} \le p_0$
$m_1 = 2^{i_1} = 2^8 = 256 \sim J$
$p_1 = p_0 - m_1 = 263 - 256 = 7$

3. $m_2 = 2^{i_2}$ *such us* $2^{i_2} = \max\left\{2^0, 2^1, ...\right\} \le p_1$
$m_2 = 2^{i_2} = 2^2 = 4 \sim C$

$p_2 = p_1 - m_2 = 7 - 4 = 3$

4. $m_3 = 2^{i_3}\ such us\ 2^{i_3} = \max\left\{2^0, 2^1, ...\right\} \le p_2$

$m_3 = 2^{i_3} = 2^1 = 2 \sim B$

$p_3 = p_2 - m_3 = 3 - 2 = 1$

5. $m_4 = 2^{i_4}\ such us\ 2^{i_4} = \max\left\{2^0, 2^1, ...\right\} \le p_3$

$m_4 = 2^{i_4} = 2^0 = 1 \sim A$

$p_4 = p_3 - m_4 = 1 - 1 = 0$

Therefore, in column 263 is four factor interaction *ABCJ*, which correspond minimal 2^9 full factorial design.

Using procedure established by (I.6), it is possible to identify any interaction or main effect in 2^k full factorial design by column number where it is placed.

IV. APPLICATION OF ALLOCATION METHOD

Let consider 2_{III}^{6-3} fractional factorial design with basic factors *A, B* and *C* and nonbasic factors *D* in column 3, *E* in column 5 and F in column 6. Basic words are generated directly by adding nonbasic factors in full factorial design. Nonbasic words are generated by combination of basic words. Basic words or basic design generators for determination of alias structure are $I_1 = ABD$, $I_2 = ACE$ and $I_3 = BCF$, while non basic words are $I_4 = BCDE$, $I_5 = ACDF$, $I_6 = ABEF$ and $I_7 = DEF$ so defining relation is

$$I = I_1 = I_2 = I_3 = I_4 = I_5 = I_6 = I_7 . \qquad \text{(I.7)}$$

If nonbasic factors are represented by its number in adequate full factorial design, i.e. in example, $D=2^3$, $E=2^5$ and $F=2^6$ design generators could be expressed as:

$$I_1 = ABD = 2^0 + 2^1 + 2^3$$
$$I_2 = ACE = 2^0 + 2^2 + 2^4$$
$$I_3 = BCF = 2^1 + 2^2 + 2^1 + 2^2$$
$$I_4 = BCDE = 2^1 + 2^2 + 2^3 + 2^4 \qquad \text{(I.8)- (I.13)}$$

For example, application of equation (I.8.-I.13.) leads to alias structure for factor *C* (basic column 4) as:

$$C \sim 2^2 \Rightarrow I_1 \cdot C = ABD \cdot C = ABCD \Leftrightarrow 2^0 + 2^1 + 2^3 - 2^2 = 2^0 + 2^1 - 2^2 + 2^3 \sim ABCD$$
$$\Rightarrow I_2 \cdot C = ACE \cdot C = AE \Leftrightarrow 2^0 + 2^2 + 2^4 - 2^2 = 2^0 + 2^4 \sim AE$$
$$\Rightarrow I_3 \cdot C = BCF \cdot C = BF \Leftrightarrow 2^1 + 2^2 + 2^1 + 2^2 - 2^2 = 2^1 + \left(2^1 + 2^2\right) \sim BF$$
$$\Rightarrow I_4 \cdot C = BCDE \cdot C = BDE \Leftrightarrow 2^1 + 2^2 + 2^3 + 2^4 - 2^2 = 2^1 + 2^3 + 2^4 \sim BDE$$
$$\Rightarrow I_5 \cdot C = ACDF \cdot C = ADF \Leftrightarrow 2^0 + 2^2 + 2^0 + 2^1 + 2^1 + 2^2 - 2^2 = 2^1 + 2^3 + 2^4 = 2^0 + \left(2^0 + 2^1\right) + \left(2^1 + 2^2\right) \sim ADF$$

.....

Therefore, alias structure for column 4 in observed 2_{III}^{6-3} design is *C, AE, BF, BDE, ADF, ABCD, CDEF* and *ABCEF*. Alias structure for the other columns cold is obtained on the same way.

In the case of two level fractional factorial designs described procedure is more complex than in traditional DOE approach.

CONCLUSIONS

This paper present initial step in development of methodology for convergence experimental set-ups for factorial designs. Paper proposes method for identification of effects in certain columns, separately and independently for basic and nonbasic columns.

For 2^{k-n} factorials, for identification of alias structure, when factors are mixed-up, better solution is the method proposed by Bisgaard (Bisgaard 1993).

Full potential of the method is visible in case of s^k designs, where $s>2$. Then is possible to develop identification procedures for effect allocations and alias structures that will make it easier for engineering application. With necessary changes method is developed for tree, four and five level factorials, which correspond to Taguchi's orthogonal arrays (Veljković, 2005).

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APPLICATION OF PETRI NET DECOMPOSITION METHOD FOR THE MODELLING AND ANALYSIS OF MANUFACTURING PROCESSES

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Abstract

A Petri nets are powerful tool for modelling and design of different technical process. In thi paper is explain the method decomposition of Petri nets on example a modelling cuclic manufacturing process. Invariants of beginning net can to use to analisys and optimisation of process.

Key words:Petri nets, decomposition, manufacturing processes

1. DEFINITION OF PETRI NETS

A Petri nets are power tool for modeling,analysis and design of manufacturing process andsystems. Petri nets are directed bipartite graphs wich have two types of node called places and transitions. Places and transitions (or transitions and places) are join by directed arcs. A directed arcs never joins a place to place or transitions to transitions. In graphical show, places are represented by circles and transitions by rectangles or bars. A place may contain tokens wich described a dynamics of the systems. A weight may is associated with arc.

Formally definition

A Petri net (PN) is six-tuple PN (P, T, A, M, K, W) where are:

P= { p_1, p_2, ... p_n } - finite set of places,

T= { t_1, t_2, ... t_q } - finite set of transition,

A= (PxT) U (TxP) - finite set of arcs,

M - marking (a number of tokens in the place p),

K - kapacity of the place,

W - weight finction attached to the arcs,

with note that P ∩ T = O.

A Petri net without marking is N = (P, T, A, W).

A Petri net is ordinary when allthe weights are equal to 1.

2. CYCLIC MANUFACTURING PROCESS

Cyclic manufacturing process designed for producing simultaneously different types of parts. This process is and he can to use of multioperation systems,automated transportation systems, supervising systems, managing manufacturing activities. Manufac-Ture of a parts realised by performing a set operations (transformation operations, assembly and disassembly operations). Manufacturing process of a part can Be described by block diagram or graph.

Some manufacturing process is given in Figure 1.

Manufacturing of parts reqires:

- set of machines (M_1, M_2, M_3),
- assembly operations (O_1, O_2, O_3),
- set of transportation resources (TR_1, TR_2).

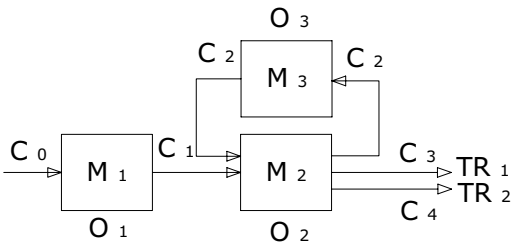


Figure 1.

One unit of component Co visits machine M_1 where is performing operation O_1. This operation transforms Co into component C_1. Component C_1

visit machine M_2 where is perfoming operation O_2. This operation transforms C_1 into one unit of component C_2, one unit of component C_3 and one unit of component C_4. Components C_3 and C_4 leaves manyfacturing process by transportation resources TR_1 and TR_2. Component C_2 visits machine M_3. Afther performing operation O_3 component come back to machine M_2.

3. DECOMPOSITION OF PETRI NETS

We only consider PNs which have sink and source transitions. Decomposable nets will be used to model manufacturing systems wich requires us to model the arrival and departure of the parts in the system.

Petri net which is a model of manufacturing process from Figure 1. is given on Figure 2.

Method decomoposition will be explain on example a define t- invariant of a beginning Petri nets.

Let W be the t-invariant of Petri net N.A petri net Nw is said to be W-derived from N if is:

- set of transitions of Nw is $||W||$,
- for any t element $||W||$, ${}_ot$ and t_o are the same in N and Nw,
- the weight of any arc of Nw is the same as the weight of the samearc in N.

Reccal that

$W = (W_1,... W_2)$ is a t- invariant if:

1. $Wi > 0$ for any i element (1,2,...q)
2. Exists at least one index i element (1,2,...q) such that $Wi>0$
3. $U*Wt = O$, where U is incidence matrix of the PN.

Figure 2. represented a cyclic production process given on Figure 2.

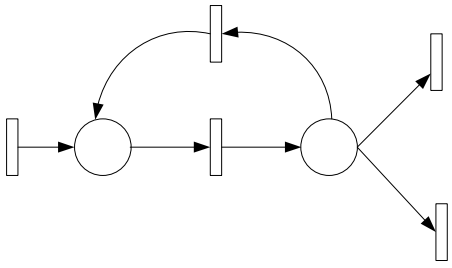


Figure 2.

The incidence matrix o the PN i U :

$$U = \begin{array}{c} t_1 \quad t_2 \quad t_3 \quad t_4 \quad t_5 \\ \begin{bmatrix} 1 & -1 & 0 & 0 & 1 \\ 0 & 1 & -1 & -1 & -1 \end{bmatrix} \end{array} \begin{array}{c} \\ p_1 \\ p_2 \end{array}$$

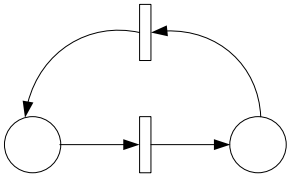
$W= [W_1,W_2,W_3,W_4,W_5]$ is a t-invariant, then $U*Wt =O$

$$W_1 - W_2 \qquad\qquad W_5 = O$$
$$W_2 - W_3 - W_4 - W_5 = O$$

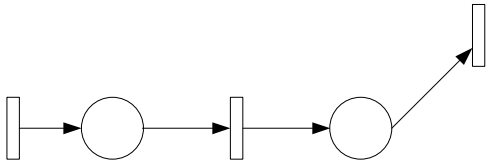
Some of the t- invariants are:

$W_1 = [0,1,0,0,1]$
$W_2 = [1,1,1,0,0]$
$W_3 = [1,1,0,1,0]$

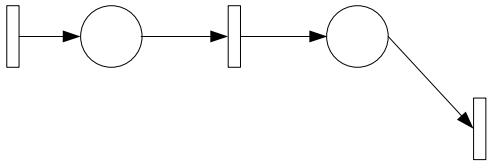
The PNs wich are W_1, W_2 and W_3 – derived from the PN are presented in Figure 3.



W_1 – derived from N



W_2 – derived from N



W_3- derived from N

Figure 3.

4. CONCLUSION

A Petri nets an irreplaceable tool for the preliminary design of manufacturing process and systems. They arew graphical support which is easily accepted by desig ners. The goal of this work is toprovide a text dedicated to the preliminary design and the managment of manufacturing systems and process in a Petri net environment.

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SUPPORT OF MULTICRITERIA OPTIMIZATION FOR COMPUTER LANGUAGE SELECTION

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Abstract *– This paper presents an approach to solving one of the key elements of software companies - the choice of computer languages. Based on several alternatives and criteria, selection is performed by a method of multicriteria optimization, and originally developed software for automation of their calculations. The paper, in addition to multicriteria optimization methods, discusses the applied criteria and alternatives. It is a key element in the application of multicriteria optimization.*

Key Words *– Computer languages, Multicriteria optimization*

1.0 INTRODUCTION

The choice of computer languages for application development is one of the main problems faced by each software company. There are a number of influential factors that could have a role in their choice, such as:

- types of applications that are developed (primarily for the Internet or Desktop)
- preference for Open Source platform or purchased Development Platform
- previously developed software solutions
- knowledge of languages or tools by programmers

Already at the beginning of consideration of this issue can be noted that these criteria are not only, but their number is much higher. In addition, proper selection of criteria and alternatives is a key element for making a final decision. Problems then become difficult due to valuation of certain criteria, as well as their individual importance, which are often left to the experience of decision makers.

Multicriteria optimization methods are applicable theoretical basis for support of this issue. Adoption of best solutions in terms of alternatives, based on multiple criteria, using methods of multicriteria optimization is performed by any of a previously developed mathematical model. In this work is used modified PROMETHEE method. This method represents a modern approach to decision support for decision making.

Methods of multicriteria optimization are based on complex mathematical models and different approaches in determining the best alternatives. Computer support for these methods is a significant element in their use. The end-user and decision makers are released to introduce the details of mathematical models. His focus is primarily devoted to their use. This is very significant in practical terms of multicriteria optimization methods. The user is offered the simplicity and speed of their use, with less need to introduce all the theoretical elements. In this work is used originally developed software for implementation of the modified PROMETHEE method.

2.0 SELECTION OF CRITERIA AND ALTERNATIVE

Selection of criteria and alterative is a key moment in implementation multicriteria optimization methods. The reason for this is in fact that the selection is left to the decision-maker, to his knowledge and experience. Undoubtedly it can be concluded that modern tools for the development of computer applications supporting these claims, along with many other characteristics. Some of them are (details in reference [4]):

- Interactive development of user interface
- Using of CASE tools specialized in certain phases of program development

- Using the Wizard technology for formation of the skeleton of applications, or some of its parts
- Using the architecture of the Windows operating system, which greatly simplifies and reduces the development time of applications (work in the network, the use of peripheral devices, etc.)
- Using the graphical desktop environment, not only in developing object-oriented applications, but also to standardize the user interface of the developed application solutions
- The ability for creating Internet applications in the existing development environment
- A large number of other common characteristics

This paper is based on practical considerations and software solutions for information systems of a large factory. In this case, the needs of the development tools are primarily related to:

- development of different types of applications (Web, Desktop)
- a need for quick creation of applications in the developed and modern environment
- possibility of buying licensed software for this purpose
- creating client / server applications in a network environment, where the central server is Microsoft SQL Server, and use standardized SQL language for access to relational databases (more [3]).

Object - oriented approach to application development also represents an indispensable condition, which contributes to simplification of the principle of applications development, a great possibility of re-utilization of code with minimal possibility of error and reduce code [9], [6]).

Concept of NET technologies (based on Java) is also a condition that is necessary to point out. Some of the main characteristics that contribute to the implementation of this technology are [2]:

- Concept of assemblies
- Language independence
- Just in time compiling
- Improving of performances
- Increased security
- Metadata
- Error handling using exceptions
- Developed system for databases utilization, and many others

There are a number of reasons for the selection of a particular computer language. Some of them are [5]:

- **Determination of a software company for the specific language.** By purchase of a legal software, in addition to legal requirements, allows the presence of the original literature, contact with manufacturers of software and upgrades to new versions. Orientation to the determinate language enables all developers teamwork, code intelligibility, implementation of other software tools for support of application development in this language.
- **Knowledge of a language** is one factor in the choice of programming language.
- **The strategic choice of companies for software development** should be taken into account. This means that the programming language will be present in the future, and, of course, enriched with new versions.
- **The orientation of a company for a specified a manufacturer of computer languages**. This determination is very important because software tools and languages, of a single manufacturer, have a larger compatibility (e.g. Microsoft Visual Studio).
- **Type of application that is developed.** If the software solution may be performed in higher-level programming language is not necessary to use lower-level language, which means a longer and more complex syntax.
- **Already developed software solutions in a language** impose the need for their further development and upgrade.
- **Popularity of a programming language** is a significant factor in the decision for his choice.
- **The operating system,** over which the programming language is running, makes possible to use features that it offers.

3.0 IMPLEMENTATNION OF MULTI-CRITERIA OPTIMIZATION METHODS

In this paper, it is applied a modified approach to PROMETHEE method of multi-criteria decision making. This approach is based on the use of Universal preference functions (detailed in references [10] and [12]). In this paper, it is necessary only to emphasize the meaning of some parameters of this function:

α, β – parameters of intensity (speed) of preferences
p – border of preference intensity changes
q – borders of preference

This feature replaces the six generalized functions of preference and generates an unlimited number of others. The main objective of the modified PROMETHEE method is to effectively express preference by individual criteria, taking into account the various important criteria. This feature allows the holder of decision to express certain specific problems and their preference for the used criteria. Applying this method, we can express all the complexity of preference functions in optimization problems, when ROMETHEE method is used [11].
In the considered examples were selected following criteria, which were previously described:

- Criteria1 - Determination of a software company for the specific language.
- Criteria2 - Knowledge of a language
- Criteria3 - The strategic choice of companies for software development
- Criteria4 - The orientation of a company for a specified a manufacturer of computer languages
- Criteria5 - Type of application that is developed
- Criteria6 - Popularity of a programming language
- Criteria7 - The operating system

Entering criteria, parameters of preference function are defined, which for each criterion allow specific expression of subjective preference. Start by considering the Criteria1 ($\alpha = 0$), we get one of six generalized criteria - common criteria, which emphasizes the importance of equal criteria in total criterion space (Figure 1).

The Figure 2 demonstrates preference function of other criteria, which gives expressively preference near the border of preference intensity changes ($\alpha = 3$). In this case, decision maker highlights the importance of this criterion in the vicinity of the border of intensity changes. This limit is defined by the number 1, which assumed the maximum percentage volume of preferences. It is important to emphasize that the values of alternatives can be expressed in different and various numerical values, which gives exceptional importance to this method.

The Figure 3 shows the comparative visual display of the previous function (Criteria 2) with preference function of criteria 6. This criterion has the same type of preference function, but with slightly lower growth in the border of preference ($\alpha = 2$). By this, decision-maker points out, as in the previous case, the importance of the criteria in this area, but with a slightly lower level of preference. The possibility of comparative graphics view provides the decision-maker intuitive approach to their determination and analysis.

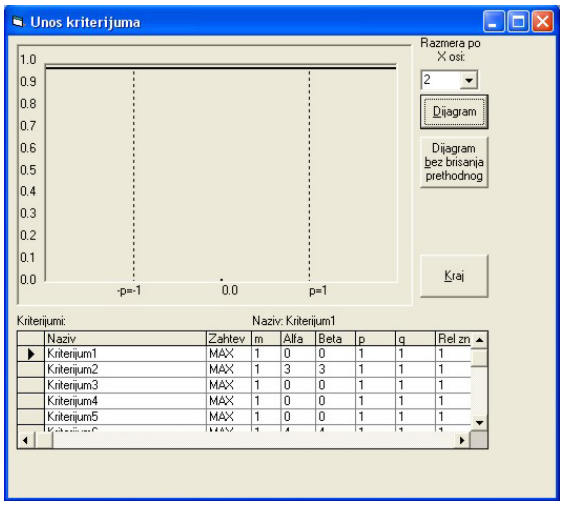

Figure 1. Display of a simple criterion

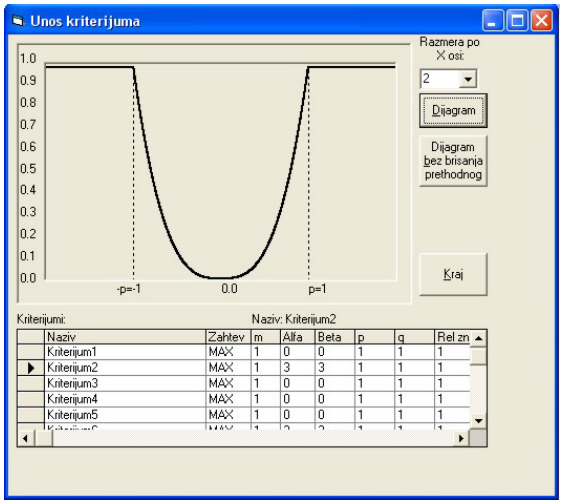

Figure 2. Dijagram izrazite preferencije u blizini granice preferencije

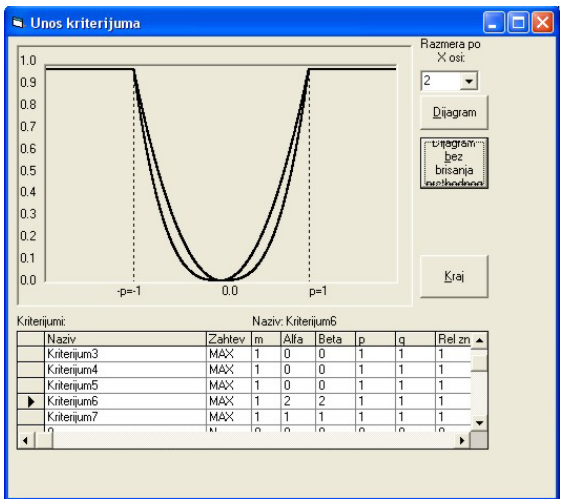

Figure 3. Comparative visual analysis of the two functions with the same type of preference

In the Figure 4. is shown form for input of values, of certain alternatives, by some criteria, and obtaining the final solution - rank of alternatives.

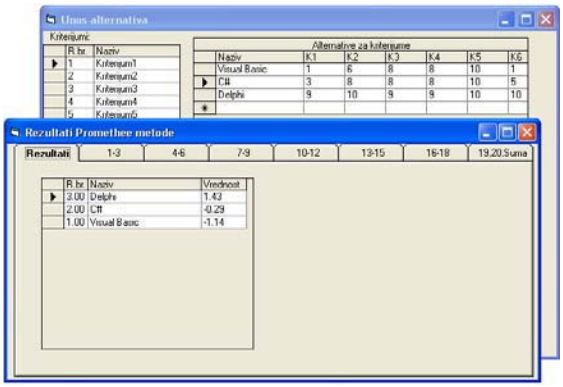

Figure 4. The values of alternatives and the final solution

4. CONCLUSION

This paper describes the use of a complex mathematical model implemented in the modified PROMETHEE method of multi-criteria decision making. It is featured just some elements, that show the possibilities of sophisticated expression of a decision-maker, under certain criteria.

In addition, it can be concluded that the implementation of computer support for this method extremely facilitates its use. Decision maker is allowed to introduce its use only, but not specification of the mathematical model. Feature of graphical preview of preference functions, allows a more sophisticated method for simplification the analysis of criteria.

In the previous illustration, it is shown the final solution of the computer language selection, in this specific case. However, it is necessary to emphasize that this final solution largely depends on the selection criteria, the values of alternatives by some criteria, the choice of parameters, and their relative importance. These are the elements which can be left only the man. Therefore, this method of decision making can be offered primarily for the analysis of ranking alternatives, based on the influential criteria. The final decision is still left to be the holder of decision making. But nevertheless, it can be concluded that the application of such tools greatly facilitates making the final decisions - selection of the best alternatives (or their ranking) based on multiple criteria.

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INFORMATION SYSTEM SAFETY

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Ministry of Telecommunications and Information Society

Abstract
Information is any data that has a benefit for the person who has. Governments, banks, health facilities, the security authorities, companies and other institutions of economy and society of a country need to protect information. Trend of increasing the flow of internet and computer processor speed affect leading to an increased number of attacks on systems. Most information is now stored and exchanged through computers and computer networks on which they are located.

1.INTRODUCTION

We are witnesses that the information means that the new direction of development of market economy. Internet in the last 30 years has accelerated the exchange of information and introduced a new dimension of communication in the world market. However, the development of applications that are used in the exchange of information has led to security vulnerabilities and opportunities and theft. Throughout history rulers wanted to have a safe and secure communication system information flow between their armies during the conquest of territory. If confidential information came into possession of the enemy, there was a danger to reverse the result of the battle and the entire war. This required the development of new methods of data encryption and encoding. [1] Today, data protection is just so the priority in the development of information systems and computer networks. Development of new technologies and the Internet as a communication system and demanded a new approach to information protection.

2. DEVELOPMENT OF SAFETY

According to Nielsen-speed internet for ten years increased 57 times, or 50% per year (Figure 1). This follows the increasing speed of computer processors, according to Moore for ten years has increased 100 times, or 60% per year. Forecasts are that this trend will continue to 2015 year. [2]

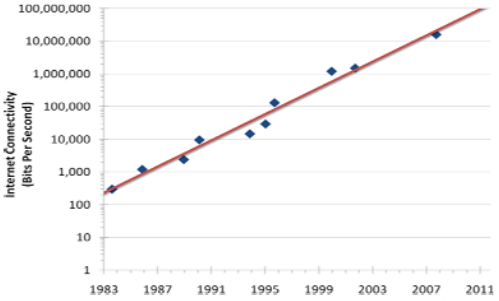

Figure1. Increasing the flow of traffic on the internet

Trend of increasing the flow of internet and computer processor speed affect the development of all branches of society: economy, industry, etc. Internet use following the development of applications and software used for all communication: on-line banking, web conferencing, VoIP communications and the like. Application development and writing software for them, unfortunately, cause a large number of errors in their writing, and comes to the creation of security vulnerabilities that leave developers in the software.
According to Symantec in less than five years of threats and attacks on the Internet has increased more than 80 times (Figure 2). [3] These threats and attacks are different: breaking the codes, enter the information systems and databases, and their abuse, classic fraud over the Internet (social engineering and phishing), the

overthrow of sites (government, banks, large companies and the like.

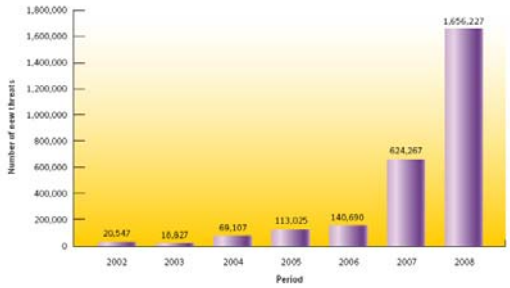

Figure2. Increase of threats on the Internet 2002-2008

Access to the requested information is very easy. Development of communication influence on society and the market grow, data protection and encryption becomes their priority. Today the communication between the computers performs a variety of ways. E-mail, E-bank, VoIP, wireless and other forms of communication over the internet go through thousands of computers. Each communication today can be intercepted and diverted (from people who have the knowledge to do so) to the computers they want.

3. DATA ACCESS SECURITY .

What is needed serious approach to the protection of information and communication the fact that the only one on 27 April 2007. The complete structure of the Republic of Estonia website attacked and blocked. With DDoS (Distributed Denial of Service) attacks are blocked Web sites of almost all institutions in the country. The attack was initiated by the political decision of the Estonian government to remove a monument of Russian troops from the center of the capital Tallinn. The attacks were carried out by botnets and the group of computers and servers that were previously infected with malicious software through which it was taken control of several thousands of computers that were used to attack the servers of almost all institutions of the Republic of Estonia.

Protection of information today has become an imperative of modern society. The development of modern industrial society requires information security and intellectual property. Proper design is task of information systems and computer networks. Administration of computer network and exchange of information between users of the network also.

Safe approach to data protection is a continuous process and education, training and introduction of new technologies and types of computer attacks. Also need education users of computer networks, and ways how users behave online and what services users are allowed to approach and what information may use and share.

4. SECURITY ISSUE

CERT (Computer Emergency Response Team) is an international organization for research, analysis and development of protection technology and training administrator for security of information systems and networks. CERT is the area of protection specified in several areas: Software security, security systems, security and organizational response to the attacks.

Software security includes:

• Safe coding
•Analysis of vulnerabilities
• functional analysis.

Secure Coding - Safe encoding study and improve ways of writing secure software. This analysis reduces the percentage of security gaps and vulnerabilities in the software and the impact on the reduction of attacks on systems where the software is implemented.

Vulnerability Analysis - Analysis of vulnerabilities includes Vulnerability Discovery (reveal the vulnerability of the system) and Vulnerability remediation (to remove the vulnerability). Engineers indicate how you can find and fix errors that may arise due to the unprofessional writing software code.

Unfortunately, a great probability that the software that implements the information system has many security vulnerabilities have to be removed by engineers when designing. In that sense, reveals the vulnerability of the system and the way the system and its safety can improve, and vulnerability as much as possible removed.

Function Extraction - Functional analysis of new technologies in the field of security aimed to improve the economy of software and to ensure the software systems.

Security systems include:

• Sustainability System
• Knowledge of network structure

Survivable Systems Engineering - System Sustainability examine the existing state system in favor of finding problems and suggestions to improve design. This includes analysis of the security system in relation to the sophisticated attacks on him.

SITUATIONAL Network Awareness - Knowledge of network structure improves solutions and analyzes the status and activities of the entire network.

Security Organization - Organizational security includes:
• Performance Management
• Internal threats
• Flight Safety

5. NETWORK SECURITY FORENSICS

This is a new method of collecting and analyzing computer network traffic. Each package of traffic during the exchange of information through a computer network is archived and examined. Network engineers are now faced with daily attacks and attempts of unauthorized computer intrusions in the network, from taking control over user computers in the network to the theft of confidential information (industrial espionage).

The computer forensics IDS - Intrusion Detection System hardware / software solutions are used for the analysis and testing of computer attacks. IDS technology aims to detect an attack and thus warn about what kind of attack is when the attack began (Figure3).

Figure3. IDS - *Intrusion Detection System*

At the same time IPS - Intrusion Prevention System is a hardware / software solution that is in addition to IDS systems and serves to monitor the traffic that is done in the computer network. IPS is designed to reject the package of traffic that he was suspicious. Some types of IPS systems have the feature of the firewall technology, but basically they work only monitor network traffic.

The quality of training of engineers and customers and properly designed network systems and software used for the detection of computer attacks will depend on prevention and protection system and an adequate response to the attack (Figure4).

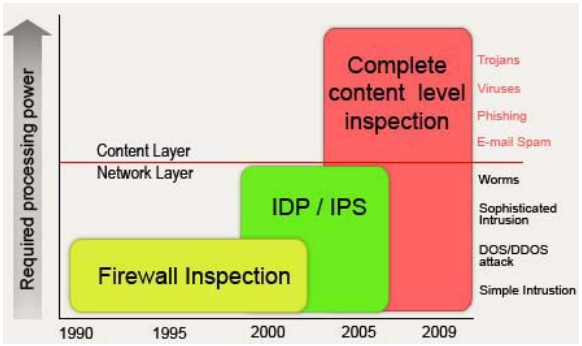

Figure4. Prevention and system security

6. COORDINATED ANSWER

When computer attacks start, an organization that is responsible for computer security has to react quickly and effectively. It is a task of building capacity to respond to such attacks a priority during the design of computer networks and information systems. The correct approach in determining the rules is of almost importance that information systems are functioning and that the information is processed are not misused.

The existing development, diversity and sophistication of attacks on information systems tell us that it is a process that lasts and will not stop. Technologies attack will be more perfected and improve a person dealing with security will have to follow the technology and know and share their experiences at the global level (Figure5.).

It is important to provide mechanisms for cooperation and resolution of these issues. Exchange of information is not sufficient to solve these problems, but it must be coordinated way of defense by those who possess this knowledge.

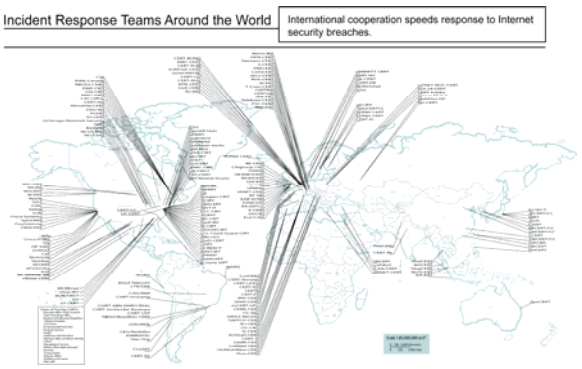

Figure5. International cooperation

Through international cooperation and exchange of experience will be easier to get to the location from which the attack was launched and the way the attack can be stopped and refuse. [5]

7.CONCLUSION

Development of information systems and computer networks and their security will affect the entire course of movement of state and society. It will secure information infrastructure that affect the company recommend for a safe investment and consequently on its development. If confidential information is easy available and thus abused, to society or the state will be marked as unstable and economically uncompetitive on world markets.

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RANKING OF SMALL ENTERPRISES BASED ON PROMETHEE-GAIA MULTI CRITERIA ANALYSIS

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Abstract
This paper has several criteria analysis of short-term business plans considering small entrepreneur attempts with help of PROMETHEE-GAIA methodology and the choice for the most optimal solution. Due to offered business plans referring different activities and approximately same financial investment and with the appliance of PROMETHEE-GAIA method, the future entrepreneur should choose the alternative (entrepreneur attempt) which is going to be the best for his needs.
Keywords: *entrepreneur, business plan, multi criteria analysis, PROMETHEE-GAIA method*

1. INTRODUCTION

The great number of entrepreneurs has many difficulties to make the decision about creating new business. Even when such decision is made there is a question which activity to choose if there are a number of alternatives, or, simply which business to choose. In recent years, new methods of assessing a firm's risk were developed, which thanks to the advancements of computer and information science. [17]
Rating is also needed when the decision is made which alternative to choose. In some cases such ranking will be spontaneous, based on knowledge and experience of the decision maker, while in precise evaluations and application of various methods. The very same set of enterprises can be a over alternative b.[5] The evaluation table is the starting point of the PROMETHEE method. In this table, the alternatives are evaluated on the different criteria. These evaluations involve mainly quantitative data. The implementation of PROMETHEE requires two additional types of information, namely:

- the information on the relative importance that is the weights of the criteria considered and

some other cases such ranking has to be based on ranked in different ways at a given time depending on the person performing the ranking . These diferences are based on using different criterions of business efficiency and diffrent methods. Efficiency is a complex and multidimensional concept whose contents depend upon decisions within an economic system and upon the features of the current economic policy. [2]
This work will perform ranking of business plans based on determine criterions using the method of multicriteria decision-making. We shall use the PROMETHEE-GAIA method for final ranking.

2. THE PROMETHEE-GAIA method

The relatively large amount of data generated in a practical research made it difficult to compare the sites and important particle sizes using univariate analysis only. This problem was overcome by using multivariate approaches in order to explore and understand relationships between the objects and the variables. [13] The selected particle size ranges and sites were ranked with the help of multi criteria decision making methods (MCDM). [10]
Like all outranking methods, PROMETHEE proceeds to a pair of wise comparison of alternatives in each single criterion in order to determine partial binary relations denoting the strength of preference of an alternative

- the information on the DM preference function, which he/she uses when comparing the contribution of the alternatives in terms of each separate criterion . [14,12]

Weights. The weights coefficients can be determined according to various methods. [15] In the present paper, weight factors reflecting the DMs previous experience and their insights are adopted.
Preference function. The preference function (Pj) translates the difference between the evaluations obtained by two alternatives (a and b) in terms of a

particular criterion, into a preference degree ranging from 0 to 1. Let

$$Pj(a,b) = Gj[dj(a,b)] \forall a,b \in A, \quad (1)$$

$$dj(a,b) = fj(a) - fj(b), \quad (2)$$

$$0 \le Pj(a,b) \le 1 \quad (3)$$

be the preference function associated to the criterion, fj(i) where Gj is a no decreasing function of the observed deviation (d) between fj(a) and fj(b). In order to facilitate the selection of a specific preference function, six basic types have been proposed: usual function, U-shape function, V-shape function, level function, linear function and Gaussian function [8,16] .

Individual group analysis. PROMETHEE permits the computation of the following quantities for each alternative (a) and (b):

$$\pi_r(a,b) = \sum_{j=1}^{k} Pj(a,b) w_{r,j}; \quad (4)$$

$$\varphi^+(\alpha) = \sum_{x=A} \pi_r(x,a); \quad (5)$$

$$\varphi^-(\alpha) = \sum_{x=A} \pi_r(a,x); \quad (6)$$

$$\varphi(\alpha) = \varphi^+(\alpha) - \varphi^-(\alpha); \quad (7)$$

For each alternative (a), belonging to the set A of alternatives, π(a,b) is an overall preference index of (a) over (b), taking into account all the criteria, $\varphi^+(\alpha)$ and $\varphi^-(\alpha)$. φ (α) represent a value function, whereby a higher value reflects a higher attractiveness of alternative (a) and is called net flow. [9,8]

- m - indifference threshold;
- n - strict preference threshold;
- σ - middle value between m and n.

The two main PROMETHEE tools can be used to analyze the evaluation problem:

- the PROMETHEE I partial ranking,
- the PROMETHEE II complete ranking.

The PROMETHEE I partial ranking provides a ranking of alternatives. In some cases, this ranking may be incomplete. This means that some alternatives cannot be compared and, therefore, cannot be included in a complete ranking. This occurs when the first alternative obtains high scores on particular criteria for which the second alternative obtains low scores and the opposite occurs for other criteria. The use of PROMETHEE I, then, suggests that the DM should engage in additional evaluation efforts.

PROMETHEE II provides a complete ranking of the alternatives from the best to the worst one. [16] Here, the net flow is used to rank the alternatives.

Additional tools, such as the 'walking weights', can be used to further analyze the sensitivity of the results in function of weight changes.

GAIA, on the other hand, is a descriptive complement to the PROMETHEE methods, which makes use of the principles of principal component analysis (PCA). The GAIA plane corresponds to the projection of PROMETHEE II results on the first two orthogonal principal components. [8,9,11] Criteria or variables are then represented by axes or vectors, whose orientation and length illustrate the importance of the variables. Axes oriented in similar directions correspond to variables that are in general agreement and the length of the variable vector shows the amount of important deviations observed. Thus, a variable with a larger deviation will have a longer axis than a variable with a small deviation. Further information on how to use PROMETHEE and GAIA as well as the algorithms for these procedures has been documented elsewhere. [5,6,18]

2.1. Multi criteria analysis of small enterprises using PROMETHEE-GAIA METHOD

Considering the facts that in Serbia as well as in the whole world in the last few years there is a great importance of independent entrepreneur development and there is a great number of people who have lost their jobs in the period of transition, people are constrained to think about starting their own business and opening their own companies. Therefore, many institutions have been founded to give advice to future entrepreneurs, to make business plans and to help clarifying anything that is ambiguous in that process.

This paper presents one possibility of future business. The future entrepreneur has ten business plans to choose from and they all satisfy his financial and other personal needs. He has to select the right one which will give the best results by any criteria. All business plans are harmonized with current prices of products or services in Serbia, with the price of workforce in that field, with the costs in the similar companies and with taxes set by law in Serbia. So, it is about short-term business plans which refer on period of time for five years.Given options are referred to present market production and service needs of local community.The characteristics of the alternatives have been following describes the 10 possible solutions used in the evaluation (Table 2): (A1 - Catering service; A2 - Beauty salon; A3 - Production of wedding-dress; A4 - Balloon production; A5 - Honey production; A6 - Gaming establishment for children; A7 - Internet club; A8 - Pizza restaurant; A9 - Chicken farm; A10 - Flower shop (Selling of fresh flowers))

The future entrepreneur has chosen nine criteria based on the economic indicators, which he thinks are the most important for choosing own business, and has given them proper weights (Table 2): (K1-Number of employee; K2-Revenues; K3-

Competitors; K4-Material cost; K5-Gross earnings; K6- Nonmaterial cost; K7-Income tax; K8-Internal Rate of Return; K9-Investments).

Therefore he has given every criterion one of the six types of function of preferences, which are shown in the Table 2. Quantity values are given, with the help of the scale from 1 to 10, to those criteria that are descriptively (quality), shown in the Table 1.

Table 1. Linear scale used to quantify the quality attributes

0	1	2	3	4	5	6	7	8	9	10
Extremely low			Low		Middle		High		Extremely high	

Table 2. Evaluation table

	Criteria								
	K1	K2	K3	K4	K5	K6	K7	K8	K9
Min/max	min	max	min	min	min	min	min	min	min
	V-shape	Linear	V-Shape	Level	Level	V-Shape	Linear	U-Shape	V-Shape
Indiference threshold	-	1	-	1	1	-	0,250	1	-
Preference threshold	1	3	1,5	2	2	0,5	0,5	-	1,5
A1	3	144000	21157	9550	95700	4500	1309,3	1,36	5
A2	5	280100	8000	39500	165300	10000	5730	0,12	7
A3	6	182250	6900	24900	90000	2125	5832,5	1	3
A4	2	118000	16434	34000	42000	5500	2006,6	3	3
A5	3	120000	21255	27500	47250	5500	1849,5	4	5
A6	2	120000	17734	22500	42000	7500	3026,6	2,6	1
A7	2	129600	20691	32500	42000	5500	2890,9	3	5
A8	2	140000	12007	27500	42000	11250	4724,3	1,2	5
A9	4	371520	26400	96288	72000	6000	17083,2	1,4	3
A10	2	130000	16543	28500	42000	5000	3795,7	1,9	5
Weights	0,05	0,2	0,2	0,08	0,05	0,04	0,04	0,14	0,2

Different types of software can be used to help this decision making process. [11] In further research, methods referred to as PROMETHEE and GAIA were used with the aid of DecisionLab software.

Ranking of alternatives using PROMETHEE method is doing on paired compare principe, eg. using methods PROMETHEE I i PROMETHEE II, as it is shown on Figures 1 and 4. PROMETHEE I ensure partial ranking with positive and negative preference flows, while PROMETHEE II is enabling complete ranking, which balance these two preferences flows (positive-input and negative-output) and seek the best compromise. [6,7,8,9]

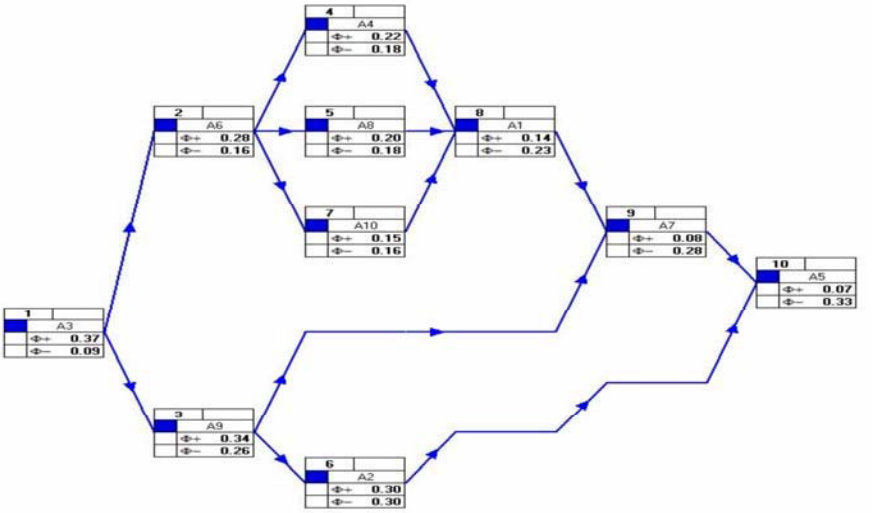

Fig.1. PROMETHEE I partial ranking

PROMETHEE II method enables possibility of complete alternative ranking to decision maker. Therefore, we can conclude that the complex order is as it shown in Figure 2.

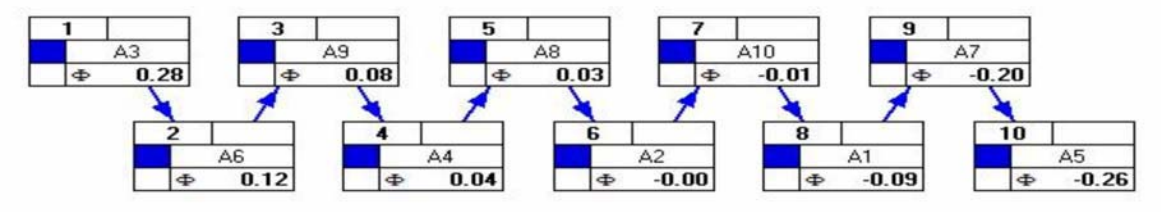

Fig. 2. PROMETHEE II complete ranking

Decision problem is presented graphically by GAIA analysis which ensures complete examination overview of conflicts between criteria, action characteristics and weight measured parameters. In Decision – Lab this method is used together with 3D so it could help the decision makers to identify the best compromise decisions. Its orientation is a compromise which matches ranking by PROMETHEE II method. For making decisions GAIA plane ensures, as it is shown on Figure 3, easier and more content view. Criteria in plain are shown with green squares, so if we look at orientated axis, we can quickly identify conflicts between criteria. Alternatives are shown with blue triangles, so their position in plain enables identification of strong and slack properties of alternatives. Decision Pi axis presents weight of measured parameters. It is a compromised illustration which matches weights parameters. If we change weight criterion parameters, we can see in GAIA plane how the decision axis is moving.

One of the advantages of using PROMETHEE and GAIA in this work was that PROMETHEE ranked the each alternative for given criterions while the GAIA plane is a useful analytical tool that some remarks can be detected from the alternatives. [1] Another advantage of these MCDM is that GAIA incorporates a decision axis, pi, which complements the decision from the PROMETHEE ranking. When pi is long, the most preferred objects are oriented in its direction and furthest from the point of interception of the principal component 1 and principal component 2 axes. With the "minimized" modeling option, variables which are associated with particular objects were displayed opposite those objects. Quadratic shapes represent the variables in the GAIA-analysis (number of employee, revenues, competitors, material cost, gross earnings, nonmaterial cost, income tax, internal rate of return, investments), while the size fractions of each site are represented by rectangle shapes.

In this case based on the positions of criterions in GAIA plane it is obvious that all criterions are very conflict among each other (different axis directions). Also some alternatives are very good for specific criterion (directed in place of the certain criterion). For example, alternative A9 is good for criterion, K2; alternative A2 is good for criterion K8, etc., also some alternatives are good for several criterions. According to the positions of alternative A3 and directions of decision axis, pi, we can also conclude that this option is the best solution since it is directed in orientation of decision axis.

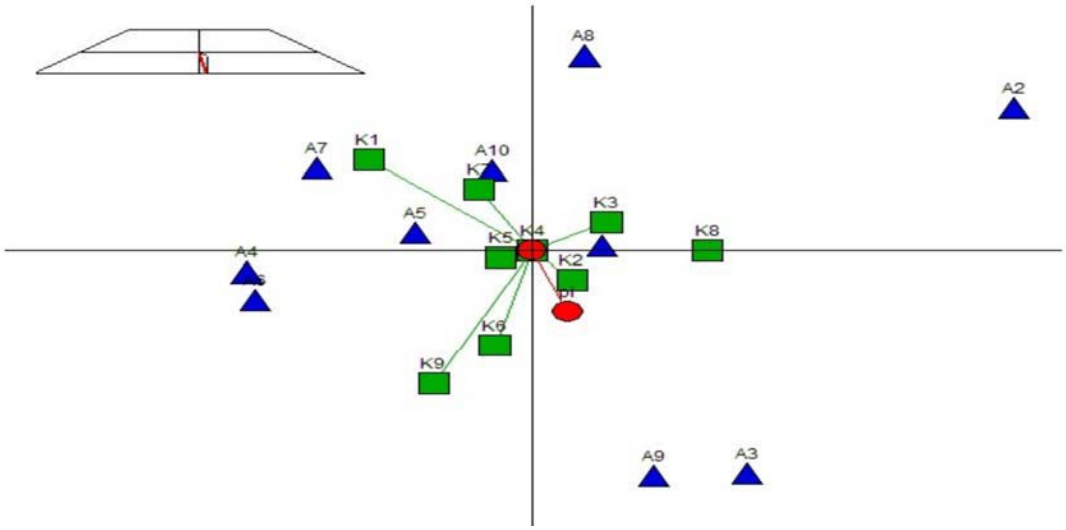

Fig.3. GAIA plane with decision stick

3. CONCLUSION

This paper introduced multi criteria decision making approach based on the PROMETHEE-GAIA method, applying it in hypothetical selection of the final solution of multi-objective optimization problem. The MCDM process has been used to define the most optimal business plan concerning on future business. On the basis PROMETHEE I, PROMETHEE II and PROMETHEE-GAIA analysis we can conclude that the most optimal solution to decision maker is alternative A3, then also are acceptable and alternatives A6 and A9 while the worst solutions are A1, A7 and A5. If decision maker chooses alternative A3 he will gain enterprise that is the most convenient to his financial possibilities and criterions of maximal incomes and minimal losses what is the main goal for every entrepreneur.

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THE APPLICATION OF ARTIFICIAL NEURAL NETWORKS IN THE METALLURGICAL INDUSTRY

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ABSTRACT

This paper presents the possibility of applying the Artificial Neural Networks (ANNs) as the tool for solving nonlinear multivariate problems in the metallurgical industry. Using comparative analysis during application of the Multivariate Regression Analysis (MRA) and the ANNs on the same data set, for prediction of the copper content in the waste sulfide smelting slag, following values of coefficient of determination (R^2) were obtained: 0.09 and 0.999, respectively. Those results indicated that ANNs have higher applicability for solving nonlinear problems of the technological processes at the industrial level.
Keywords: multivariate regression, artificial neural networks, copper content, slag

1. INTRODUCTION

In the last decade, artificial neural networks (ANNs) have emerged as attractive tools for nonlinear process modeling especially in situation where the development of phenomenological or conventional regression models becomes impractical or cumbersome. ANN is a computer modeling approach that learns from examples through iterations without requiring a prior knowledge of the relationships of process parameters and is, consequently, capable of dealing with uncertainness, noisy data, and non-linear relationships (Baughman and Liu, 1995)

2. ARTIFICIEL NEURAL NETWORK ARCHITECTURE

The ANN used in the model development is depicted in fig.1. As shown, the network usually consists of three layers of nodes. The layers described as input, hidden and output layers, comprise N, L and K number of processing nodes, respectively. Each node in the input (hidden) layer is linked to all the nodes in the hidden (output) layer using weighted connections. In addition to the N and L number of input and hidden nodes, the ANN architecture also houses a bias node (with fixed output + 1) in its input and hidden layers; the bias nodes are also connected to all the nodes in the subsequent layer and they provide additional adjustable parameters (weights) for the model fitting. The number of nodes (N) in the ANN network input layer is equal to the number of inputs in the process whereas the number of output nodes (K) equals the number of the process outputs. However, the number of hidden nodes (L) is an adjustable parameter magnitude of which is determined by issues, such as the desired approximation and generalization capabilities of the network model (Zeng and Chen, 1997; Dreyftus, 2004).

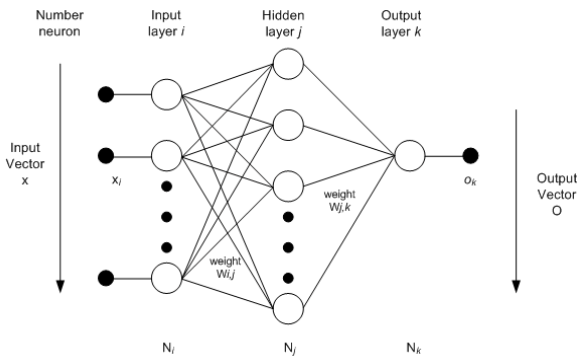


Figure 1. A schematic diagram of ANN with one hidden layer

2. THE APPLICATION OF THE ANN FOR PREDICTION OF THE COPPER CONTENT IN THE SMELTING SLAG – A CASE STUDY

Crucial stage of the copper extraction process is smelting phase which results with two products: waste slag and copper matte. Waste slag is discharged at the specially prepared dumpsite (waste yard), while the copper matte if further processed according to the technological procedure of copper extraction. Regardless the stage of the technologies life cycle (Živković, D., and Živković, Ž, 2007) global problem of the slag discharge is requiring local solutions (Parnel, 2006). Analytical dependences between slag composition and its copper content, as well as influence of matte composition on copper losses in slag, are present in the literature (Živković, et al., 2009). Those dependences were defined using the MRA methodology. For calculations, whose results are presented in this paper, industrial data obtained from RTB Bor Copper Smelter Plant were used (for the time period of 2003 to 2009)

According to the main constituents of the copper smelting waste slag, following dependence of the copper content was defined (Živković, et al. 2009):

$$(Cu) = a + b(SiO_2) + c(FeO) + d\,(Fe_3O_4) + e(CaO) + f\,(Al_2O_3) + g\,[Cu] \quad (1)$$

where: a,b,c,d,e,f and g – coefficients of the linear regression equation, ( ) - concentration of the slag components in wt. % and [ ] - concentration of the matte components in wt. %.

After applying the MRA methodology on the above defined data set, considering the slag and the matte composition, with total number of 67 data lines, following results were obtained:

$$(Cu) = -\,0.728 + 0.031(SiO)_2 + 0.001(FeO) + 0.016(Fe_3O_4) - 0.031(CaO) + 0.034(Al_2O_3) + 0.002[Cu] \quad (2)$$

The coefficient of determination of this dependence is $R^2 = 0.09$, which indicate very low fitting of obtained results. Figure 2, presents the dependence between measured and calculated values of copper content in the slag, using MRA.

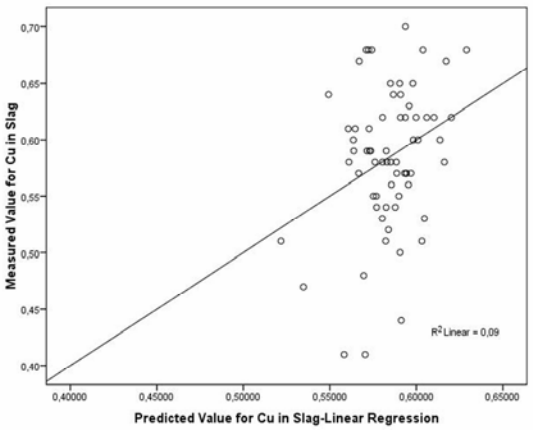


Figure 2. Dependence between calculated and measured values of the copper content in the slag, as the function of its composition

To apply the ANN methodology, on the same data set, it was randomly divided in to two groups. First group contained 46 (68.7%) data lines, while the second group comprehended remaining 21 data lines (31.3%). First group was used for the training and the second one for testing of the network.

The input variables (X_i) includes the: (SiO_2), (FeO), (CaO), (Fe_3O_4), (Al_2O_3) and the [Cu], while the output data Y_i presents the copper content in the waste slag (Cu). For one hidden neuron layer selected, ANN is created according to the architecture presented in the Figure 3.

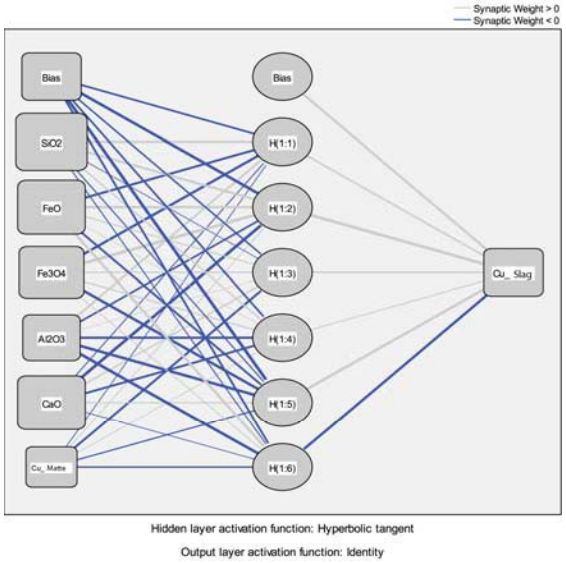


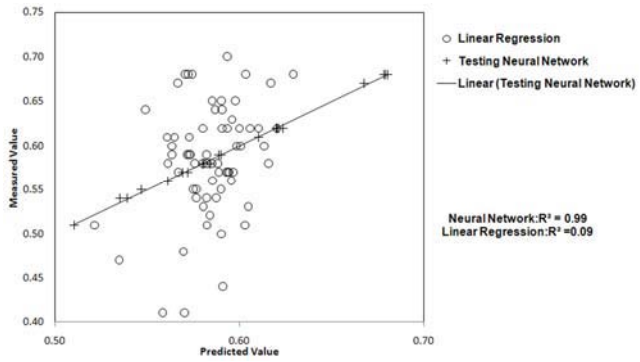
Figure 3. The ANN architecture applied for prediction of the copper content in the smelting slag

4. DISCUSSION OF THE RESULTS

During the first phase of the ANN development, the training of the network was performed on 46 vectors (out of total number of 67). Adequate number of iterations was performed during the

training of the network, until the error of prediction obtained the constant value. This error is actually based on difference between measured and calculated values of copper content in the slag. Results obtained during training phase can be evaluated after comparison between measured Cu content in the slag and the values calculated using ANN. Such comparison resulted with degree of determination (R^2) equal to 0.997.

After defining such "trained" network, second stage included its testing on the remaining data from the initial dataset, which comprised 21 vectors (testing of the network). During the testing stage, calculated values of the copper content in the smelting slag were compared to the measured values. Statistical value of the coefficient of determination (R^2) was, at this stage, further improved and reached the value of 0.999. Figure 4, is presenting concurrent comparison between the values calculated using MLRA and the ANN methods in respect to measured copper content in the slag. Results presented in Figure 4, indicated that the ANN yielded much better results of prediction.



Sl.4. Comparison between the calculated and measured values of the copper content in the slag using ANN and MLRA methodology (o - MLRA; x – ANN in the testing phase; — ideal position)

5. CONCLUSIONS

This paper presents the comparative analysis of two statistical techniques: artificial neural networks (ANNs) and multiple linear regression analysis (MLRA); applied on same technological problem. The topic of investigation was the copper content in the slag obtained during copper concentrate smelting in the reverberatory furnace as the function of the slag composition and the copper content in the corresponding matte. The results of the investigations indicated that ANNs can be successfully used for prediction of the copper content in the smelting slag, if its composition and the copper content in the matte are known. This investigation revealed that copper content in the slag can be determined with high accuracy as the function of slags composition and the composition of the matte, using ANN methodology. This fact is important since the composition of the slag can be predefined by controlling the composition of the input charge. On the other hand, the copper matte composition can be controlled by the degree of desulfurization obtained during oxidative roasting of the charge. This way, ANNs can be used for prediction of the final copper content in the slag. Considering the large capacity of the ANNs and their relatively simple algorithm, they can be used for solving large number of nonlinear problems, including those appearing in the metallurgical processes at the industrial level, as well as in the chemical technology processes.

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THE COMPROMISE RANKING METHOD FOR BOILER SELECTION

Živko Ralić, B.Sc. ME

Summary: *The paper presents the application of the compromise ranking method in making the selection of a boiler for central heating. Evaluation of alternatives was carried out within the system of six criteria (f_1, f_2...f_6) with various relative weights and with various demands for maximization and minimization by established criteria. A system of the most favourable alternative of a boiler was formed out of the eight compared ones (a_1, a_2...a_8).*

Key words: Compromise Ranking method, boiler selection

1.0 INTRODUCTION

The energy crisis of the 1970s definitely changed the attitude of society towards the issue of energy sources. Limited sources are warning the public against the selection of energy products to be used for heating the facilities.

The issue of boiler selection is becoming increasingly complex and difficult to solve. The approach whereby decision makers rely upon ''common sense“ can not answer the questions posed by the contemporary environment.

Contemporary approach to organizational systems and decision making processes implies scientific management of complex situations and development in any domain of human activities. It is thus established the direct connection of systemic approach with scientific methods and techniques of complex situations analysis [1].

Decision making support systems are deployed when the decision maker needs computerized support in solving the problem [2].

The possibility of selection is frequently limited by the communal infrastructure, where the facility is situated. For example, natural gas can be used only in those parts of the settlement where the gasification projects have been carried out.

The utilization of solid fuel is possible regardless of communal infrastructure. The reliability of energy product availability is very high, however, it is avoided due to ecological aspects.

Liquid soil used to be very popular because of its comparatively comfortable way of utilizing. Disorders caused by energy crisis have changed for good the price parity to other energy products and thus made this type of heating lesser attractive.

Electrical energy, being one of the most comfortable types of heating, is not widely acceptable due to its high price.

It is possible to use liquefied petroleum gas (LPG). The largest obstable to use it in the urban environment are strict regulations for its storage.

The utilization of geothermal source of heat, even though it has been in use in this country, is not widespread because of costly installations.

The task of this work is to provide assistance in boiler selection by deploying the Iterative Compromise Ranking method.

2.0 THE ITERATIVE COMPROMISE RANKING METHOD

One of the most commonly used methods for decision making in solving business problems is the method of compromise ranking.

The Iterative Compromise Ranking method (ICOR) [4] has been developed on the basis of the compromise programming elements and this method will be deployed in solving a concrete problem.

"The solution approximating most the ideal one, based on the adopted measure of distance, is referred to as a compromise solution.
Metrics is most commonly used as a measure of distance from an ideal point

$$L_p(F^*, F) = \left\{ \sum_{i=1}^{n} \left[f_i^* - f_i(x) \right]^p \right\}^{1/p} \quad ,1 \le p \le \infty$$

This metrics is a distance between two ideal points F^* and $F_{(x)}$ in the space of criterion functions." [4]

The rank order list of compared alternatives is determined on the basis of the measure defined by the relation. Decision maker, depending on the type of problem to be solved, defines the system of criteria to evaluate each of the J-alternative solutions. For each criterion, a relative weight (w_i) is defined, and by using the relations to perform calculations two independent rank order lists are obtained.

The demand for maximum group benefit is analytically expressed on the basis of determining the measure of deviation S_j, so one rank order list is obtained. The demand for minimization of maximum deviation of some alternative from the "ideal" one is expressed on the basis of the measure of deviation R_j and the second rank order list is thus obtained..

Establishing the compromise rank order list which integrates measures S_j and R_j is performed by means of the compromise measure Q_j. Calculations for each alternative deviation, based on analytical relation for Q_j, provide for ranking of compared alternative solutions [5].

The compromise ranking technique will be demonstrated on an example of practical decision making i.e. the selection of the most favorable alternative for a boiler out of the eight compared alternatives (a_1, a_2…, a_8). Evaluation of the alternatives was performed within the system of six criteria (f_1, f_2…, f_6) having various relative weights and various demands for maximization or minimization by established criteria. A criteria system was formed, all criteria differing in character: technical-technological, economic-financial, market and ecological. Thereafter, the evaluation of compared alternatives was carried out, which is tabulated.

3.0 PROBLEM FORMULATION

The analysis will embrace two boilers each, for four types of energy products, which can be potentially used for heating the facility.

The boilers, alternatives, to be compared are as follows:

1. **Natural gas** boiler JUNKERS – ZS 24. Installed boiler house components. Power 24kW, efficiency η = 0.95, warranty period – 2 years.
2. **Natural gas** boiler VALLIANT – atmoTEC 24. Installed boiler house components. Power 24 kW, efficiency η = 0.97, warranty period – 2 years.
3. **Solid fuel** boiler TERMOMONT – TŽ 24, steel made. Power 24 kW, efficiency η = 0.70, warranty period – 5 years.
4. **Solid fuel** boiler JUNKERS – SUPRACLASS S 24, steel made. Power 24 kW, efficiency η = 0.79, warranty period – 2 years.
5. **Liquid fuel** boiler CENTROMETAL – EKO CUP M3 K4101, steel made. Power 24 kW, efficiency η = 0.93, warranty period – 2 years.
6. **Liquid fuel** boiler SIME RONDO 4, cast. Power 31 kW, efficiency η = 0.90, warranty period – 1 year.
7. **Electric** boiler TERMOMONT – ETK SET 24. Installed boiler house components. Power 24 kW, efficiency η = 0.90, warranty period – 5 years, electric components – 12 months.
8. **Electric** boiler IMP 24. Installed boiler house components. Power 24 kW, efficiency η = 0.90, warranty period – 12 months.

Evaluation of the alternatives was carried out within a 6-criterion system: energy product price, boiler price, reliable energy product supply, boiler reliability, technical characteristics and ecological criterion.

4.0 PROBLEM SOLUTION

Price is a deterministic quantity and it often happens that it has a crucial impact on decision making for selection. The price of energy products is a permanent expenditure and of a boiler a lump sum, primarily depending on boiler quality, equipment level, brand and the like.

Alternative symbol	CRITERIA						
		Energy Price	Boiler Price (RSD)	Reliable energy supply	Boiler Reliable	Technical characteristics	Ecological criterion
	Criterion weight	0,34	0,20	0,22	0,10	0,08	0,06
	Demand max/min	min.	min.	max.	max.	max.	max.
A_1	Junkers gas	1.42	84,843 (6)	4	2 (4)	7	7
A_2	Vaillant gas	1.42	85,553 (6)	4	2 (4)	8	7
A_3	Termomont sol. f.	1.00	81,561 (4)	7	5 (7)	4	2
A_4	Junkers sol. f.	1.00	76,569 (4)	7	2 (4)	5	2
A_5	Centrometal liq. f.	3.71	60,636 (3)	4	1 (2)	3	4
A_6	SimeRondo4 liq. f.	3.71	51,158 (4)	4	1 (2)	2	4
A_7	Termomont el.	5.10	52,108 (7)	5	2 (4)	6	6
A_8	IMP el.	5.10	51,226 (7)	5	1 (2)	7	6

Table 1. Criteria and alternatives

It was found by expert analysis that energy price plays a dominant role in solving the observed problem. Fig. 1 displays price indexes for energy products in general consumption [6]. The cheapest energy product at the domestic market is coal Kostolac. It was assigned index 1.0. Other relevant energy products were assigned indexes against the cheapest energy product.

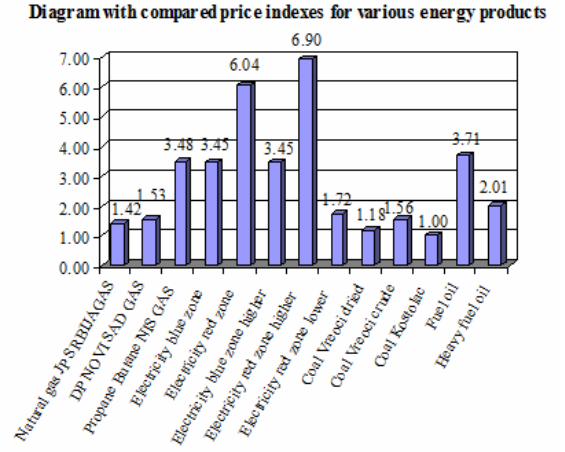

Fig. 1 Price indexes for energy products in general consumption

Description	Evalualua.
Markedly favorable, good quality,reliable	9 - 10
Very favorable, good quality, reliable	7 - 8
Favorable, good quality, reliable	4 - 6
Comparati.favorable,good quality,reliable	2 - 3
Unfavorable, poor quality, unreliable	0 - 1

Table 2. Evaluation applied for alternatives

The ratio of prices for the observed energy products is shown in Tab. 1. Each boiler was assigned an index depending on the type of fuel it uses.

Boiler prices are given in RSD, after the source [7], Tab. 1. Difference in installed equipment level and quality will be taken into account within the framework of boiler price (in parentheses) and the Technical characteristics criterion.

The reliability of energy product supply was subjected to expert analysis. Coal, being energy product of domestic origin, is more certain to supply. The supply of imported energy products (gas to a higher extent) and extra light fuel oil is dependent on the state's financial resources and global turmoil. Electrical energy as a domestic energy product is not reliable enough due to deficiency of production capacities. Evaluation of reliability is given in Tab. 1.

Boiler reliability was evaluated on the basis of warranty period length that is prescribed by the manufacturer itself. Where the length of warranty period was not given, a minimum of 1 year was taken. The length of warranty period and evaluation of reliability are shown in Tab. 1.

Evaluation criteria for boiler technical characteristics are: efficiency η, quality of manufacture, installed equipment, exploitation potential etc. The results of evaluation are presented in Tab. 1.

Ecological criterion was evaluated according to the type of energy product used and boiler technical characteristics (η). The results of evaluation are found in Tab. 1.

Using the program for the Iterative Compromise Ranking method (ICOR), a compromise rank order list of alternatives is obtained:

1. ALTERNATIVE 4
2. ALTERNATIVE 3
3. ALTERNATIVE 2
4. ALTERNATIVE 1
5. ALTERNATIVE 6
6. ALTERNATIVE 5
7. ALTERNATIVE 7
8. ALTERNATIVE 8

5.0 CONCLUSION

The Iterative Compromise Ranking method (ICOR) performs the ranking of alternatives in solving a concrete decision making problem. It is possible to establish a compromise rank order list by calculating deviations of each alternative from the "ideal" one. Ranking is achieved by comparing the alternative solutions [4].

By solving the task, an analyst should propose to the decision maker a single solution best suited to his expressed preferences. Calculations for each alternative deviation makes possible to rank the compared alternative solutions [5].

In concrete problem solving a decision maker has expressed in advance, prior to solving the task (ICOR), his attitude towards the criteria (a priori approach) [3]. Priority or hierarchy of criteria was established, weight was assigned to some criteria and relative relationship between the alternatives was determined within the framework of criteria.

The significance was assigned to some criteria on the basis of perception of the ambient where evaluation is done. Difficult economic situation has "imposed" the price as the most prominent criterion. The value of two criteria containing in themselves the price and the demand for minimization is 50% in total. The price of energy, the criterion with the highest significance individually, is formed by the state. It contains in itself, apart from economic component, diverse attempts on the part of the state to exercise influence on general stability.

Reliability of energy supply, the second criterion in significance, is of importance in broader environment. Domestic energy products have thus attained a higher relative importance compared with those imported. Disorders in supply are present in other countries as well but richer countries possess capacity to mitigate them.

Boiler reliability, technical characteristics and ecological criterion were assigned relatively lesser importance compared to the aforementioned criteria. If ranking were performed in another (economically more stable) environment, the results would be different for sure. Ecological criterion and technical characteristics would necessarily exert dominant influence however the price would be again a significant criterion.

The thus set task would place natural gas boilers in the foreground. Natural gas combustion is considered to be ecologically acceptable. Technical characteristics of boilers that use natural gas are at higher level than other types of boilers.

Ecological criterion, unfortunately, is not of importance with us as much as it should be. It is not enough to change the regulations, but change is necessary for the sake of changing the attitudes. It is much more difficult to change awareness of how important the problem is.

The application of quantitative method produced the results which are the outcome of significance assigned to criteria and evaluation of available alternatives. The applied method ranked the alternatives and as such they assist decision maker to make a selection of the final solution.

This work, the application of Iterative Compromise Ranking (ICOR) in boiler selection, has demonstrated that some changes in our living environment are necessary.

Qualitative analysis indicates that perception of a concrete problem is needed not only from the aspect of ambient limitations where it was performed. If higher significance were assigned to other criteria, the results of ranking would be different.

Decision maker is not obliged to accept the proposed solution but must take it into account. The solution provides great assistance in a more complex perception of the problem. It demonstrates the attitude of decision maker towards the established criteria.

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THE VISUALISATION OF THE BINARY NUMBERS ADDITION WITHOUT THE MEMORY USAGE

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Abstract – This paper, using an example of the binary numbers addition, shows the application which allows the visualization of the arithmetical-logical unit (ALU) work. The visual tool allows users to understand the data flow from the input devices, through the ALU, to the output devices without usage of the memory. To develope this application the MS Visual Basic 6.0 was used.

Keywords – modeling, visualization, simulation, education, ALU.

1. INTRODUCTION

Fast development of computers technology, in the second part of the twentieth century, mainly from the perspective of the computers components manufacturing, demands the efficient way how to introduce more users who should know about the computers functionalities.

As a part of it the visualization of the computers work is a powerful way for education of potential users. When the microcomputers become popular, people ask for an appropriate software tool to visual and simulate their work. So, the visualization becomes the natural way to understand things clearly and deeply.

The world wide is possible to find many simulators of the computer systems. They allow to obtain the knowledge in areas of computer science and architecture and some of these are SPECS (developed by ETF in Belgrade) [6,7], HASE (developed at University of Edinburg) [8], ESCAPE (developed at University of Gentu) [9], DLXView (developed at University of Purdue) [10], LMC (Little Man Computer developed at MIT) [11] etc.

In this paper, using the example of the addition of two binary numbers, the visual application is explained. It allows follow-up of the complete data flow, from the beginning to the end, going through the ALU and without usage of RAM (Random Access Memory) [1].

2. MODELING AND SIMULATION

In order to make the successful simulation firstly the modeling must be done. The modeling uses creativity in the way to define specific functions which cope with a real system. Based on the model the simulation is done, and it can be assumed as a number of relations between the model and a computer which is used for calculations [1, 2].

The modeling is one of the basic humane being intellect processes and is related to the way how the humane being thinks and resolves problems. It is a part of daily activities of the humane being and makes a man different from other creatures (allows the man to think, describe, use symbols and languages, communicate, share different experience etc.). Based on that, the modeling is often considered as a very important conceptual way which the humane being can use [3].

The word “simulation” usually can be used for many different activities. If the process of making an abstract model of the real system and experiments are done on the computer, then it is called computer modeling and simulation. Today the modeling is almost not possible without the computers. The computers for modeling are used in two purposes: to develop a model and to do calculations based on that model.

The modeling and simulation are complex activities that include three key elements: the real system, the model, and the computer. Figure 1. [2] depicts these three elements and their relations.

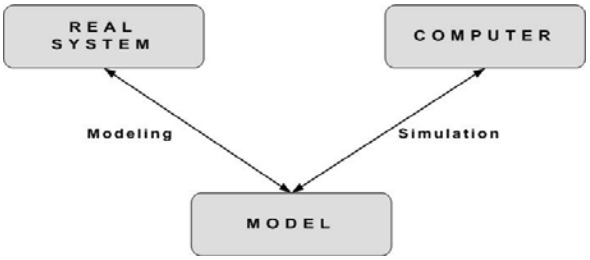

Fig. 1 – Key elements for modeling and simulation

The real system is a source of data for the model specifications. It is the source of data which depicts the real system behavior. The model is an abstract picture of real system. It has the real system structure, components, and interactions among components. Since the computer is mostly used for simulation then the model can be considered as a group of instructions (program) which is used to generate the behavior of the simulated system. The computer is able to execute the set of model instructions and based on the data input to generate the model transition states in time.

The modeling relations are processes where the real system data and model's data are compared in order to confirm the validity of the model. The simulation relations are used to check up if the simulation program truly brings model characteristics to the computer and how precisely the computer executes model's instructions.

3. THE SYNTHESIS OF THE COMPUTER ARCHITECTURE

To make the synthesis of the computer architecture it is important firstly to define necessary arithmetical and logical operations, then inputs and outputs, work with the memory locations, work with registries, and to define other functions that allows data manipulation. In order to analyze the computer architecture someone can start with the limited number of instructions that allows simulation of the basic computer operations. In this paper the set of instructions is used which allows the addition of two binary numbers.

In order to make the arithmetical operation addition two binary numbers are necessary (as operands) , then two registries and arithmetical-logical unit (ALU) for general purpose. The numbers are added to the system through the input devices, while the result of addition is sent to the output devices. The necessary hardware structure which is used for the arithmetic operation addition is given in Figure 2 [4].

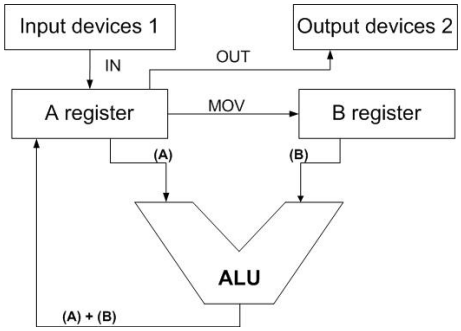

Fig. 2 – The schema for inputs, manipulations and outputs

The program sequence which allows the realization of input, move, addition and output is given in Table 1.

Table 1. The program sequence for addition

IN 1	(A) ← First number
MOV	(B) ← (A)
IN 1	(A) ← Second number
ADD	(A) ← (A) + (B)
OUT 2	Result ← (A)

To make an input of data through the input devices it must be used the machine instruction IN. The register A is dedicated for the input data. During the addition operation (ADD) for data must be defined mechanizm how to transfer data to register B. This transfer can be completed using an operation MOV which moving data from register A to register B. The result of addition is sent to the output device using OUT instruction. Evry input-output device has a number which specifies its address. In this example the input device has the address 1, and the output device has the address 2.

4. THE REALISATION OF PROGRAM SEQUENCE WITHOUT THE MEMORY USAGE

The application which is described here has a purpose to demonstrate someone how the addition for two numbers can be executed, simulating the step by step data flow from the input devices, through the ALU, to the output devices, without the memory usage. The software was developed for Microsoft Windows XP platform using the programming language Microsoft Visual Basic 6.0 [5].

The addition of two numbers is demonstrated using decimal numbers 23 and 25. The appropriate binary numbers for them are 10111 and 11001. When the application started the screen will be as shown in Figure 3.

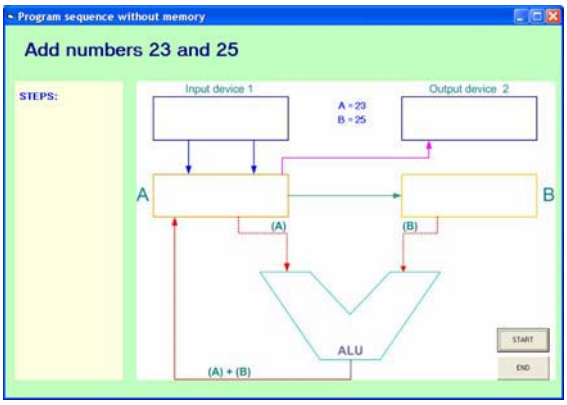

Fig. 3 The starting screen for addition

After the user press a command button "START" the demonstration starts and goes through 8 steps. The actions in every step is demonstrated in a part called "STEPS:", while every simulation step is numbered with 1,2,..

At the beginning (Entry number 23) the first number is added to the system using the input device (Figure 4). The binary represenatation of this number (23) is 10111.

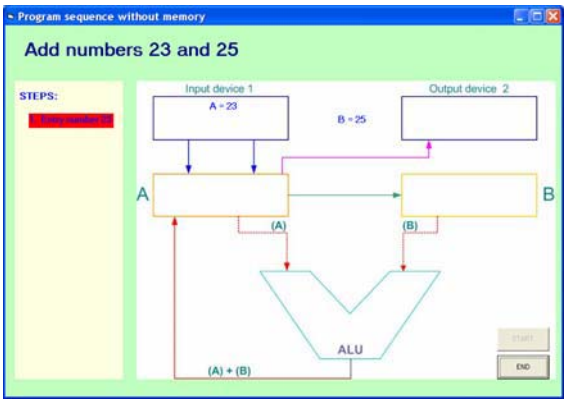

Fig. 4 – The first step – entry for the first number

At the second step (IN 1) the binary number 10111 is going to the register A. The Figure 5 shows the momentum when the sequence is written in the register A.

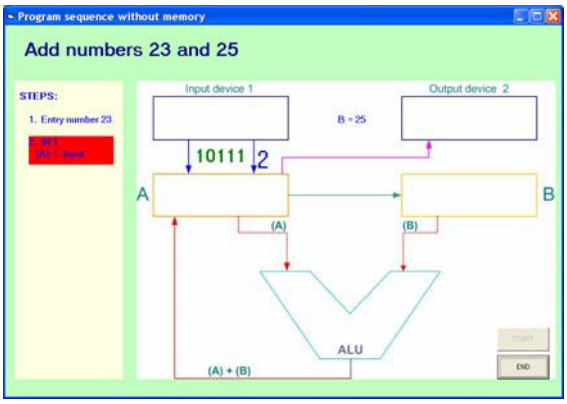

Fig. 5 – The second step – the number 10111 is written into the register A (IN 1)

In order to make addition of two number, the second number must be added to the system too. Because the register A is currently populated with the first number then its contains should be moved somewhere. Because this example does not use the memory, then the supporting register B should be used. To move the number from register A to the register B the machine instruction MOV is used. The figure 6 shows the momentum when data is moved from the register A to register B.

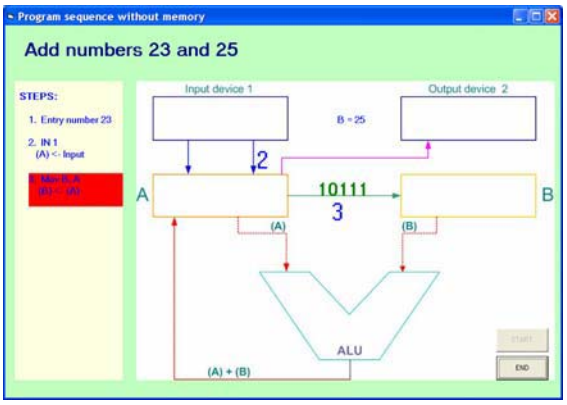

Fig. 6 – The third step – moving data from the register A to the register B (MOV B, A)

Now the register A is empty so the second number can be added in it. This is done through the next two steps. The Figure 7 depicts the momentum when the second number is added to the register A.

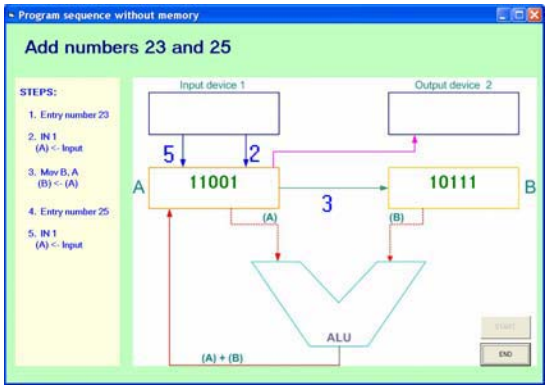

Fig. 7 – The fifth step – adding second number into the register A (IN 1)

Now, the numbers on which the addition should be done are placed in registers A and B. The contains of these registeres should go to ALU and there the arithmetical operation addition should be completed. This is depicted in the sixth step (ALU⇐(A),(B)) (Figure 8).

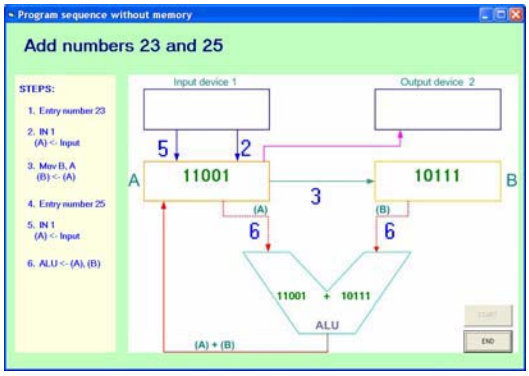

Fig. 8 – The sixth step – The completion of addition using ALU-u (ALU⇐(A),(B))

The program continues with next step: After the ALU did arithmetical operations (ADD B,A) the result (110000) goes to register A. ((A)⇐(A)+(B)). The Figure 9 gives seventh step of this simulation where ALU sends results to register A (the result is still not written in register A).

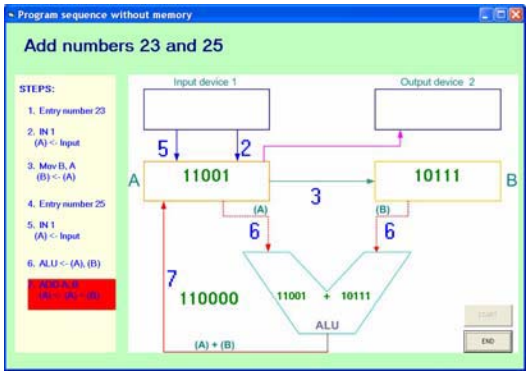

Fig. 9 – The seventh step – The result of addition A and B (ADD A, B)

At the last step the result is going to register A and then it can be shown on some output device. To send the result the OUT machine instruction was used (Figure 10).

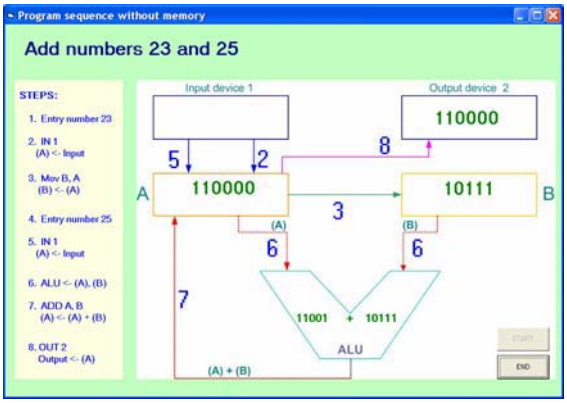

Fig. 10 – Finish – The result is shown at the output device (OUT 2)

5. CONCLUSION

In this paper is demonstrated how the arithmetic operation addition can be done usage the visual tool. This operation has been depicted through the basic steps what allows users to get deep and clear knowledge about the computer architecture for this specific topic. The main goal of this paper is to help users to understand some low level problems in the computers science.

The further work will be focused on the integration adding other arithmetical and logical operations and including the memory, stack, parallel work and more sophisticated requirements.

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SESSION D – ORGANIZATIONAL BEHAVIOR AND HUMAN FACTORS

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STRUCTURAL ANALYSIS OF INFORMATION PROCESSING MODEL ACCORDING TO HABER AND HERSHENSON

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Abstract. Information processing model of Haber and Herhenson is the model that is used in some textbooks for explanation of human information processing. Human information processing approach is of great importance for controlling and managing of the man - machine system. The aim of this research is to give a new consideration about adequacy of the model of Haber and Hershenson for explanation of the human information processes, by means of structural and functional analysis of the model. It is pointed out to some shortcomings of the model and to a conditional limitation of the model for explanation of the human information processing.
Keywords: human information processing, information processing models.

INTRODUCTION

The basic purpose of different information processing models is to provide an insight about the ways that man process different information, by symbolic (schematic) presentation. Although these models are generally formed to explain some specific appearances about processing of information, some researches often tray to explain almost all occurrences concerning information processing by one complex model. However, it is not a rare case that some weakness of the models becomes apparent by a detailed structural and functional analysis (see for example Zunjic and Milanovic, Zunjic 2007).

THE AIM OF RESEARCH

Information processing model of Haber and Herhenson is the model that is used in some textbooks for explanation of human information processing. The aim of this research is to give a new consideration about adequacy of the model of Haber and Hershenson for explanation of the human information processes, by means of structural and functional analysis of the model.

ANALYSIS AND DISCUSION OF THE MODEL

Information processing model according to Haber and Hershenson is presented on the figure 1.

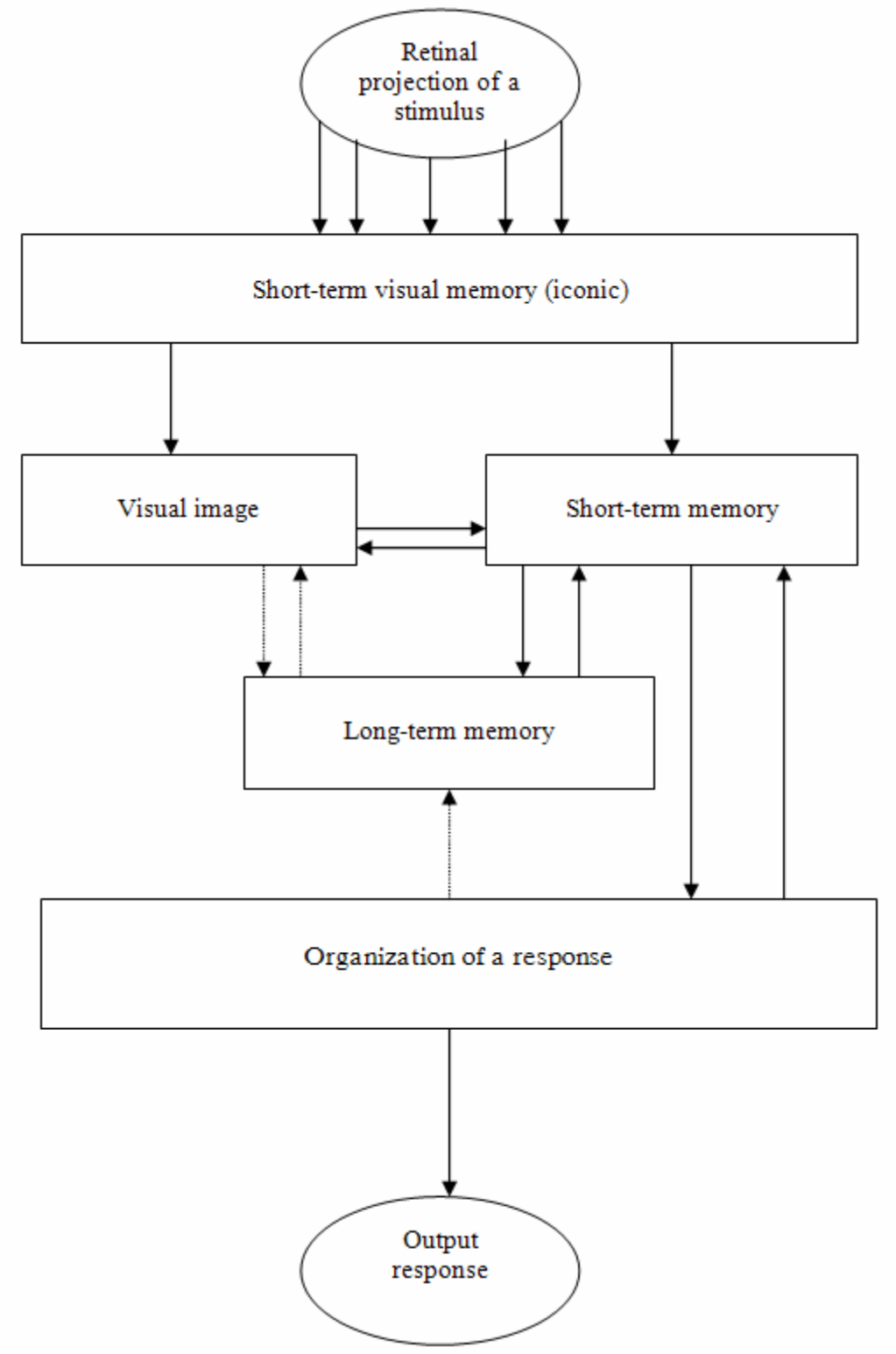

Figure 1. Information processing model of Haber and Hershenson (McCormick and Sanders).

Figure 2 shows information processing model in the case of receiving of the auditory and visual information, according to Haber and Hershenson.

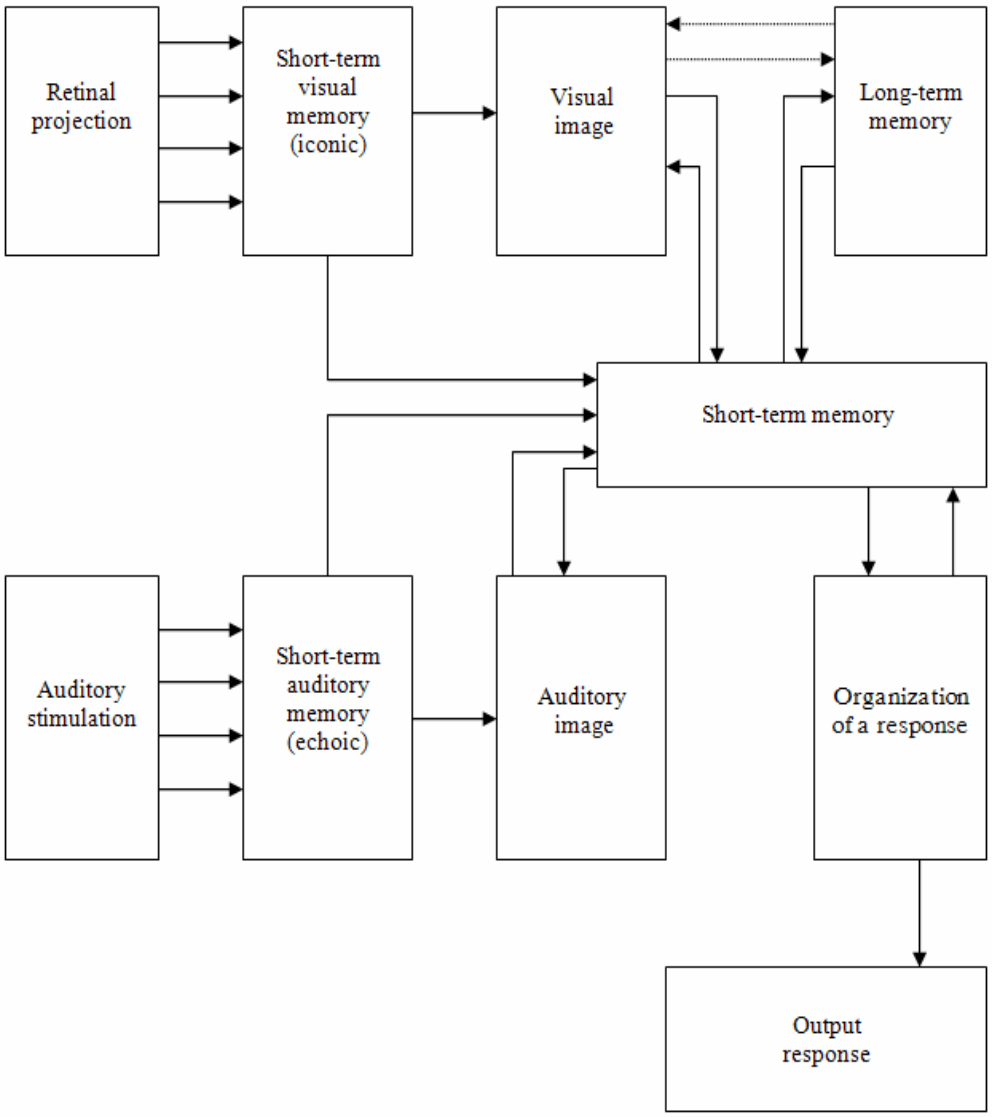

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Figure 2. Information processing model for the visual and auditory input information, according to Haber and Hershenson (Haber and Hershenson).

From the figures 1 and 2 we can perceive that the model shown in figure 1 is completely comprised in figure 2, in the part that relates on processing of visual information. Haber and Hershenson consider that the processes of information coding perform in short-term memory. Information coding represents a preparation for the storage of information in the long-term memory, or for a response giving. Besides, information retains in the short-term memory only few seconds, although its stay can be prolonged with repetition. Accordingly, internal repetition of information at the individual stages of processing represents the sub phase process, i.e. processing that performs on the same location in the system (iconic memory, short-term memory some authors often call the phases of processing). For example, such kind of processing enables that some visual construction can be "refreshed" internally, without any additional information inputs from short-term or iconic memory.

Differences and similarities with other models

Globally considered, models of Haber and Hershenson differentiate from the single channel Broadbent model therein the short-term memory undertakes the function of the Broadbent's p - system, i.e. the role of the channel of limited capacity (McCormick and Sanders). Broadbent's information processing model is shown in the figure 3.

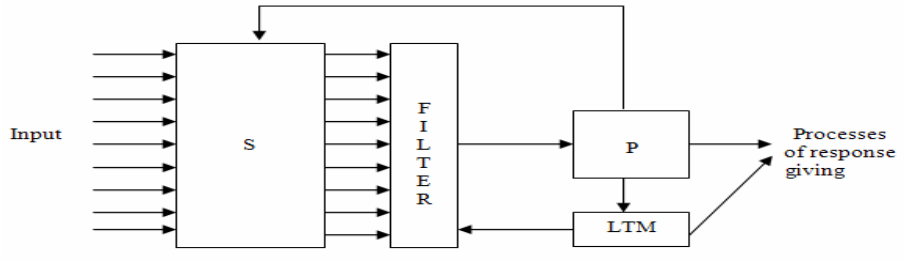

Figure 3. Information processing model according to Broadbent (Barber and Leg).

Haber and Hershenson consider that their model mainly corresponds to the information processing models of other authors. However, primary item that separates their model from the other information processing models is the block of a visual image presentation. According to this authors, in this block performs a creation of a complex visual image, based on a determined number of visual sense fixation (i.e. in that way forms an image of the world that surround us). Because of that, it is necessary to make the difference between this block and the block of iconic memory, which content is determined with retinal projection in the extent of one visual sense fixation. In the visual image block, information retains longer than in the iconic memory, i.e. longer than 250 ms, although it is not known exactly how long (Haber and Hershenson).

Character of the connections in the model

According to the kind of components that are in the content of the structure, model of Haber and Hershenson does not differ much from the majority of other information processing models. In addition to the block of visual image, the characteristic that this model separates from the other models is the character of the connections between the structural components.

In the figure 2, it is shown that the information flow between individual segments can be accomplished in the both directions. Therefore, it is punctuated the information exchange interdependency between the elements that participate in the processing of information.

However, certain details that relates to the information flow between structural elements offers some questions, although the model of Haber and Hershenson does not offer an answer. When we observe the connection between long-term memory and visual image (figure 2), we can see that it is mutual. So, if exists the analogy in the way of processing of auditory and visual information (which perceives in the conception of the model), than we can notice that mutual connection between long-term memory and auditory image does not exist. In addition, the connection between long-term memory and visual image is not clearly defined. For that connection, Haber and Hershenson cite that it has conceptual or ideological character. They punctuate that it is not known is it possible to construct visual image direct from long-term memory, or it is necessary that information firstly passes from long-term memory to the short-term memory, and then in the block of visual image. Therefore, the connection between the long-term memory and visual image is presented with a broken line. Nevertheless, Haber and Hershenson did not explain what presents the visual image. Understanding of occurrences in this block can be useful for a revelation of the connection between long-term memory and auditory image and its adequacy.

CONCLUSION

Performed analysis in this paper indicates that model of information processing of Haber and Hershenson have some shortcomings. Therefore, its adequacy for explanation of human information processing has limited character.

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RESEARCH OF ENVIRONMENTAL CONDITIONS OF VDT OPERATORS IN CALL CENTRE

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Abstract. Call centre VDT operators are special category of VDT users, due to limitations regarding resting interval usage, continual sitting position, limited ability to leave the workplace when it is necessary or to take a standing position, acoustic isolation of the room and some other design or organizational factors. Occupational disease is common appearance among this population of VDT users. Because of that, it is important to provide optimal environmental working conditions for the call centre VDT operators. Unfortunately, there is little or no research concerning evaluation of environmental conditions in call centres. This paper relates to the evaluation of environmental conditions in the call centre of Telekom Serbia.
Keywords:call centre, VDT operators, ergonomics.

INTRODUCTION

Call centre defines as a place where the telephone users are served by an organization, along with the use of computer technology (ETSI, 2002). The operator in a call centre is a person whose job predominantly requires responding or making telephone calls whilst simultaneously using VDT equipment. Characteristically for the call centres is the accomplishment of 24/7 operation, which means that service lasts 24 hours per day, seven days per week. The "hot desking" system is applied, which means that the operator usually does not possess one VDT workplace, but work begins at the terminal that is not momentarily occupied. Operators that work in the call centre present particularly endangered population of VDT users, because their static work is related to a continual video display terminal use. Thereafter, it is needed to determine whether and to what extent the call centre VDT operators are exposed to inadequate environmental conditions.

AIM OF THE RESEARCH

In the Telecom Serbia, about 90 % of operator's working time consists of VDT work. Although it is known that the call centre operator's work is especially stressed and strained, very little scientific research relates to the examination of their work. The reason for this maybe can be found in the fact that the call centre operator's work is monitored and controlled by the trade union organization activity, which agents sit in the rooms where this kind of activity is performed. Optimal environmental conditions are very important for VDT operators, because of nature of the task they perform and due to the fact that they cannot easy regulate environmental conditions. Having in mind all mentioned, the aim of this paper is to examine existing solution in the call centre of Telekom Serbia regarding the environmental conditions, first of all from the operator's standpoint.

METHOD

VDT checklists are used in this research as a basic tool. The checklists contain a list of situations for which it can be presumed that might occur in given circumstances (Sinclair, 1995). The application of the checklists belongs to the group of subjective research methods, which in the case of video display terminal work enables very realistic approach (Howarth, 1995).
VDT checklists present a tool that contains elements in the form of questions. Putting the questions, we can determine and control whether and to what extent the observed human - computer system can be considered as

suitable and ergonomically appropriate for the operator's work. Concerning content and structure, existing VDT checklists are often mutually different. Having in mind the variety of questions in different VDT checklists, the general checklist that joined the different areas and items is formed for human - computer interaction evaluation, whereby the next VDT checklists are used as a basis for its designing: OEHS (2002), WSDLI (2002), LHC (1993), DOSH (1998), NYCOSH (2002), OSHA (1997), OSHA (2001), OML (1995), as well as the checklist of Somers et al. (1991). For the purpose of this research, the area of this general checklist called environmental condition is used. The formed checklist consists of two parts. The first part refers to the questions from the part of checklist for which the answers gave the operators. The second part refers to the questions from the part of the checklist for which the answers gave the researcher (expert). The first part of the checklist regarding environmental conditions contains the next questions:

Q21. Is additional (task) lighting adjustable concerning a position, in relation to the task and operator?
Q22. Can you independently control the artificial lighting in the room?
Q25. Are some measures taken to mitigate the reflection and glare?
Q26. Is the total illumination of the VDT workplace provides comfortable conditions for work?
Q28. Is the temperature of the VDT workplace provides comfortable conditions for work?
Q29. Is the humidity of the VDT workplace provides comfortable conditions for work?
Q30. Is the noise that comes from the basic and additional equipment on the VDT workplace interferes with performance of the tasks?
Q31. Is the noise that comes from remote areas of work hindering a realization of the tasks?
Q32. Is the noise from the street influences on the task performance?
Q33. Are there distracting fumes from other equipment located in the room?
Q35. Is it provided a comfortable air flow at the VDT workplace?

The second part of the checklist regarding environmental conditions contains next questions:

Q11. Is adequate natural lighting provided?
Q12. Are reflections and glare on the VDT screen exist?
Q13. Do reflections and glare on the VDT screen are derived from natural sources of light?
Q14. Do reflections and glare in the adjacent surrounding of VDT workplace of natural light sources exist?
Q15. Do reflections and glare in the remote surrounding of VDT workplace of natural light sources exist?
Q16. Do reflections and glare on the VDT screen come from artificial sources of light?
Q17. Do reflections and glare in the adjacent surrounding of VDT workplace of artificial light sources exist?
Q18. Do reflections and glare in the remote surrounding of the VDT workplace of artificial light source exist?
Q19. Is the setting of natural lighting regulated by curtains that are arranged on the windows?
Q20. Does any additional (task) lighting installed on the desk exist?
Q23. Is the VDT screen placed at the right angle in relation to a light source?
Q24. Are VDT workplaces placed between rows of artificial light sources?
Q27. Is the protective screen filter in use at the VDT workplace?
Q34. Is it installed a special anti-static equipment at the VDT workplace?

In this research, 33 operators participated in the Telecom Serbia call centre. The subjects were 25.5 years of age in average. Additional information and explanations regarding the environmental conditions are obtained by interviewing. Besides, as additional methods, observation and photo recording are used.

RESULTS

The figure 1 refers to the questions from the part of checklist for which the answers gave the operators. Figure 2 refers to the questions from the part of checklist for which the answers gave the researcher based on the insight into the system for the same VDT workplaces (or operators). Abscise is marked with Q and refers to the questions, while the ordinate is marked with N and refers to the number of given positive answers.

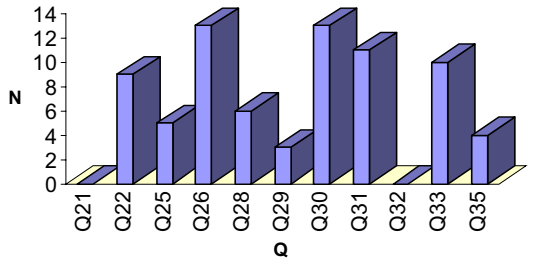

Figure1. Dependence of the number of VDT operators with the positive answers given and the type of control question for the environmental condition area.

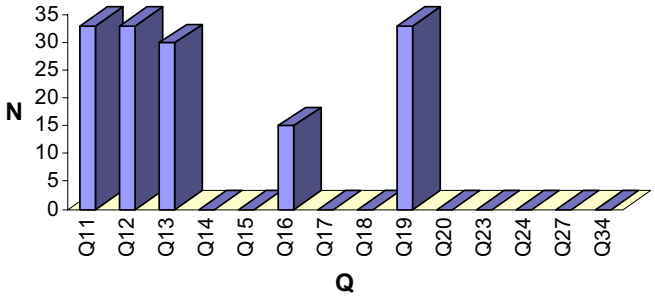

Figure 2. Number of positive answers given in relation to the control questions from the environmental condition area, based on the insight into the human - computer system.

ANALYSIS OF RESULTS

Based on the answers of VDT operators, calculated percents indicate the following:

100% of VDT operators state that additional lighting is not adjustable concerning a position, in relation to the task and operator
27.27% of VDT operators state that they can independently regulate the artificial lighting in the room
15.15% of VDT operators state that certain measures are taken to reduce the reflection and glare
39.39% of VDT operators consider that the total illumination of the VDT workplace provides comfortable conditions for work
81.82% of VDT operators consider that the temperature in the workplace do not ensure comfortable conditions for work
39.39% of VDT operators consider that the noise that comes from the basic and additional equipment in the workplace hinders execution of the tasks
33.33% of VDT operators consider that the noise that comes from remote working areas interferes with execution of the tasks
0% of VDT operators consider that the noise from the street influences on the performance of the tasks
30.30% of VDT operators state that there are disruptive fumes from other equipment
87.88% of VDT operators state that is not provided a comfortable airflow in the workplace.

Based on the answers of researcher (expert), calculated percents indicate the following:

In 100% of cases, it is provided adequate natural lighting of VDT workplaces
In 100% of cases there are reflections and glare on the VDT screen
In 90.90% of cases the reflections and glare on the VDT monitor are caused by natural sources of light
In 100% of cases there are not registered distracting reflections and glare in the adjacent surrounding of VDT workplaces of natural light sources
In 100% of cases there are not registered distracting reflections and glare in the remote surrounding of VDT workplaces of natural light sources
In 45.45% of the cases reflections and glare on the VDT screens come from artificial light sources
In 100% of cases there are not recorded distracting reflections and glare in the adjacent surrounding of VDT workplaces of artificial light sources
In 100% of cases there are not recorded distracting reflections and glare in the remote surrounding of the VDT workplaces of artificial light sources
In 100% of the cases setting of natural lighting is regulated by curtains that are arranged on the windows
In the 0% of cases, it is installed additional lighting on VDT desk

In 0% of cases the VDT monitor is set at the right angle in relation to a light source
In 0% of cases, the VDT workplace is set between rows of artificial light sources
In 0% of cases the protective screen filter is in use at the VDT workplace
In the 0% of cases at the VDT workplace, it is installed special anti-static equipment.

DISCUSION OF RESULTS AND CONCLUSION

In relation to the 21st question (Q21), VDT operators have declared that additional lighting is not adjustable in relation to the work task and the operator. In this regard, it should be noted that on the VDT worktables did not set the lamps at all, as a source of task lighting.

Concerning the 22nd question (Q22), 27.27% of the VDT operators declared that they could alone regulate the artificial lighting in the room. These percentage points to those VDT operators who occasionally self-regulate lighting in the room, while for the rest of the VDT operators such practice is not common. VDT operators who do not participate in a regulation of lighting in the room stated that the main reason for that is the assumption that for all VDT operators do not match the same illumination.

Regarding the 25th question (Q25), 15.15% of VDT operators state that certain measures are taken to reduce the reflection and glare. Interweaving revealed that this relates to the curtains that are arranged on the windows and the realized system of indirect artificial lighting. However, there are not implemented additional possibilities for glare reducing.

In relation to the 28th question (Q28), a significant part of VDT operators (81.82%) declared that the existing temperature at the workplace does not provide comfortable working conditions. The reason for this is in the fact that the temperature in the room of call centre regulates only through air conditioning systems, since open windows are not allowed because of the distracting noise from the street. However, the regulatory mechanism of the installed air conditioning system does not provide satisfactory range of temperature changes, so that the room temperature of call centre according to the VDT operators is in the winter low and in summer is high. In addition, the air conditioning system does not maintains often enough, which can also affect the temperature and air quality in the room.

Concerning the 32nd questions (Q32), none of the VDT operators considered that noise from the street interfere with their work. The reason for this is in the fact that call centre room is very good acoustically isolated, with very massive front door that is for this purpose specially designed.

Regarding the 33rd question, 30.30% of the VDT operators state that occasionally appears distracting fumes in the room. This vapor appears at the time of gasoline transfer at a nearby petrol station, which the installed air conditioning system is not able to filter out. In addition, the previously mentioned air conditioning system represents a reason why 87.88% of the VDT operators are not satisfied with realized airflow in the room.

Generally observed, it can be noticed that the VDT workplaces in the Telekom Serbia are well designed. However, the biggest unsolved problems are glare, temperature regulation and airflow.

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CHALLENGES OF LOBBYING IN GLOBAL BUSINESS

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Abstract:
The purpose of lobbying is to influence government policy and its implementation, and to help set the political agenda, in favour of political, social, ecological, business, and other aims. Lobbying is often an efficient way of influencing decision-makers, but the success depends on our knowledge, our resources and our contacts. Lobbying is used to influence knowledge, values and action among decision-makers. The lobbyists can strong support the decision-makers by giving them well-documented and credible facts and analyses for free, and thereby influence them to make decisions that suits the lobbyists
Key words: *lobbying ,business, communication, lobbying techniques, lobbyists, business intelligence*

1. INTRODUCTION: WHAT IS LOBBYING AND WHY USE IT?

In today's inter-dependent global economy, leading companies and other high-profile organizations want to understand and manage a wider range of opportunities, impacts, relationships and risks than ever before. It is increasingly recognised that the health of the global economy depends on a foundation of global security, spreading affluence and good governance, and that the private sector's capacities and creativity can help to achieve these goals. In short, business is becoming an integral part of the governance process at all levels from the local to the global. Increasingly, therefore, companies' reputations, licence to operate, and ultimately accountability, require them to demonstrate consistency in performance on issues like human rights, environmental impacts and corporate governance. Lobbying is an important component of this accountability and consistency.[1]

The concept of lobbying and lobby firm is differently explained in the professional literature. Since there are many different kinds of lobbying (political, economic, legal, etc.), main differences in the definition of the term lobbying are made depending on the area in which lobbying takes place. Lobbying in the global aspect represents the interests of individuals or interest groups articulated in order to realize their goals.

Lobbying is a word with many possible definitions, but will in this paper be defined as public or private actors legally trying to influence legislators or other public officials and politicians for or against a specific cause. The word comes from the English "lobby", which is a foyer or public room next to the assembly chamber of a legislative body. It was used in the beginning as a term for the journalists waiting in the lobby for the English parliamentary sessions to end, so that they could talk to the politicians.[2]

A major problem lies with public perception of the verb "lobbying": "*One man thinks of lobbying as the factual presentation of useful data to legislators. To another, it means sinister influence peddling by pressure groups with reckless disregard for the general welfare."* The generally prevalent negative image based on the assumption of sleaze, corruption and morally non defendable practices, is certainly due to some isolated scandals highly publicized by the media and the fact that the results of lobbying are not visible to the public.

The history of lobbying is a controversial one, and is quite often seen as a 'dirty word'; in some languages the word 'lobbyist' has particularly negative connotations. If one looks back on developments in lobbying and the involvement of companies and other actors in politics more generally, one can begin to understand why. Companies have long been seen to defend the status quo, often accompanied by

[1] *Towards Responsible Lobbying*, Accountability, 2005, p 17

[2] More in: Dragojlovic Predrag (2009), *Lobbying as a method of Business Communication*, Zbornik radova "Poslovno okruzenje u Srbiji i svetska ekonomska kriza", Novi Sad,

accusations that special interests operated to the detriment of wider society.

Lobbying is the practice of trying to persuade legislators or officials to propose, pass, or defeat legislation or to change existing laws. Lobbying may be done by constituents, organized groups, or other legislators. Governments often define and regulate lobbying by organized groups. Lobbying takes place on international, national, state, local, and municipal levels, wherever a government or organization of any kind makes decisions on public policy. A lobbyist may be a professional paid to work on behalf of a special interest group such as a trade association, labor union, or nonprofit organization, or a private individual who acts out of personal commitment to a particular cause. *Direct lobbying* involves meeting personally with political people or decision makers and attempting to persuade them. *Indirect lobbying* can take the form of advertising campaigns, media publicity, the filing of lawsuits, and public relations initiatives; or of influencing the people who are in direct contact with the decision-maker.[3]

2. LOBBYING AND BUSINESS INTELLIGENCE

Global competitive pressures are putting constant pressures on restructuring and finding additional sources of profitability. Organizations are becoming more and more aware of the importance of knowledge as a key factor in obtaining competitive advantage. A possible solution in knowledge management is Business Intelligence that involves the collection, evaluation, processing, analysis, and dissemination of economic data (about products, clients, competitors, etc.) inside organizations. But, this is not enough to make better business decisions. For decades companies also have been spending millions on enterprise resource planning (ERP), customer resource management (CRM) and data warehousing (DW) tools. With so much information locked in repositories, managers are putting pressure on IT to unlock information trapped in those systems.

In the knowledge-based economy, business intelligence and ICT (Information and Communication Technologies) represent basic components of competitive research and innovation strategies. In this paper, the concept of "business intelligence" refers to the product resulting from the collection, evaluation, analysis, integration and interpretation of all available information, supportive of the decision-making processes pertaining to the organizational goals of stability, security and development. Focused primarily on information available outside the organization, the scope of Business Intelligence covers wide fields, ranging from information technologies to market or legal topics. Business Intelligence is closely correlated with other information management approaches such as Knowledge Management (that works, in our opinion, on information collected inside the organization), or use of software tools dealing mainly with quantitative information.

Knowledge Management focuses on the existing knowledge inside the organization and comprises a range of practices used in order to identify, create, represent, distribute and enable adoption of insights and experiences. Economic Intelligence mainly addresses users in need of up to-date information in order to make the best decisions in the framework of a defined strategy. The widely adopted Business Intelligence focuses on dealing with quantitative information and the software methods and tools to process it, such as Data mining or Data Warehouse.

On the other hand, lobbying can be broadly defined as seeking to influence decisions made by public office holders; such decisions can include the scope or content of legislation, the letting of a contract, or the broad direction of public policy. Lobbying can therefore involve a wide variety of activities and motivations. Many organisations lobby themselves, others employ multi-client lobbying firms to seek to influence on their behalf. Such firms may also offer other services under the banner of 'public relations' or 'public affairs' such as media monitoring or media strategies.

Lobbyists in Europe of all stripes – contract lobbyists, corporate lobbyists and not-for-profit lobbyists – recognize there is a damaging public perception of undue influence-peddling by the lobbying profession. As a result, more than three-fourths of surveyed lobbyists support public transparency of lobbying activities. A large majority of lobbyists support a mandatory system of lobbyist transparency. However, sharp differences begin to emerge within the lobbying profession over who would best manage a lobbyist transparency programme. Most notably, lobbyists who believe that inappropriate influence peddling within the profession is a "frequent" or "occasional" problem, strongly favour a government-run lobbyist transparency programme.

3. WHAT AND HOW BUSINESS LOBBYISTS DO FOR CLIENTS?

Probably the most important thing we need to know when lobbying is our subject. What is the substance of the legislation? Why is it important? What will happen if it passes? What will be the consequences if it fails? How much will it cost? Most important, what will be the impact of the legislation on the legislator's constituents? Lobbying can be an effort to influence different levels of government (local, national, regional or transnational) or different branches of government (judicial, legislative or executive). It can be carried on by many different actors with very different objectives, such as corporate lobbyists, contract lobbyists, not-for-profit lobbyists, public relations professionals and even governments

[3] Dragojlovic, ibid, p. 111

attempting to influence each other. Some lobbyists may carry out lobbying activities as incidental to other activities, such as lawyers pursuing the legal interests of their clients or political activists attempting to influence elections. Lobbying can take the form of "direct lobbying" contacts with government officials or as indirect appeals to the general public to influence governmental decisions, generally known as "grassroots lobbying."[4]

As mentioned above, a general definition of lobbying is: *"To try to influence the thinking of legislators or other public officials for or against a specific cause."* It includes both direct lobbying in relation to a specific piece of legislation and more general 'atmosphere setting' around an issue or public debate. This takes a number of different forms:

- Face-to-face meetings with politicians or civil servants.
- Communication with politicians (letters, memos, etc.)
- Serving on government advisory groups or regulation drafting groups
- Making formal submissions to Government consultations
- Presentations at conferences and symposia
- Commissioning business impact assessments to support or oppose proposed legislation.
- Writing letters to newspapers, public bodies, etc.
- Organizational participation of Multi-sector Partnership (especially in relation to standard setting)
- Providing or sponsoring research/information to policy makers
- Financial donations and gifts, arranging visits and trips.
- Grassroots and public relations campaigns encouraging employees, customers and other individuals to contact their government representatives[5]

The key questions are: 'what you want to achieve' and 'what is feasible in reality'. But you should always stretch your limits (as although politics is the 'art of the possible', the process of negotiation always involves bartering and bargaining, so you always achieve a lot less than your 'opening bid'). The type of international and external factors involved in strategy analysis for lobbying would include:

- ***Internal Factors:*** The organization's strengths and weaknesses - (unique) capabilities (e.g. staffing, availability of funds, contacts in government, access to legal expertise),
- ***External Factors:*** External opportunities and threats (e.g. seriousness of the problem, urgency, public support, opponents' strength)

[4] *Lobbyists, government and public trust: Promoting integrity by self-regulation,* Organisation for Economic Co-operation and Development (OECD), GOV/PGC(2009)9,

[5] *Towards…*, pp. 39-40

Lobbying always is a combination of psychology and legal/political knowledge. We need to know the legislation (and legislative threats and opportunities), the legislative structures, processes and systems. But equally important is to know the people involved – both their positions and power bases, and their personal attributes. Understanding the people involved, and their views and motivations, can be central to successful lobbying.

Therefore, the profession of lobbying today is at a crossroads when it comes to supporting or undermining political legitimacy. While lobbying continues to be a necessary and important part of democratic governance, communicating to the government the concerns of the governed, the profession in many advanced democratic societies has become so closely identified with wealthy special interests that the public's trust in government in general, and lobbyists in particular, has fallen to dangerous lows. Survey after survey shows that many citizens widely believe governments are run by a few special interests and that politicians and lobbyists tend to be untrustworthy.[6]

The use of the media is one of the most powerful tools that can be used in grassroots lobbying. In the age that we live in, the media has a large and powerful influence over the government and their agenda. This means that the more media attention that a cause receives the more likely that government is going to take up the cause. Lobbyists gain media attention by writing stories for newspapers and magazines. Lobbyists also often pop up on talk shows to discuss their issue this enabling the public to obtain a greater understanding and awareness of the issue. Lobbyists need to understand what the media thinks about the issue, what academics think, who our opponents are.

4. SOME BASIC RULES FOR LOBBYING

The basis for successful lobbying is in forming credible partnerships and effective communication. The next basic rules of effective communication, adopted from standard advertising practices, offer a convenient guide:

- Be clear about your issue, your facts and your position
- Use lobbying only for important issues that will improve life in the community and make very sure that our position is the right one before we start lobbying
- Be careful not to speak "on behalf of people" unless we have consulted them and involved them in developing our lobbying strategy
- Target the right people - analyze who has the power to make a decision on our issue and target our lobbying at these people
- Build a lobby group - analyze who [individuals and organizations] can influence the decision-

[6] OECD, p. 17

makers and try to mobilize them to support our issue – never try to lobby alone. People with political power are often most sensitive to grassroots mobilization that represents their voters.

- Prepare for opposition - analyze the opposition's position and develop counter arguments to that since they may also be lobbying the same person
- Think about our target audience - how the decision-maker can benefit from agreeing with us and include this in our arguments – most decision-makers will agree more easily if they can see how our proposals link to their concerns
- Never use blackmail or bribery or even gifts and favours to persuade someone. That is corruption, not lobbying.

5. CONCLUSION

Lobbying as a process of influence on decision makers getting an increasing importance in contemporary global business practice. Although possible abuses make certain dilemma towards this, lobbying as special way of business support and communication, should be introduced in our business practice. Modern information technology can significantly improve business lobbying. In sum, lobbying and influencing are long term strategies. Therefore, they must be planned, proactive and personalised. Lobbying is often an efficient way of influencing decision-makers, but the success depends on our knowledge, our resources and our contacts. There are however no guarantees for succeeding, as there is almost always at least one interest lobbying against our cause.

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DEVELOPMENT OF THE DOUBLE TASK METHOD FOR MEASURING MENTAL EFFORT DURING WORK

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Abstract. *In this paper further development of the double choice method for measuring mental effort during work, which fulfills criteria such as: sensitivity, selectivity, interference, reliability and acceptability is presented.*
Key words: *mental effort, mental capacity, information flow.*

1. INTRODUCTION

Today global situation makes this paper very current. Starting from the fact that future may be read from the past, one world famous writer, for the morning of industrial revolution, among other things, said: "It has been the time of Light, it has been the time of Darkness, it has been spring of hope, it has been winter of despair."

Today, when we are, so to say, in postindustrial society we find our world to be filled with contrasts, which are as dramatic as they were in those times. There is high probability that this period can be estimated as both the worst and the best of all times.

The phrase "transition age" is probably right description of decades before us. Contemporary management has to solve phenomena of this age so that we could survive "a leap of future".

That is why study of the interdisciplinary scientific fields belonging to the industrial engineering at the Faculty of Mechanical Engineering in Belgrade is visionary move. In the scope of the stated, according to Bulat (1991), apart from the technical, technological, organizational and economic disciplines in ergonomics, the following scientific disciplines also should not be omitted: physiology, anthropology, biomechanics, psychology, sociology, ecology, industrial modeling, etc.

Today it is already certain that the mental effort is prevailing in all human activities.

2. PROBLEM FORMULATION AND AIM OF RESEARCH

We can, after all, define success in work as follows: "To achieve with minimal resources and with the lowest participation of live work within the shortest time possible the biggest success." One of the basic criteria of success is the productivity of live work, the accuracy of the tests.

Based on the well known Kalsbeek's point of view that the maximum capacity of the man's consciences attention lasts three minutes, further research introduced the need to further move the three minute limit of the maximum mental load up to ten minutes. That is why the goal of this research is as follows:
To develop a method for continual measuring of the mental capacity available for the performance of the mental activities during longer period of time, i.e. to perform experimental scientific investigation and check whether extending duration of the maximum mental effort from three to ten minutes as a consequence has significant decrease of the maximum capacity of the central nervous system.

3. RESEARCH METHOD

Regarding formulated problem and goal, let us adopt the zero hypothesis:
Quotient of the linear correlation between the maximum capacity of the central nervous system and the duration of mental effort within the interval from 0 to 10 minutes is statistically insignificant at the level of 0.05 or/and 0.01.

The alternative hypothesis we could adopt, if it shows that the zero hypothesis is not correct, may say:
Quotient of the linear correlation between the maximum capacity of the central nervous system and the duration of mental effort during work within the interval from 0 to 10 minutes is statistically

significant at the level of 0.05 or/and 0.01 and it cannot be neglected during measuring mental effort.

For the experimental research of the stated zero hypothesis we shall use visual manual version of the double choice task that enables very precise computer measuring of the mental capacity of the central nervous system. The method, developed by Svetlana Pantelic, consists of the following:

The interviewee is shown on a computer screen one digit numbers from 0 to 9 in random order and they are used as stimuli. The interviewee has a task to respond to each digit by pressing their finger on one taster if the digit is even, or on other taster if the digit is odd. Digits appear in equal time intervals, which length depends on the stimuli appearance speed. Speed is set before the measuring starts and is represented by number of digits per minute. Program enables speed interval from 10 to 95 digits per minute, and duration of the test can be chosen
minutes, and ordinate represents average value of the mental effort in % for each minute for the entire population of the interviewees. Although we know that there is also a productivity of means of work. In order to increase productivity of work, since Tailor, of large number of scientific and other workers complete attention was paid to the study of work with the stress on physical fatigue. However, the world developed and changed, especially with the development of science and technique, to the extent that the mental effort during work became dominant.

Ergonomics adopted the supposition that man's behavior is determined by the inner information flow in organism. The information flow cannot be observed, but it is reasonable to conclude that it consists of: attention, receipt of information through sensory system, perception, coding, decoding, learning, memory, remembrance, thinking, judgment, information transfer and physical performance of the response.

Based on this supposition, a large number of scientists and researchers developed several methods for measuring mental effort during work. However, most of those methods did not lead to the reliable quantification of the mental effort during work.

Kalsbeek (1974) proposed measuring of the mental effort during work by indirect method using double task that interviewee should perform. Culic (1974) at the Faculty of Mechanical Engineering in Belgrade using this method measured mental effort for different industrial jobs, and then his associates and others further developed this method.

Kalsbeek points out that the maximal mental effort capacity can only be endured during first three minutes and that it suddenly decreases after that.

Since the research at the Faculty of Mechanical Engineering in Belgrade were conducted in duration of ten minutes, the author of this paper saw this as a significant problem, which may make us question
within the interval from 1 to 10 minutes or speed interval from 55 to 95 digits per minute with the same test duration.

Program records stimuli and response of the interviewee and calculates number and percentage of correct responses in each minute, stores these data within a table and has table printing option.

Prior to measuring each interviewee does a trial test in duration of three minutes to determine maximal capacity of the central nervous system. This principle was also applied by Kalsbeek.

Measuring was conducted on a randomly chosen sample of 40 interviewees in continual duration of 10 minutes. Based on this we got average value of mental effort for each interviewee for each of 10 minutes, and for the entire sample as well.

Then quotient of the linear correlation between the average value of mental effort, i.e. maximal capacity of central nervous system in percentage and duration of the mental effort in minutes is calculated.

In the end conclusion is drawn on significance of the generated values of linear correlation quotients and based on this zero hypothesis formulated in the previous chapter is adopted or rejected.

4. RESULTS AND ANALYSIS OF THE RESEARCH

Research results with all elements for each interviewee individually in elaborate tables are not shown, but rather cumulative results in table 1. as follows.

Column 2 of the table 1 shows that three minute test for each interviewee, with some exceptions, confirmed Kalsbeek's (1974) claim that there is limited number of moments of conscious attention per minute which are available to control our behavior, which is 60 to 80 on average.

With so adopted number of double choices, test was conducted in duration of 10 minutes, while percentage of correct responses for each interviewee for each minute was determined. Based on this average value for each interviewee and average

value for the entire population for each minute was determined which is from 90 to 93, and average value for all 10 minutes for the entire population is 92. Based on these results diagram number 1 was made, where abscissa represents number of test

No. of double choices	Percentage of correct responses per minutes for all 40 interviewees										
68	1	2	3	4	5	6	7	8	9	10	For all 10 minutes
Average for the entire population	92	93	93	91	91	92	90	91	91	92	92

Table number 1. Results of the testing mental effort during work for 40 interviewees

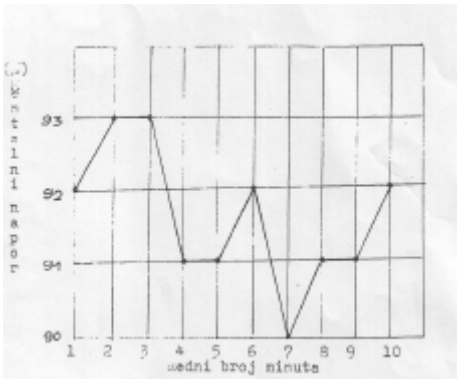

Diagram 1 Average value of mental effort in % , per minutes for whole population of interviewees

Results shown in the table number 1 and diagram number 1 it is established: That maximal capacity of the central nervous system can be measured, not only for the first 3 minutes, after what time it rapidly decreases according to Kalsbeek (1974), but it can also be measure further on up to 10 minutes. In this way we confirmed that it is justified to measure mental effort during work in duration of 10 minutes, which was done at the Faculty of Mechanical Engineering in Belgrade. We also confirmed results of other researchers at this faculty.

5. PROOF OF STATED HYPOTHESIS

By calculating quotient of the linear correlation rxy between the maximal capacity of the central nervous system, i.e. mental effort during work, shown on the ordinates Y of the diagram number 1 (see diagram at the end of the text) and duration of mental effort within 10 minutes shown on ordinates X , as means of connection between the variables according to the formula:

$$r_{xy} = \frac{\sum\left(\frac{x}{\sigma_x} \bullet \frac{y}{\sigma_y}\right)}{N}$$

where is :sigma x - standard deviation of the variable X

sigma y - standard deviation of the variable Y

x= X- Mx

y= Y-My

Mx and My are arithmetic means of the corresponding variables

N is size of the sample; N= 10

Mx= (SUMX/N)= 55/10 = 5.5; My = (SUMY/N) = 916/10 = 91.6

Which is shown in the table number 2

From the starting formula for r_{xy} we can develop formula

SUM X =55; SUM Y = 916; SUM x = 0 ;

SUM y = 0 ; SUM x2 = 82,5; SUM y2 = 8,4;

SUM xy = -13

quotient we shall establish the degree of freedom, which in our case is:

df=N-2=10-2=8 where N is a number of elements in a sample, and in the table no. 1 we see that there are 10 measurements. For this value of the degree of freedom from the statistical tables Dragicevic (1986) follows:

for df = 8	t_{005}	t	$t_{0.}01$
	0.63		0.076

By comparing absolute values of the linear correlation quotient with the values from the tables we receive the following: 0.49<0.63<0.76, based on which we can conclude:

Linear correlation quotient rxy statistically IS NOT significant at the level 0.05 as well as on the level 0.01, so on both these levels we accept ZERO HYPOTHESIS Ho that states:

Quotient of the linear correlation between the maximal capacity of the central nervous system and the duration of the mental effort within the interval from 0 to 10 minutes is not statistically significant on the level 0.05 or on the level 0.01.

On the other hand, since the zero hypothesis is correct we reject the alternative hypothesis.
However, it was justified to accept the zero hypothesis with some reserve, considering the rxy = -0.49 until its statistical significance is verified.

6. CONCLUSION

1. This research has proven that measuring of mental effort during work in duration of 10 minutes can be conducted with full reliability;
2. Experimental part solved dilemmas stated in the chapter ''Problem formulation'' , related to the

$$r_{xy} = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}}$$

To calculate concrete values, required data are sorted in the table number 2 as follows
By applying the above formula, quotient of the linear correlation is:

$$rxy = \frac{-13}{82.5*8.4} = -0.49$$

Correlation quotient, calculated by any method, can vary within the interval from -1 to +1
Positive value means that increase of the measure of one variable causes, in most cases, increase in other variable, while negative value means that increase of measures in one variable causes, in most cases, decrease of measures in other variable.

By absolute value of the correlation quotient we determine strength if connection between the variables.

According to the received results for rxy = -0.49 increase of duration of the test causes decrease in number of moments of conscious control per minute, i.e. due to the occurrence of fatigue the capacity of the central nervous system decreases. Statement made by Kalsbeek (1974);
3. It is significant to discern on the diagram number 1 that it value of the mental effort during work is clearly represented for the first 3 minutes and on up to the 10 minutes, which was not the case in earlier research. It shows that the lowest level was reached in 7th minute, but even then the average value was 90%.
4. This method enables conduct of the very accurate measurements with the possibility to notice changes in the mental effort occurring from various reasons, such as task training, etc.
However, it can happen that the value of the correlation is accidentally different from zero, which would mean that there is no connection between the variables.

That is why it is necessary to test statistical significance of the calculated correlation quotient, in order to determine whether it is a consequence of the effect of random factors or it is a result of constantly present elements that cannot be neglected.
To test the statistical significance of the calculated.

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COMPUTER ERGONOMICS

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Abstract: *Today, in modern time, computer becomes a part of our everyday life. Using of computers brings to us lot of advantages in everyday life, like up to date possibilities of communications, better doing of business transactions, better economize the time etc. But, also there are some disadvantages of using computers in everyday life, like some professional diseases. Be cause of that fact, this work will show basic principles of ergonomics.*

Keywords: *Ergonomics design of working place, computer ergonomics, monitor ergonomics*

1. INTRODUCTION

In the last decades we are witness of strong development of information technologies. Fastest grow was in the field of micro computers and software industry. There were parallel development of new technologies and industry orientation on applying of new technologies. After invention of computer mans mind process is manifest through the information content [2].
Ergonomics should leads further technical development along with mans life. Stewart Kirk, ergonomics professor from England says that primary ergonomics aim is to make work safer, more efficiency and more pleasant to worker which is achieved by adaptation of clothes, booths, machines, equipment and working process surrounding to mans physical and mental possibilities. The only way to describe ergonomics is that ergonomics is science which studies relationship between a man and surrounding in purpose of adaptation surrounding to a man. Ergonomics originated from fast development of technique and technical resources which becomes much better and more efficiency, but also there are limits of man capacities which also limit technical development. If we talk about some very advanced technical resource which man could not use in efficient way, we could not say that this resource is ergonomic. Strong technical and scientific development brings to us new problems connected with work. Computer is the leading tool of today it is necessary to take care about ergonomics and business aspect when we make procurement of computers.
It is often to happen that computer is procured non professional and that it is used in wrong way. There were cases in which computer is procured, and than we look after why it is procured. One of the biggest mistakes is to underrate proper designing and analyzing of system [3].

1.1. **Research**

In one research 33 operators participated in the Telecom Serbia call centre. The subjects were 25.5 years of age in average. All video display terminal workplaces had nearly the same equipment, which involved CRT monitors without the screen filters. The subject's task consisted of encircling an answer yes or no beside the corresponding question. Additional information and explanations as regards the vision and operator's work are obtained by interviewing. Research showed elements of syndrome of computer seeing [6].
According to researches in the following parts of this work will shown suggestion of gauges which should be taken in the aim of better works on computers.

2. COMPUTER ERGONOMICS

Natural process of the human body development during the centuries has not prepared a human body for modern way of life. Our body is prepared for motion, not for sitting. Modern way of life imposes different needs, and in that sense there are questions about computer usage risks.

Bytes, disks, memories, terms, XP an NET technologies, everything is important. But, health is more important. We become aware of the fact at the moment when it is often a bit too late. Definitely computers could be used in everyday life and work but with some heed and proper way of using. Applying of proper use and heed in using of computers reducing risks of using computers.

If we use computer intensively there is big possibility that we will end up with some severe diseases or suffer from "computer hand" or "tennis elbow".

As for now, there is no universal name for these health problems. They represent different changes in muscles and bones caused by repeated or forceful movements during working hours. The consequences are tired muscles, pressure on nerves, tissue inflammation and other changes in soft tissues which are used in work or hold the body in the position for work. These changes appear in hands, arms, elbows, shoulders, neck, back, with people who work at the computers (Figure 1).

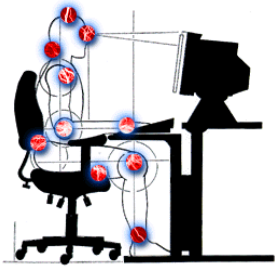

Figure 1: Critical points when working at the computer

The signs are pain, torpid, numbness, annealing, sticking and other unpleasant feelings such as the loss of sense or strength, blush and welling, stiffness, loss of coordination, tiredness, and painful points or in muscles callosity, disturbed sleep, and depression. Some people do not show these symptoms although they cannot perform all activities. People who suffer cumulative trauma suffer from more numbered diseases and dysfunction at the same time.

To avoid these kinds of consequences caused by continuous work at the computer, it is necessary to adapt a place of work, way and organization of work and constantly perform physical exercises.

It is necessary to learn more about regular positions and ways to correct errors.

Due to an increasing number of occupations where people use computers, damages caused by the computer usage are becoming a serious issue of the modern world. In USA, more people use computer as a tool than any other device. According to their Employment Bureau, during the past 14 years, the symptoms of damages caused by different repeated moves have increased by 1000%. Our country has not carry out an overall research yet because data on these issues have not been collected in details and because of the lack of standards set up and adequate measuring procedures.

The techniques of computer writing, computer equipment, office furniture and overall working environment, work organization (including the breaks organization during the working hours) as well as psychical aspect of a job have the crucial role.

An average person makes 50 000-200 000 fingers strokes a day while working at the computer. It is really significant number of repeated moves which influence tiny body structures. These small but often repeated moves burthen muscles, tendons and ligments and cause various disturbances in muscle-bone composition.

The best workers are at the highest risks. These people work long and try hard, with the maximum level of the psycho-physical strain. Job comes before relaxation and rest with them.

If we examine the work at computers in more details, we can spot several different threats for human health. Every of these threats should be treated seriously and we should undertake appropriate measures to decrease danger and increase the level of safety at work.

3.COMPUTER EQUIPEMENT ERGONOMICS

3.1 Monitor

One of the serious risks for health is tired eyes. There are several actions that can diminish this risk. Firstly, purchase of quality monitor and video card significantly helps eyes. Namely, the main reason for tired eyes is the picture flashing, its unequal sharpness and deformations at edges. They are all symptoms of "bad and cheap monitor". Therefore, before the monitor purchase, it is necessary to think twice because savengs on a monitor is basically equal to saving on the sight. Constant headache, pain in eyes, tingling, leaking and eye blush, "double sight effect" and unclear picture, are also one of the pa vomiting, present just a small number

of computer revolution. Continuous work at the computer can bring to tired eyes and bad fusion (cooperation of both eyes). If you recognize some of the symptoms and suffer from one of the 21st century disease, ask for help of an ophthalmologist.
Good fusion can be kept by proper monitor positioning, limited time spent in front of a monitor, protective filters (Figure 2) and special glasses. Protective filters are used in order to eliminate light reflection. They protect from radiation. They are made of net, glass and plastic.

Figure 2: Monitor with filter protection

One of the most common reasons for tired eyes when working at the computer is a monitor positioned too close. It is very difficult to determine the minimal distance to position a monitor, but as the various researches have showed, the satisfying distance would be some 60 cm. They came to this number by considering distances at which our eyes do not converge while looking at some other objects. The eyes are the least tired at this distance. With majority of people, this distance is some 110 cm when looking flat and some 90 cm when looking down under the angle of some 90 cm (Figure 3). In the distance, observing specific objects significantly smaller than this one causes noticeable tiredness in eyes. It is necessary to stick to the values mentioned as much as possible when it comes to monitor positioning.

Figure 3: Ergonomic monitor positioning

By putting the monitor down, we decrease the eye ball exposure and keep eyes moist enough. Therefore, you should position a Monroe so that the center of the monitor is lower 10-20 cm than the eyes area because it is proven that you see best when your sight is slightly down and when the distance of a monitor is 50-60 cm.
If possible, avoid continuous work, longer than six hours. Use every opportunity to have a short eye break. Every half an hour remove eyes from a monitor and observe a distant object for a couple o minutes.

3.2 Keyboard and mouse

Due to overburdened hands and shoulders, it is very important to pay attention to a keyboard and a mouse. It is not the design that is important but the place where they are placed. A keyboard and a mouse should be placed at the same working area. Enough space for work should be provided. It is also necessary that a mouse cable does not remit some moves. The ideal position for a keyboard is at the height of elbows so that hands are placed along the body.

4. ERGONOMY OF WORKING ENVIRONMENT

Working environment has a great influence on our working abilities. Therefore, it is essential to try to keep the environment as pleasant place to work in as possible. This is determined by both physically and psychically.
The combination of artificial light and daylight can cause serious problems during the work with a computer.
Therefore, it is the best solution to have a monitor placed parallel with a window (Figure 4).

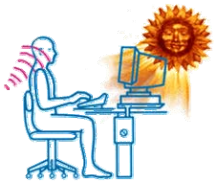

Figure 4: Light and working environment

The artificial light is eliminated by turning them off or, believe it or not, with the cap which eliminates all unnecessary light that comes from above. The desk lamp should be directed the way it suits you best.
It is recommendable to have more sources of light: one diffusive for general lightning and one stronger for providing the light at the working area.

5. CONTINUOUS SITTING AT THE COMPUTER DESK REQUIRES CAUTION AND OBEDIENCE OF ERGONOMIC RULES

The recommendations of scientists studying ergonomics are very important. They as well refer to the proper sitting at the computer desk (Figure 5).

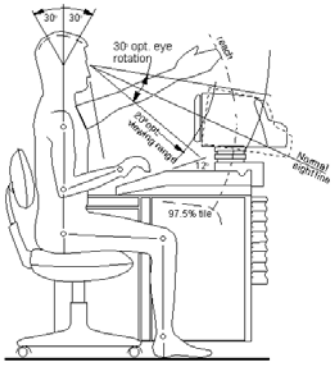

Figure 5: Recommendations for the proper sitting at the computer

Proper body position provides comfort during the computer use in the proper way: back must be supported by chair– you should sit relaxed, with back slightly leaned back; a chair must not press legs behind knees; legs should be leaned in knees under 90 degrees and to stand firm on the surface; head must not be leaned forward or back too much; upper arm should be relaxed beside the body a hands leaned in elbows under 90 degrees or a bit more; ankles should be in flat position so that stretched hand and forearm make a line.

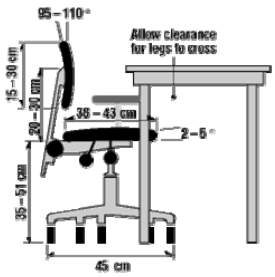

Figure 6: Recommended ergonomic measures

Chairs (Figure 6) with a certain possibility to adjust height of the sitting part and angle of the back that can be adjusted in line with a person's characteristics contribute to a great extent to the proper body positioning especially of the backbone. According to the international standard of ergonomic parameters ISO-9241, chairs that provide an active support (pillows) for weak parts of a spine such as neck and lumbar part, are considered convenient. Handholds are not essential but they are desirable detail that enables relaxing muscles of the shoulders area and proper position of forearm. A proper chair should enable limited moves that stimulate circulation for a worker while the pressure on legs must not be as high as to disables their supply with blood and efficacious drainage process.

Figure 7: Ergonomic chair

The working desk space area is determined by the same standard. It should be spacious, must not transmit strong vibrations and extreme temperatures. If it has drawers, they should not have to possibility of full opening (prevention from traumatism).

6. CONCLUSION

Due to modern lifestyle and fast technology development, in order to protect or health, it is recommendable to use ergonomic rules.
The explanations above lead us to conclusion that ergonomics helps to increase the safety and effectiveness level of a user. Also, it makes the use of computers easier for a consumer increasing the sense of comfort and pleasure. Most of the computer elements are not suitable for longer use but with the application of ergonomic recommendations, problems that can appear will be decreased to the lowest level possible.
Ergonomics is trying making the balance between computers and possibilities and limitations of a man.
By using the ergonomic products and advice you will increase your productivity and save your health.

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ORGANIZATIONAL CULTURE AN IMPORTANT FACTOR FOR SUCCESSFUL BUSINESS

Mr.Ljiljana Pecić, dipl.ing.maš.

Abstract: The globalization of world markets in the political and economic terms caused very intensive internationalization of companies. But this process gave birth to the problem of the efficient functioning companies because of the great cultural diversity. Trying to solve that kind of a problem as soon as possible by the developed countries, imposed the existence of standards to provide quality of products and services, as one of the standard model for organizational culture.
Keywords: business, culture, management, market, quality, total quality

1. INTRODUCTION

Culture is, according to the general description, the totality of the original and exemplary solutions devised in a group of human beings to adapt themselves to their natural and social environment. The original model of solutions are contained in knowledge, wisdom, skills and in the prevailing value system.

Something simpler terms, culture is the way you behave, ie. model of behavior which adhere to all who belong to the same cultural group. This model occurs slowly over time or as a common conclusion from a situation that was crucial for the observed group of people.

Therefore, at the very root of culture is what is most important, ie. rules of conduct, morality, ethics and values of the group. All that connect individuals to a group of committed and one of the primary needs of the individual - to belong to somebody, can be satisfied.
Organization through its structure and processes developed in them put their members in the mutual relations and interactions. During the time in larger organizations can be recognized or felt something that permeates the organization-its decisions, its policies, its actions, its behavior in one word. That all pervading ether, and the core values and beliefs that dominate the organization, are called the culture of the organization. It determines the behavior and communication, but also and interaction, commitment to its members a common goal and work in the organization.

2. ORGANIZATIONAL CULTURE

The company is a separate organizational creature whose main task is achieving business goals. It has its own interior and its exterior and business objectives are achieved in an interactive relationship between interior and exterior. Starting from the fact that the organizational culture includes a common system of values, rules, beliefs, attitudes, motives and affinities of members to the organization changes, for organizational culture in general, can be said that reflects the behavior of employees in the company towards the realization of business objectives in relations with the environment. Therefore, in this context, relevant definition for organizational culture is :"the collective programming the opinion of members of the company." Also characteristic is the understanding that the culture of the company is related to the atmosphere of "mood", as well as explicit values or principles that can be find out in the organizational mission statement. Some authors even suggest that organizational culture is "the way the company sees itself and its environment.
Pragmatically determining the organizational culture assumes that the company organized a group of people in such a way to increase the effectiveness of the process for solving problems. Specific company culture, functional culture then culture of parts of the

organization under this approach are basically the way the group organizes to solve problems or answer to the challenges placed before them. Main dimensions of culture companies with significant international aspects of treatment are: history and tradition of the company, the vision of leaders, culture related to the business sector, culture headquarters, if the company is a multinational corporation, culture, or leading team or professional groups, cultures of key links and networks, external views and expectations, the way of business, the homogeneity of values and beliefs, the requirements for business success.

Organizational culture can be recognized on the base of various symptoms such as: the mission statement of the company, the system of values and business ethics, organizational structure, the importance of relationship-based networking, access to decision making, access authority, means of communication, information channels, delegation of responsibility, emphasis on team paper, focus on quality, degree of specialization, tolerance for diversity, speed of action, methods of control, increasing the degree of mutual commitment to learn and develop, openness to the outside.

3. MANAGEMENT AND ORGANIZATIONAL CULTURE

Companies that we look, for any reason, can and often have very different cultures, much more diverse than they were manufacturing programs, labor productivity, marketing, etc..

Organizational culture - the inner frame and the ether which determines the behavior - may be more or less consistent with the management (what we call the ruling paradigm, management style) and to a less or greater conflict. The intensity of this conflict and consent matter determines the economic and social performance and the company's ability to survive and succeed.

It is a great probability that changing the mission, goals and strategy will not be successful if it is carried out against the accepted culture of the company or business unit, since employees will resist to the radical changes in philosophy and direction of development, if they are not sufficiently clear and close to understanding their values. On the other hand, if the organizational culture is compatible with the new strategy, it represents a significant internal power of companies. Therefore, it is necessary, for top-level managers in companies to consider strategic options which are followed by their compatibility with the culture of companies, business units or companies.

However, it must be borne in mind that the restriction only on those strategies that are fully consistent with the culture of the company can eliminate most promising strategic alternatives from the consideration.

Thus opens the complex issue of improving organizational culture and in that sense its compliance with the requirements of new strategic options. Changing the culture of the company is very difficult and requires a certain period of time. In case that the company undertook major impact, for example. integration with other enterprise, changing the internal organizational structure, decomposition to parts, privatization, greater technological modernization, it will be successful with that change only if then is between members of the collective established deeper relationships and developed the culture that keeps them together in the direction which expresses the desired change. Transitioning to a radically new situation for a company is more or less painful transition, always longer than expected. It is believed that in developed world, 3 to 4 year are needed to put new organizational structure in power and to valid "start working".

From the preceding, in shortest terms, it follows: first, every major change in the company, asks new organizational culture, second, the central problem of any major change is much less technical and much more cultural nature, and third, shaping the culture for change is one of the central problems of management and Fourth, in the modern world, management is, at least, educated for solving this problem.

4.GLOBALIZATION ANDORGANIZATIONAL MARKETS CULTURE

Today, we are witnesses how more and more rapidly the international community comes in the post industrial era and culture in the postmodern era. The main economic achievement of such developments is the increasing global market and bigger and bigger presence of internationalization of companies.

This concept of internationalization of companies has three basic characteristics. The first characteristic is the growth of multinational companies, the other is the growth of the company whose environment is multinational, and the third is the much faster growth in the number of companies that operate in internal and external multicultural environment.

Cultural diversity of contemporary companies grow, either because the company is under a different national culture, either because the national company has close cooperation with companies of other national cultures (solid alliances), either because the company has a stable customers or suppliers from other cultures . Finally, the global

market of supply and demand brings cultural diversity into a national company. Company with cultural diversity are faced with the new and specific problems and the new and special abilities and capacities. Where did this occur? Different cultures create different standpoints and they, in turn, lead to different interpretations of the same reality. Thus, behavior that is acceptable in one national culture may be totally unacceptable in another.

This produces differences, misinterpreted and so, as a rule, any evaluation of people from other culture says more about those who estimates than about those who were evaluated. In one culture - national or organizational culture there is a tendency of hiding ,in the second tendency for wide distribution of information to lower levels.

In the quest for a culture solution readily revealed the ignorance of one who is looking for a solution - because the focus is on the problem, in another culture solving the problem is postponing , even hidden if because of incompetence of the manager. Thus cultural gaps exist in any international or multicultural company.

5.QUALITY ASSURANCE AND ORGANIZATIONAL CULTURE

Faced with the opportunities of global market valid and problems of multiculturalism, international companies in developed countries triggered in the late eighties, need for a general package of rules for the regulation of behavior according to the fulfillment customer requirements, in terms of used quality of products and services in national and international frameworks. The package of general rules from the point of international standardization is called a series of standards ISO 9000 and with the aspect of philosophy which maintains, for the introduction of standards and certification of quality system in companies.

The basic meaning of these standards is actually entering in the company the appropriate uniform behavior culture for all employees in which, the primary purpose of the company, in fact, the maximization of profit, maximize principle guarantees to quality of products and services to the customer. At the very beginning of its appearance, this philosophy did not exactly get support, but as time passed, there was a growing confirmation of its practical results and to its universal acceptance. And not only that, there is happening its further development in the conceptual and structural terms, first as an upgrade to the requirements for the provision of environmental quality companies and then spread as a general approach to quality management company called Total Quality Management (TQM). One such versatile approach to managing the quality of the company essentially has a unique purpose to put in order management in all segments of business, provided that quality is always a key parameter of success of management. In this company management issues about quality are always approached in the function of the needs, expectations and demands of customers.

6.CONCLUSION

If the culture, said in the simplest words, is the way we behave, then the organizational culture can be defined as the way the company sees itself and its environment.

The formation of organizational culture most affects on management through harmonization of behavior of all employees in the company with the requirements of applicable strategic options. Such coordination is realized through the implementation of appropriate processes which have complex characters, and usually last longer.

The general development of the international community has imposed, as one of the pronounced needs, global market gives the internationalization of companies but also the diversity of their cultures. Such a phenomenon has become a hindrance to efficient functioning of companies, especially in international terms. That born the philosophy of quality management and services under a system of unique principles of many series of standards ISO 9000 Thus, if a company wants to have permanent status of successful business, then that in must incorporate in itself the culture of behavior that is contained in the philosophy of total quality management (TQM).

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ORGANISING ENERGY MANAGEMENT -CORPORATE APPROACH

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Abstract
All management processes need a structured approach if they are to be implemented successfully, and energy management is no different. The energy management matrix has been developed to help organizations implement the five-step approach. The matrix is a simple tool which helps an organization to understand the present status of energy management, set priorities and assess progress. It has been used successfully in a wide range of public and private sector organizations.
Key words:cost, energy management matrix, organization, consumption

INTRODUCTION

The primary objective of a manufacturing enterprise is to make profits for its company. It does so by buying in raw materials and converting them into products which it sells to its customers. To ensure its long term survival, a company must also re-invest at last part of the proceeds; to allow for expansion, to become more competitive and to provide for the development of new products that will be its source of income in future years.
Energy is one of the few cost elements present in the manufacture of every industrial product. Energy is also one of the five largest measurable and controllable cost elements in at least 80% of all industrial production. Reducing energy costs is an investment area for which financial appraisal is ideally suited. Energy managers who make time to understand the purpose and principles of financial appraisal may appreciate the strengths and weaknesses of their organization's financial management more. They can then use this knowledge to ensure that energy efficiency obtains the appropriate investment priority within the organization. Energy monitoring and target setting is the collection, interpretation and reporting of information on energy use. Its role within energy management is to measure and maintain performance and to locate opportunities for reducing energy consumption and cost.
All management processes need a structured approach if they are to be implemented successfully, and energy management is no different. The energy management matrix has been developed to help organizations implement the five-step approach. The matrix is a simple tool which helps an organization to understand the present status of energy management, set priorities and assess progress. It has been used successfully in a wide range of public and private sector organizations.

1.ENERGY MANAGEMENT MATRIX

The matrix has been devised to[15]:

- help to identify and describe the current priority attached to different aspects of energy management in organization
- indicate alternative ways of organizing energy management

The rows of the matrix represent increasing levels of complexity or sophistication in dealing with six key management issues. Moving up the matrix signifies an increasingly mature and formal approach to handling energy management activities and implies increasingly "good" practice.
In summary we should[3]:

- locate organization on the matrix
- concentrate on those columns where we can make the most progress
- identify obstacles to progress and decide how these might be overcome
- identify opportunities for improvement and decide how these can be exploited
- involve others, both senior managers and users, in the process.

The matrix provides a quick, easy to use but effective method to establish our organizational profile. Each column of the matrix deals with one of six organizational issues: organization, motivation, information, systems, marketing and investment. The ascending rows, from 0 to 4 , represent increasingly sophisticated handling of these issues. Our aim is to move up through these levels towards current "best practice", and we develop balance across the columns.
When we draw a line through each of the matrix cells which best describes our organizational approach to energy management, we will probably find that some aspects are advanced or sophisticated than others. This is not unusual. Our organizational profile will show as those aspects where some further attention is required to ensure energy management is developed in a rounded, effective way. Only by developing energy management evenly will we be sure of getting the most out of our investment. The energy management matrix has been developed to help organizations implement the five-step approach.

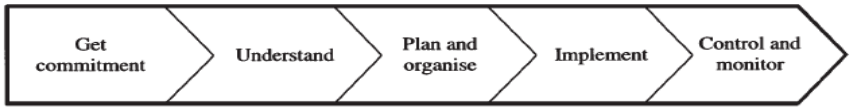

fig.1 five-step approach

Level	Energy Policy	Organising	Motivation	Information systems	Marketing	Investment
4	Energy policy, action plan and regular review have commitment of top management as part of an environmental strategy	Energy management fully integrated into management structure. Clear delegation of responsibility for energy consumption	Formal and informal channels of communication regularly exploited by energy manager and energy staff at all levels	Comprehensive system sets targets, monitors consumption, identifies faults, quantifies savings and provides budget tracking	Marketing the value of energy efficiency and the performance of energy management both within the organisation and outside it	Positive discrimination in favour of 'green' schemes with detailed investment appraisal of all new-build and refurbishment opportunities
3	Formal energy policy, but no active commitment from top management	Energy manager accountable to energy committee representing all users, chaired by a member of the managing board	Energy committee used as main channel together with direct contact with major users	M&T reports for individual premises based on sub-metering, but savings not reported effectively to users	Programme of staff awareness and regular publicity campaigns	Same pay back criteria employed as for all other investment
2	Unadopted energy policy set by energy manager or senior departmental manager	Energy manager in post, reporting to ad-hoc committee, but line management and authority are unclear	Contact with major users through ad hoc committee chaired by senior departmental manager	Monitoring and targeting reports based on supply meter data. Energy unit has ad hoc involvement in budget setting	Some ad hoc staff awareness training	Investment using short term pay back criteria only
1	An unwritten set of guidelines	Energy management the part-time responsibility of someone with only limited authority or influence	Informal contacts between engineer and a few users	Cost reporting based on invoice data. Engineer compiles reports for internal use within technical department	Informal contacts used to promote energy efficiency	Only low cost measures taken
0	No explicit policy	No energy management or any formal delegation of responsibility for energy consumption	No contact with users	No information system. No accounting for energy consumption	No promotion of energy efficiency	No investment in increasing energy efficiency in premises

fig.2 ENERGY MANAGEMENT MATRIX
(BRECSU 1993)

Lavel 0
Energy management is non-existent. There is no energy policy, staff and formal delegation of responsibility for energy use. Energy consumption is not monitored and there is no promoting awareess of energy use within the organization.

Lavel 1
Although there is no explicit energy policy, the organization does employ an energy specialist. The person has created a rudimentary information system based fuel invoices but any reporting is only within his department. The energy specialist promotes an awareness of energy matters through informal contacts with those directly responsible for energy consumption and responds to requests for advice on an ad hoc basis.

Lavel 2
Senior managers accept the importance of energy management but, in practice, there is little active commitment or support for energy management activites. Energy staff are usually based in a technical department and report to an ad hoc committee of people from other departments. The effectiveness of energy management activates is restricted by the interest and enthusiasm of these committee members.

Lavel 3
Energy management is taken more seriously by senior managers and is woven into formal managerial structures. Consumption is assigned to cost centre

budgets. There is a comprehensive information system and an established system of reporting. There is also an agreed programme for promoting energy management and investing in energy efficiency.

Lavel 4

There is clear delegation of responsibility for energy consumption throughout the organization. The energy manager regularly exploits formal and informal channels of communication to influence users' behavior and promote energy efficiency. There is a comprehensive information system and energy consumption is fully integrated into management accounting. Actual performance is monitored against targets and the benefits of energy efficiency measures calculated. Achievements in energy management are well reported and energy consumption is related to its impact on wider environmental issues. The managing board is committed to energy efficiency

fig.3

fig.4

1.1Using the matrix to promote organizational change

If we are going to help bring about the organizational changes and development required to improve energy management, we need a way of[5]:

1. identifying the issues with the highest priority for us
2. reviewing how well you personally are performing
3. assessing the quality and level of support which we are being given
4. focusing on our present situation and identifying where we want to get to next.

One possible method for measuring progress is to use Energy Management Matrix at the end of the period to identify how the organizational profile has changed.

1.2Phasing energy management

Is a clear sequence to developing energy management activities. Any organization, whether introducing energy management for the first time or upgrading its existing activities, needs to be aware of this and adapt its effort accordingly. This sequence can be visualized as series of overlapping phases[8]:

- gaining control over energy consumption
- investing in energy saving measures
- maintaining control over consumption

Energy management has to be located somewhere. There are five options[13]:

- technical department
- personnel department
- finance department
- chief executive's office
- outside consultants

2.PRIORITISING ACTIONS

Having established an overview of the existing energy management practices within our organization, we will now need to target a number of activities for follow-up action. For matrices at second level(energy management, financial management, awareness and information and technical matrices),the aim should be to have a balanced profile, and to then move up the matrices in a balanced way. Decide which columns contain issues that are most important in our situation. Choose two columns where we would most like to see an improvement, ideally making sure that our matrices become more balanced. Often these will be the columns in whish our score is lowest, but not always so. There may be obstacles which seem insuperable, in which case it is better to concentrate on areas where there is good chance of success. Then decide on what actions are needed to make the improvements we have identified. Discuss these with our manager, and use them as the basis for developing a coasted action plan. The aim should be to move up through these levels toward current best practice and, in so during, develop or maintain a balance across the columns. Once a priority has been set, there is often a temptation to concentrate on that activity until it meets the level 4 requirement of the matrix. This should be

avoided. A deviation of plus or minus one label about the mean is acceptable. Any results significantly above the mean are unlikely to contribute to the current energy efficiency status.

3.CONCLUSION

Energy management offers all companies the opportunity to save money by reducing energy costs.It will also help the environment by using less power, most of which is derived from the burning of fossil fuels. Much can be achieved by treating energy as a costly resource and managing it like other raw materials. fossil fuels. The financial incentive for energy minimisation has been increased with the introduction of the Climate Change Levy - increasing the cost of each kWh of energy used. Much can be achieved by treating energy as a costly resource and managing it like other raw materials.Target setting within given timescales will help the workforce to reduce energy consumption, eg as an environmental improvement initiative. Targets should be realistic and achievable, for example, a 10% reduction in electricity use within the next 12 months. Most companies could save 10 - 20% of their energy bills by implementing low-cost good housekeeping measures.All such targets will be relevant to production and, therefore, record-keeping of power used against production output will be essential. Many savings can be made for little or no cost, while further savings can be made by investment in measures with a potential payback of less than two years.The matrix is used to assess the level of strategic energy management activities that have an impact on the entire organization, and the columns should assessed accordingly. It has been used successfully by a wide range of public and private sector bodies and is a well-established and recognized energy management tool. Energy management reporting systems are also analyzed, along with investment criteria for energy efficiency and energy management promotional activities.

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MULTICRITERIA OPTIMIZATION FOR THE SELECTION OF MATERIALS FOR ARTIFICIAL HIP

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Abstract

The paper describes the multicriteria optimization for the selection of materials for artificial hip using decision support system. Decision model is defined for seven different alternatives for materials: CrNiMo 18 10, CrNiTi 18 10, NiCrTi 26 15, CrNiCu 17 4, CoCrMo, Ti6Al4V, non-alloyed Ti. The model uses eight criteria (biocompatibility, corrosion resistance, toughness, tensile strength, dynamic endurance, resistance to abrasion, elasticity modulus and price) in order to offer the optimal solution. As one the most common decision support systems, Criterium Desicion Plus is used, applying the analytical hierarchical process (AHP), as a tool for making decisions in choosing optimal alternative.

1. INTRODUCTION

When selecting material for a product one can face a few different situations. For some products there are precisely defined materials from which they are made, in which case there is no problem with the selection. However, there are many products for which a number of suitable materials are found, but none fully satisfies all requirements. In that case from the multiple-choice alternative materials the most suitable should be chosen, depending on characteristics of materials that are the priority in a specific problem.

When a situation like this occurs, different decision support systems can help to make a complete analysis of existing alternatives in a short period in time, providing the best solution in respect to the selected priorities. Without such systems, i.e. software, analysis like this would last for days.

The case where for one product there are always more options, i.e. different materials, is the choice of a biomaterial. Biomaterials can be defined as synthetic or modified natural materials which are used as implants, i.e. to replace part of the living system and to become functional in contact with tissue. Not every material can be biomaterial. There are very important and complex criteria that the material must satisfy to be used as biomaterial.

The situation is very complex because it involves human body. First, the success of implementation can be as high as 90%, but one can not say that it is sufficient, because in each individual case the result must be satisfying, since each failure can lead to serious problems and cause death. In addition to this, if biomaterial is successful in all cases in which has been applied, that still does not make it completely safe, because human organisms differ and one never knows how it will react to an implant. Therefore, the one of the most important criteria that the material must satisfy is to be biocompatible. Generally speaking, biocompatibility is the interaction between biomaterials (implants) and the human organism (the host). One has to know all possible impacts of an implant on body and vice versa, all possible impacts of a body on implant. The human body has to accept the implant, must not reject it and/or impair its properties, i.e. the implant environment, includes bones, tissues and various body fluids, does not affect on its properties. Finally, an implant must not in any way threaten a human body.

Another very important criterion that the material has to meet is the resistance to corrosion, because implant environment is extremely unfavorable including basic, acidic, neutral, and somewhere basic and acidic, changing in time. These are ideal conditions for corrosion, causing possible failure of implants and intoxication of body because particles are separated from the implant.

Besides biocompatibility and resistance to corrosion, the biomaterial should have certain mechanical properties, like appropriate toughness, tensile strength, dynamic endurance, resistance to abrasion

and elasticity modulus. What are the properties and the extent to which the material should have them depends on what will be its function in the body.
In this paper the selection of biomaterials for artificial hips will be analysed.

2. ARTIFICIAL HIP

Cartilage of a hip is spent during life, because it connects the femur (thigh bone) and pelvis and thus, carries high static and dynamic loading (while standing, walking, running), leading eventually to strong pain and mobility impairment, even to immobility. Besides this, different hip fracture can happen, in both cases requiring replacement of the hip, i.e. implanting of an artificial hip.

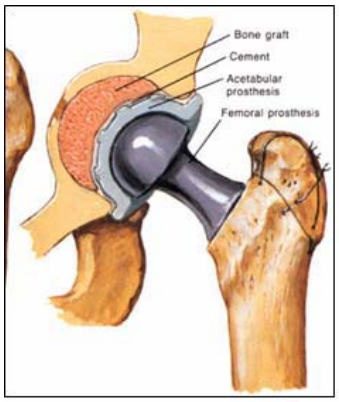

Figure 1 Artificial hip in thigh bone

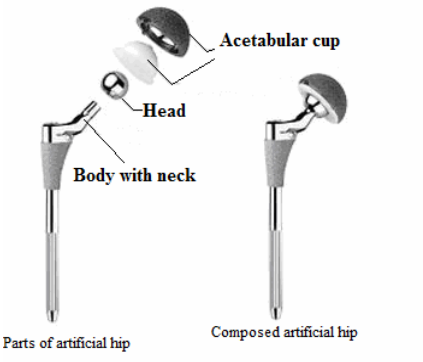

Figure 2 Artificial hip

Artificial hip consists of femoral component and acetabular cup, lying close to the pelvis, Fig. 1. Femural component consists of body with neck, and head, lying close to acetabular cup and it rotates allowing full mobility of legs, Fig. 2. Since these three components (cup, head, body with neck), have different functions, the materials for their production are significantly different. Here, only femur head is analysed.
Nowadays materials for femur head include stainless steel, Ti-alloys and different CoCr-alloys, while new solutions include also polymer composite and ceramic materials.
Besides two basic criteria, i.e. biocompatibility and resistance to corrosion, material for femur head should satisfy the criteria for minimal toughness, tensile strength and dynamic endurance, the last one being the most important because for normally active person, a hip is exposed to load 17 million times in 10 years. Of less importance is also the elasticity modulus. Contrary to that, the resistance to abrasion is very important criterion since the femur head is exposed to high abrasion while moving along acetabular cup inner surface, in the same way as with a natural hip. Finally, the price is very important, as in the most of such analysis.

3. APPLICATION OF THE DSS

As one the most common decision support systems, Criterium Desicion Plus is used. Criterium Desicion Plus applies the analytical hierarchical process (AHP), as a tool for making decisions in choosing optimal alternative.

The essence of AHP is based on structuring a problems with different criteria and alternatives that exist in different hierarchical levels, defining the criteria weights and alternative weights for each criterion, and forming the final decision score of alternatives. Thus process modeling can be divided into four phases:
1. Structuring the problem
2. Data collection
3. Determining the relative weights
4. Determination of the solution

In the first phase, the hierarchy is established with eight criteria that are key elements in selecting material for artificial hip and selected seven alternative materials, as shown in Fig 3.

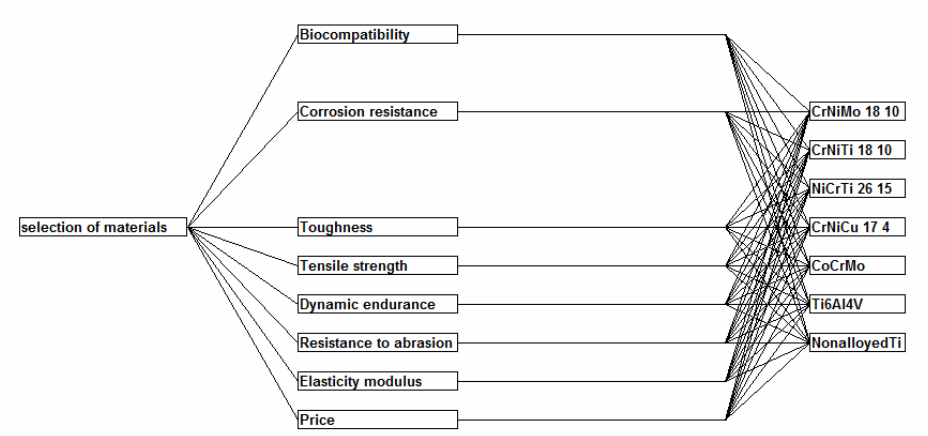

Figure 3. Generated hierarchy of criteria and alternatives

The second phase, in addition to data collection, includes its evaluation by defining the criteria weights and alternative weights for each criterion, as shown in Table 1-2. In Table 1 there is the possibility of assigning numerical and/or verbal scales. This is carried out together by the user, physician and biomedical engineer since the user determines the importance of price, the doctor has all the necessary information from the medical side of the user, a biomedical engineer knows the properties of material. Some of these criteria must be fulfilled in any case and some vary from case to case.

For example, biocompatibity and resistance to corrosion, as mentioned earlier are the two necessary criteria and must be fulfilled regardless of the case. There is less difference in the assessment of material by these two criteria, but there is a clearly defined lower limit, as shown in Tab. 1, together with limit values for some other criteria. As regarding price, it is very flexible and case-dependent. For some cases it can be just as decisive as biocompatibity and resistance but for some other cases this is the least important criterion. Resistance to abrasion and dynamic endurance depends on how the person moves. The importance of these two criteria depends on the age of person, his/her habits regarding everyday activities (standing, sitting, walking, running or other sport activities). Here the weights are given for an average case.

Table 1 Criteria weghts

Criteria	**Weights**	**Limit values**
C1: Biocompatibility	Most important / 1.0	70
C2: Corrosion resistance	Most important / 1.0	70
C3: Toughness	Not important / 0.0	20
C4: Tensile strength	Less important / 0.33	95
C5: Dynamic endurance	Very important / 0.66	33.5
C6: Resistance to abrasion	Very important / 0.66	70
C7: Elasticity modulus	Not important / 0.0	
C8: Price	Very important / 0.66	

Weights of chosen alternatives for the given criteria are defined by the specifications of the material and the data should be collected from the material manufacturer.

Table 2. Alternative Weights

Alternatives/Criterion	C1	C2	C3	C4	C5	C6	C7	C8
Scale	O-100	O-100	0-100	0-1400	0-530	0-100	205-124	0-100
A1: CrNiMo 18 10	100	70	80	585	235	80	203	90
A2: CrNiTi 18 10	90	70	100	750	260	80	203	89
A3: NiCrTi 26 15	90	80	100	1000	350	90	203	86
A4: CrNiCu 17 4	90	80	100	1400	490	90	203	86
A5: CoCrMo	100	90	20	700	250	100	205	63
A6:Ti6Al4V	80	80	83	1060	530	83	124	81
A7: Non-alloyed Ti	80	100	80	630	315	80	124	83

The third phase consists of determining the relative weights by decision support system itself using certain mathematical device.
The fourth phase. he program gives provides the optimal solution to which is has come, as shown in Figure 4. Results indicate that alternative solutions CrNiCu17 4 is the optimal one and also rank all the alternatives.

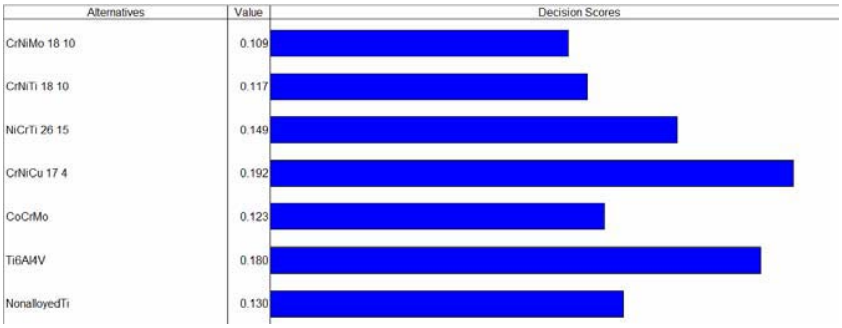

Figure 4 Decision scores

Finally Figure 5 shows the sensitivity graph indicating that change of the biocompatibility criterion weights would not influence the optimal solution. Namely even for the large range of changes of its current value (0.23=1/4.33, Table 1, sum of all criteria weights) different (material) alternatives will remain in the same rank.

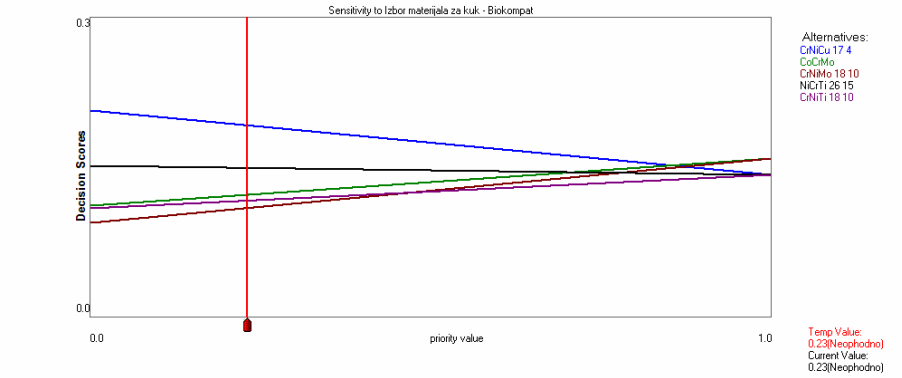

Figure 5. Chart sensitivity

3. CONCLUSION

Presented model, developed in the scope of a commonly used decision support system, can help users in selecting appropriate materials. This model is suitable for modification by changing criteria weights to adapt to needs of different users.

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RISK AND SAFETY MANAGEMENT IN INDUSTRY

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Abstract
The analysis of the risks, or risk assessment as a structured process is not self sufficient by itself, but is always part of explicit or implicit risk management process. The process of risk management, in general terms always starts with the analysis (risk assessment) providing data in information on the actual risk level present.
Keywords: RBI, Safety, Maintenance strategy, REACH regulation, Risk assessment and reducation

1 INTRODUCTION

Risk is concept meaning a probability of a specific undesired outcome or loss. A certain hazard (situation which poses a level of threat to life, health, property or environment) present can under specific circumstances (related to a probability) lead to a cetain outcome with a certain loss. Definition is also a subject of variability in scientistific disciplines. Greater loss and greater event likelihood result in a greater overall risk. The reason for necessary safety aspects categorization is in the nature of inherent hazards that can lead to a specific risk or actual damage, meaning that usually preventive measures in order to avoid damage differ between categories. Continuing with the chemicals used by the industry (and consumed by the society), the following general characteristic steps (issues) are usually observed and managed:

- Research and development of a new product/preparation/chemical
- Design, construction, regular operation and cease of operation in a chemical plant Workers at the plant are usually to a certain extent exposed to the plant specific hazards, posing a threat to their safety (occupational) and health
- Chemical products need to be transported to and from the plant-outside its boundaries. Some general society wide management provisions for safety and security of the road, rail and sea based transport are in place
- Inside industrial plants accidents involving hazardous chemicals occur. The accidental events are rare, but resulting fires, explosions and toxic releases usually lead to devastated plants, equipment, huge economic losses, fatalities among workers and contractors, offsite environmental damage

Introduction of new chemicals at the EU market is regulated by REACH regulation EC No. 1997/2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals. The main aim of the REACH is to manage the risk from new chemicals entering the EU market, remembering. REACH regulation aims to assess and manage the risk of potential chemicals with unrevealed toxiciligical properties based on common EU wide registration of new products exceeding annual marketed quantitaties in excess of certain criteria by weight. Main approaches are Registration, Evaluation of received registration documentation, Authorization and Restrictions.
Being safe mans simply absence form a potential (possible) unfavorable condition such as being injured, ill, even killed or some other kind of loss, or perceived loss. Safety as a condition thus means to be safe, or to stay in other way, the unfavorable loss can not occure and that is subject of full certainty. Jump note: o the other side, being safe from something also means that related risk does not exsist (qualitatively), or that the risk is actually equal to zero (qualitatively).

2 RISK MANAGEMENT, RISK ASSESSMENT AND RISK REDUCTION

The analysis of the risks, or risk assessment as a structured process is not self sufficient by itself, but is always part of explicit or implicit risk management process. The process of risk management, in general terms always starts with the analysis (risk assessment) providing data in information on the actual risk level present. The actual risk level needs to be somehow judged or

compared to a certain criteria. In the most general terms, we weigh the benefits of taking risks against the perceived risk level-mostly on expected scale of damage level. In certain cases, such approach is unfair, inappropriate and irrational, especially if the risk taker and the benefit taker are separated. The risk judgment should come with an answer whether we are happy or not with it.

The actual risk level is very low compared to set criteria. The risk level is at a practical low level and additional further risk measures does not have any sense, or the risk is as low as reasonably practicable-ALARP. The actual risk level is not really low, and we are excited at the level that we shall do something in practical terms, thus investing something into additional safety measures. However we do not want to react/invest in a gross disproportion, meaning that gain in lowered risk level should be in practical terms in a proportion to the investment. Now we came to the complicated case where goth risk level is above that set criteria and investment in risk reduction measure are just too high. If the risk level is not of a a concern and we are willing to take risks, we are again in ALARP region. If the issues apply, or the risks are high and risk reduction is not possible /practical, then we are facing a potential radical decision, possibly to eliminate risk source.

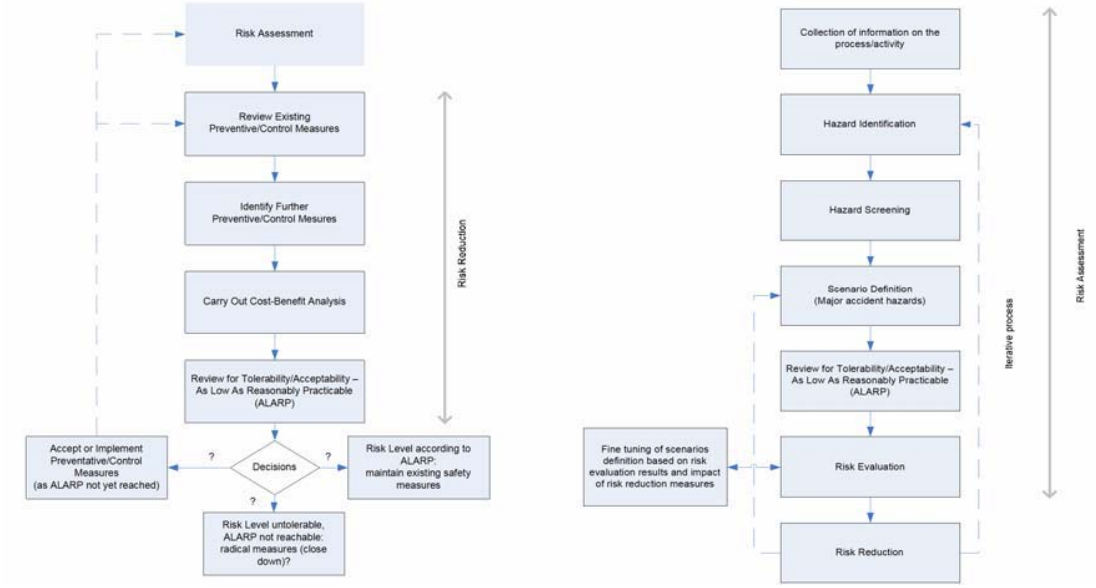

Figure 2: Risk assessment

Risk assessment Collection of information on the process/activity Hazard Identification Hazard Screening Scenario Definition (Major accident hazards) Review for Tolerability/Acceptability – As Low As Reasonably Practicable (ALARP) Risk Evaluation Risk Reduction Fine tuning of scenarios definition based on risk evaluation results and impact of risk reduction measures

3 RISK-BASED INSPECTION PROGRAMS-LEADING EDGE TECHNOLOGY

Chemical, petrochemical, oil &gas, and refinery sectors facing touher safety, environmental and mechanical integrity regulations as well as challenges associated with the need for both cost and leak reduction to improve safety and availability. Under these circumstances, it has become crucial to manage operational risk through the use of effective technology and best practices for inspection and maintenance methodologies planning. One of the highest benefit maintenance methodololgies is Risk Based Inspection (RBI). RBI signifantly reduces maintenance efforts and increases plant reliability and availability at the same time. This correlation results from shifting inspection efforts from “over inspection” of uncritical equipment to an increase in inspection cost spending on components with potentially higher probability of failure and consequence.

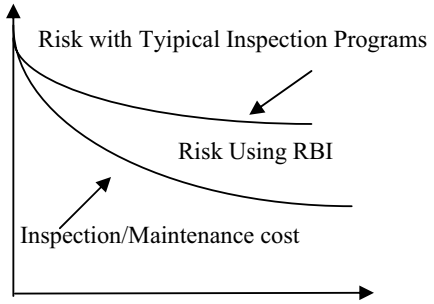

Figure 2. Risk Using RBI

The result is an overall risk reduction and increase in plant safety and reliability while constraining costs.Let me assist you in developing a leading edge RBI program which:

- Is a consequent development of traditional maintenance strategies that minimizes maintenance expenses,
- Belongs to the knowledge based methodologies focussing on safety and plant availability on demand by increasing on-stream time due to less turn-around time and a consequent reduction of unexpected failures,
- Is a systematic tool that helps users to make informed business decisions regarding inspection and maintenance expenses
- Identifies “Weak Points” and “Bad Actors”,
- Enables evolution from a “Bandage Approach” to a sustaining reliability culture,
- Is a recognized way towards “Best in Class Performance” and “Operational Excellence”,
- Means fostering replacement strategy,
- Implies prioritization in maintenance efforts,
- Extends inspection intervals where local authorities recognize RBI, and
- Allows determination of alternative inspection methods to avoid internal entry

Reliability increase are identification of Weak points, Asset Policies and Replacement Strategy. Less internal inspections are Increased Inspection Intervals, Althernative Inspection Methods and Up-front On-Line Inspections.

4 SOLUTIONS FOR IMPLEMENTING RBI

Every industry is under pressure to reduce production expenses including operation, inspection and maintenance costs. I will show you **Bayer** Technology Service targets three main areas to successfully initialize, implement and continuously align an RBI based maintenance strategy with day-to-day maintenance: Assessment including weak point analysis, bad actor analysis, identification on potential deterioration mechanisms and rates, risk matrix definition for relevant process equipment and components; Implementation of the right inspection strategy and techniques for components and damage mechanisms, effective repair strategies and concepts as well as effective troubleshooting processes, a risk-based inspection approach including inspection management, condition monitoring and the corresponding software solutions; Continuous alignment of the methods to the day-to-day inspection and maintenance business by providing an integration of RBI into strategic maintenance planning, visualizing inspection results and equipment conditions for management, and connecting the software solutions to the maintenance management system in place. As alternative to a complete program, RBI can mean beginning with just a risk evaluation of your equipment and components. Based on such a high-level consulting assignment, we can demonstrate the benefits of RBI and corresponding inspection programs.

Risk Based Inspection consulting services have proven their excellence and usability for years in day-to-day business in the Bayer group and with customers, serving owners and operators of plants and plant assets. Consultants have a high level of experience with software systems implemented and utilized in Risk Based Asset Integrity Management programs.

5 CONCLUSION

Every industry is under pressure to reduce production expenses including operation, inspection and maintenance costs. For example, Bayer Technology Services’ new RBI technology and tools empower owners and other users to manage risk associated with operating equipment, thus assuring maximum return on investment and optimal use of resources. This is accomplished by considering the likelihood of an undesirable event as well as the potential consequences. RBI represents the high-end side of modem development of maintenance methodologies and in consequence our development of a Risk-Based Asset Integrity Management. Risk-Based Asset Integrity Management is a consequent development of traditional maintenance strategies and belongs to the knowledge based methodologies. If focuses on safety and plant availability on demand by increasing on-stream time due to less turnaround time and a consequent reduction of unexpected failures due to our world wide acknowledge corrosion expertise.

A globally accepted standard software for RBI finds its basis in the API 581 specification. Practical, valuable features are built into the technology, which is based on recognized and generally accepted good engineering practices. This software implements the following purposes of RBI:

- Screen operating units to identify areas of high risk
- Estimate a risk value associated with the operation of each equipment item based on a consistent methodology
- Prioritize the equipment based on the measured risk
- Design a highly effective inspection program
- Systematically manage he risk associated with equipment failures

API industry standard RBI software is complemented by new Knowledge Based Inspection System (KBIS). This serves as an easy to apply front-end to a fully integrated inspection management system KBIS provides features and functions to utilize the system within a Risk-Based Asset Integrity Management program targeting an

evergreening plant operation, and its use on a broad plant and enterprise wide basis.

KBIS closes the gap between RBI and day-to-day Inspection Management to provide a complete solution for Asset Integrity Management. KBIS streamlines day-to-day inspection business by providing a variety of additional features to RBI software:

- Unit-wide inspection planning and scheduling
- Easy-to-use web-based access to RBI information for plant and unit personnel
- Data capturing for inspections through mobile devices for visual inspections and ultrasonic NDE-testing of wall thicknesses, etc systems for exchange of inspecti
- Integration with Enterprise Asset Management/Computerized Maintenance Management systems for exchange of inspection and non-conformance repair tasks
- Multi-language with international character sets for implementation available in German, English, Chinese and other language as needed
- Powerful reporting engine with reports available for audit trails, inspections and non-conformance tracking

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ERGONOMIC ASPECT IN DESIGNING CITIES

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Abstract

Nowadays, our cities are not ergonomic enough, which means that a lot of their elements are not adjusted to people, their standards and needs. That is why the cities are facing numerous problems of ergonomic nature which have negative influence on everyday life of their inhabitants.

However, all these deficiencies can be eliminated to a large extent by means of: urban planning, quality designing and construction of objects and elements of urban equipment, but also by educating and training personnel and population.

In order to accomplish these goals in a lawful and efficient way, it is necessary to carry out the changes of law regulations in the area of planning and construction, assemble new personnel and more efficient and responsible local and municipal management.

Key words: ergonomics, design, cities, urban planning, urban equipment, education.

1. INTRODUCTION

Cities, as organised urban settlements intended for people to live in, must be ergonomic, that is adjusted to people and their needs. Nowadays, our cities do not satisfy those conditions regarding many elements, which is why their inhabitants, in their everyday life, face many problems and negative effects. In cities, those negative aspects are manifested in different forms, starting with bad layout of main municipal functions, too many floors and densely constructed central zones, to lack of sunlight and aeration and harmful influence of pollution and noise. Particularly large problems in cities are the objects which are not adjusted to human dimensions and anatomy. They often create negative effects and represent a very big problem for disabled and handicapped people. All these problems can be solved to a large extent by applying more ergonomics in the process of city planning and arranging. That can be accomplished by means of quality urban planning and construction of objects which will contain all elements and norms of this area.

2. ERGONOMIC PROBLEMS IN OUR CITIES

Ergonomics in construction and arranging of cities can also be interpreted as activities which contribute to creation of better life and work conditions[1]. This is not only related to workplaces and housing, but also to a wider surrounding, that is the entire city.

In the process of planning and arranging of cities so far, ergonomics was not given a sufficient attention, which is why in our cities there are many problems in this area.

- Unfavourable layout of main municipal functions (work, housing, traffic and greenery) cause large problems in our cities
- In many cities industrial zones are positioned at unfavourable locations, often close to city centre and residential zones.
- Many industry plants in our cities were constructed by using harmful and filthy technology which creates big problems, both ecological and ergonomic.
- Frequent ergonomic problem in cities is the lack of parks and green areas.
- Unsolved traffic problems in cities, especially parking and pollution caused by cars.
- Ergonomic problems in our cities are also created by a large number of floors and dense construction in central city zones.
- Unfavourable position, orientation and aeration of residential zones and public and work objects.
- Problems are also made by objects which were not built according to ergonomic principles and norms. This usually implies to public objects which are not adjusted to the needs of disabled, handicapped and old people.

- Lack of pedestrian areas and cycling tracks, but also incorrectly constructed pavements and staircases.
- Negative effects are also created by urban equipment elements (kiosks, benches, advertising posts, fountains and tools at children's playgrounds) which are not ergonomically adjusted to size and anatomy of the user.

3. METHODS FOR SOLVING ERGONOMIC PROBLEMS

In order to add more quality and humanity to everyday life of people who inhabit our cities, it is necessary to give more attention to ergonomics. Ergonomics is a scientific discipline which investigates interaction between humans and their material surrounding and its adjustment to human needs[2]. Broadly speaking, ergonomics deals with the entire life and work environment to which city belongs as well. In that sense, the ergonomic aspect of the city also includes temperature, illumination, noise, vibrations, aero contamination and radiation[3].

Ergonomic engineering, as one of the areas of this discipline, is of particular importance when discussing these problems. It involves engineering measuring, designing and constructing of machines, tools, transport devices, furniture[4] and construction objects. It is important for us because its elements, principles and norms are applied when making plans for cities and some construction objects.

There is one more area which is significant for application of ergonomics in cities, and that is anthropometry, science which deals with the anatomy of human body and its dimensions[5]. It is important because it enables the application of anthropometric measures in designing[6] and construction of objects and elements of urban equipment in cities.

Solving of ergonomic problems in our cities can be done through a large number of activities - first, through urban planning, then through designing and construction of objects and urban equipment and, finally, through education and training of personnel and population.

On a higher global level, ergonomic component in cities can be achieved through manufacture and implementation of general and regulative urban planning. By general urban planning, we can realise quality layout of main functions in the city, such as work, traffic, housing and greenery. By regulative and detailed planning, we can provide optimal layout of objects, their orientation and number of floors. Such planning can successfully solve some other important municipal and ergonomic problems, such as streets, parking, green areas and pedestrian zones.

Ergonomic problems in cities can also be solved through designing of urban equipment objects and elements and their construction. In this kind of design, it is necessary to include ergonomic engineering and anthropometry. That means that anthropomorphic measures, principles and norms must be applied for public objects – kiosks, benches, ramps, staircases, rails, pavements and pedestrian paths.

The important factors for solving ergonomic problems in cities are personnel and education of population. In order to solve these problems successfully, it is necessary to educate and train new quality personnel. Such personnel should have interdisciplinary knowledge in the areas of urbanism, design, architecture, ecology, construction industry, spatial planning, management, and especially ergonomics. In solving these problems, education of population, but also of local self-government bodies, is of particular importance. Education should make the city population and all participants of decision making process aware of the importance of ergonomic factor.

By applying all those methods, we can turn cities into pleasant and appropriate environments for people, with minimal negative consequences.

4. PROPOSED METHODS FOR SOLVING ERGONOMIC PROBLEMS

Researches and analysis of ergonomic problems in our cities so far made it possible to discover the causes of their origin and problems which they bring about. By further analysis and interdisciplinary approach and by application of ergonomics, ecology, urban and architectural design and anthropometry, we established the principles for problem solving. As a final result of this research, we are offering the proposal which contains actual measures and activities for overcoming ergonomic problems in our cities.

Proposal – measures and activities:

- The Law on Planning and Construction should be amended by adding ergonomic conditions and norms with obligation to apply them in urban planning and projects.
- Amendments of the Law on Work Safety should also define the elements of ergonomic character which are to be fulfilled by public, work and residential objects.
- Law on Construction, Design Norms and Urban Equipment Construction should be amended from the ergonomic and anthropometric aspect.
- Municipal departments for urbanism should carry out issuing of conditions and control of urban planning and projects from ergonomic aspect.

- Issuing of utility licences for projects should be conditioned by fulfilment of ecological demands.
- Sanctions and penalties should be introduced for all those who do not comply with and do not apply ergonomic criteria and conditions.
- Education of population and public services in cities and local self-government bodies, related to this area, should be performed.
- New personnel, more efficient in dealing with ergonomic issues, should be assembled.

5. CONCLUSION

Ergonomic aspect in designing cities is very important. In enables creation of superior living conditions and adjustment of city functions and objects to human needs and standards. In designing and organising cities so far, this aspect was not given enough attention, which is why there are numerous problems of ergonomic nature.

Solving of these problems in cities can be achieved through design and arranging processes, but that requires new personnel and change of awareness. In our cities, that can be accomplished through activities on two levels – on a higher level, through urban planning, and on a lower level through design, constriction and arranging of objects and urban equipment element and education.

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APPLICATION OF SOME ASPECTS OF MODERN MANAGEMENT CONCEPT IN CIVIL ENGINEERING

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Abstract

Operating of majority of civil engineering companies in Serbia encounters numerous problems. They are usually of subjective nature and are related to their inadequate organisation, manner of operating and personnel. In order to solve most of these problems and make efficient and competitive companies according to European standards, it is necessary to introduce management into civil engineering. Introduction of management will enable the application of control methods and processes which will contribute to the improvement of operating and economic efficiency of the company.

In order to realise this goal, it is necessary to have personnel in the area of management in construction industry. Such personnel can be educated at the faculty of civil engineering, architecture and management in the course of main, master and specialist studies.

Key words: management, civil engineering, marketing, personnel, construction organisation.

1. INTRODUCTION

The development of society and new scientific disciplines such as management, marketing and design brings about the need to include them in the area of civil engineering. That is especially necessary after the privatisation of most of the construction companies and their transition to the
-The second important problem is the way the companies are run, because the old and outdated
-The third problem is the lack of adequate and educated personnel for almost all profiles, starting with managers, engineers, construction site supervisors to craftsmen. There is especially a lack of well-trained craftsmen for essential works, such as: carpenters, bar benders, concrete workers, parquet layers, locksmiths, insulation workers and welders.

market-oriented operating. However, most of the privatised companies did not undergo the process of restructuring and adjustment of their organisation and operating to the new market conditions. Uncontrolled and inadequate privatisation mainly led to their collapse and fragmentation. Therefore, regarding organisation and personnel, majority of privatised, but also of new companies, are not able to become included into serious works, especially on the international market. Unfortunately, most of these companies are applying the old, only slightly adjusted system of control, organisation and operating which does not give good results.

2. CURRENT PROBLEMS IN OPERATING OF CONSTRUCTION COMPANIES

Operating problems of construction companies in Serbia nowadays are numerous and considerable.

Some of them are of objective nature and related to the economical and political situation in the country, especially to the consequences of world crisis which also reflects on investments in construction. However, most problems are of subjective nature and are related to the companies: organisation, operating and personnel.

-One of the key problems is the use of old or slightly modified systems in operating and organisation of companies, which they inherited from the previous period.
methods and experience are usually applied, without management and marketing in this area.

-A big problem is also created by low-quality project documentation for objects, particularly for execution projects. This problem exists due to a small number of referent bureaus with experienced designers and limited possibilities for training young personnel. Additional problem is created by inadequate law regulations in this area which make it possible, low-quality external control of projects

and insufficient inclusion of local institutions for urbanism.

-A significant problem is created by application of outdated technology and organisation of construction, regarding a large number of objects. Most often, classic construction methods are applied in construction process, which include a lot of manual labour without modern equipment.

-For many companies and objects, quality of construction represents a big problem. That is the result of inadequate supervision and quality control, especially for objects intended for market, for which most often the basic quality criteria for executed works are not fulfilled.

-The lack of adequate regulations and standards in this area also causes difficulties, especially their non-compliance with the European ones. This is particularly the case with standards for energy efficiency of buildings, protection against noise, vibration and radiation.

3. PROPOSALS FOR SOLVING PROBLEMS IN CIVIL ENGINEERING

In order to solve such numerous problems, or at least the major part of them, it is necessary to introduce management into civil engineering. That is also needed because most participants of this economy area, starting with company owners and investors to directors and personnel with civil engineering qualifications, do not have the necessary knowledge in the area of management. That is why many problems occur in their functioning and work, including financing, provision of location, work quality and market demand. They do not have the needed knowledge in the area of market and finances, especially the knowledge needed for improving business activities of the company which should provide its successful functioning.

Modern technological developments, market economy and competition require the application of management methods and processes offered by management in the area of civil engineering as well.[1] Their application will contribute to the improvement of operating and increase of economic efficiency of the company. Management will make it possible, since it is a complex interdisciplinary science which includes other disciplines, such as information technology, design, marketing, technology, economy, psychology etc. In that way, accomplishment of process or function of efficient running of these companies is made possible, which implies: planning, organising, personnel management, directing and control.

Significant improvement of construction companies operating and solving of many accumulated problems can be accomplished by management due to parts of its operative functions, such as: production, design, marketing, research and development, finances and personnel[2].

Solving of key problems in civil engineering cannot be successfully performed without management and its components. They will make possible good managing of all parts of company and their connecting into a functional entity, which will provide fast, quality and profitable construction.

Design is an important operative function of the company[3], particularly in civil engineering. The function of the design here is to provide good and high-quality project documentation, which will solve one important problem in our civil engineering. That implies creation of high-quality general solutions, which are functional, adjusted to needs and demands of market and investors and nicely formed regarding aesthetics (design). Design in construction engineering also implies making of execution projects which should define the object precisely both in technical and technological sense. That will provide stability and reliability of the object and its thermal, sound, energy and ecological efficiency.

Marketing is another important activity within management which should harmonise the interests of beneficiaries with the interests of the company. It can contribute to solving of many problems which appear throughout operating of construction companies. Its key role is to investigate and collect information on needs of market and buyers and from the business surroundings.[4] Based on collected information, professional orientation of the company is adjusted to the needs of the market and buyers. This very important factor was not given enough attention in our civil engineering so far, which is why problems often occurred. Investors and constructors were also not very interested in what kind of objects, flats and work offices the buyers and market wanted.

Quality is another important element of the product which a good management should provide[5]. That is also a big problem of our civil engineering and it has to be overcome in order to make operating better. The decrease of quality in civil engineering appeared for many reasons – first of all because of inadequate privatisation of construction companies, but also because of insufficient offer, lack of personnel, weak control and bad law regulations.

In order to improve quality in civil engineering and make more serious and efficient construction companies, according to European standards, it is necessary to introduce management into their operating.

Personnel takes up all the activities in the company and that is why successful work of any company depends on quality of personnel.[6] Nowadays, this problem is especially prominent in construction industry, because inadequate politics

and privatisation led to departure and deficiency of personnel. Therefore, civil engineering today lacks not only experienced managerial and technical personnel, but also a large number of specialised craftsmen. That is why the introduction of management into civil engineering is expected to help solving personnel problem as well.[7] For this area of economy, specialised profiles which will introduce management into civil engineering are necessary.

That can be accomplished by forming special programmes or departments at faculties of civil engineering, architecture or management. At the faculties for civil engineering or architecture that can be done by introducing special subject in the area of management into main course of studies, but also special departments within master and specialist studies. That is where the students should acquire knowledge of managerial group of studies, such as: management, marketing, industrial and urban design, company organisation, modern technologies, information technology and others.

Such personnel can also be educated by introducing a particular department or specialist studies at faculties and colleges for management. Within those lectures from the area of management in civil engineering, the students should also acquire necessary knowledge of a particular number of subjects in the area of architecture and civil engineering. Knowledge related to constructions and material, basics of building design and construction and structural engineering, modern technology in civil engineering, construction organisation and basics of architecture, urbanism and design is particularly needed. It is also necessary that the students become familiar with laws, regulations and standards in this area.

4. CONCLUSION

In order to solve numerous problems in the area of civil engineering, it is necessary to introduce management into this area of economy. Management, as a new discipline, will provide better and more efficient operating in civil engineering and will solve many accumulated problems. Due to its interdisciplinary approach, it will lead to more efficient running of construction companies, which implies high-quality planning, organising, personnel management, directing and control.

For introduction of management into this area, it is necessary to have new personnel in the area of management in civil engineering. They can be educated at faculties of civil engineering, architecture and management and must have interdisciplinary knowledge in the area of management, civil engineering, architecture and urbanism.

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IMPROVEMENT OF BUSINESS SYSTEMS MENAGEMENT

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Abstract: *Improvement of business systems management is done through several segments and one of them is by all means investing in employees education,which has great influence on the improvement of complete organization performance. Change in technology, constant increasement of complexity, turbulence, uncertainty of professional environment and modern business ask for new, greater and different knowledge and put men in the first plan not only for development but also for organization survival. These changes make quickly knowledge old-fashioned and ask for new knowledge and permanent education. Today permanent education becomes one of the most important forms of human resources management and development.Education process always has certain outcomes but their nature is often vague and unclear. Even in the vocational education and adult education there are programmes, which are not rare, that have unintentional, inadequate and imprecisely defined outcomes that have a consequence of „production" practise of personnel who have formally acceptable qualifications but they don't have some basic competence that are expected. Permanent education and advanced training of the employees becomes one of the most efficient ways of concurents advantage, entrance on market game and competition for gaining sympathies and trust of the consumers and thus the most efficient way of conttinuous improvement of organization performance. Analysis of needs for knowledge and skills should provide information about people who need them, about the jobs they perform or will perform and about the products themselves or about the processes that are results of their r work.*

Key words*: improvement, management, organization, knowledge, skills, education,*

1. PREFACE

In order to improve organization potential, modern companies devote their resources to education, continuous training and professional qualifying of the employees. Employees training can be defined as effort to improve employees performance on their job or on some related working position. Teaching,training and retraining imply certain changes in specific vocations, abilities, skills, attitudes or behvaiour. Efficient teaching must be well planned and in accordance to the identified needs, organization needs and individual needs of the employees and to ttechnological development of the organization. Continuous employees education means employees development in order to help them develop their personal development, professional specialization that is not related only to their current working position but the aim is, by means of professional specialization, to prepare the employee to meet future orgnization demands or to develop personal career in long term period.

Professional specialization and trainings can be performed on the working position, in organization in whcich they do not work, in secondary vocational schools or in high educational institutions. Introduction of Modular teaching in secondary vocational schools and their connection with social partners and related organizations enables secondary qualified staff to gain new knowledge and skills by organizing professional specializations and retraining and thus it enables students of these vocational schools to have adequate practise in organizations that work in these fields.

Implementation of education in organizations is complex activity and task that develops and that is done in human resources management and it is one of the most important subfunctions.

2. INVESTMENT IN CONTINUOUS EDUCATION OF THE EMPLOYEES

Investment in education becomes key indicator of understanding what is happening in modern business and competition. Permanent education is one of the most important forms of human resources management and development. Changes in technology make large out-of-dating of knowledge and they ask for new knowledge and permanent education.

Aims of education are intentions and orientations of eduational organizers and teachers in the field of education and learning and first of all they are the results of analysis of needs, i.e. vocational standards. They are the basis for program planning and development. When formulating aims of specific programs, general educational aims as well as general vocational aims should be kept in mind.

The aims of education are not just basic element of didactic process, but they are also the evaluation standard for the process itself. They have the key role when choosing didactic method. Because of that, the aims of education have to be carefully classified and formulated in the program/curriculum. Having in mind the constant adaptation to changing demands of labour market, need for continuous education, advanced training, career promotion, expansion of employment possibilities, the students will be trained for:

- applying theoretical knowledge in practical context
- efficient working in groups
- taking responsibilities for permanent individual education and working and career promotion
- prompt reacting on the changes in working environment
- recognizing of professional possibilities in labour environment and in social environment
- applying safety and health measures during the working process
- using information technology in gathering, organizing and applying information in work and everyday life

Analysis of needs for knowledge and skills of the employed is realized using the model of identifying differences between what it is now and what it should be.

3. ANALYSIS OF NEEDS FOR KNOWLEDGE AND SKILLS OF THE EMPLOYEES

In new economic organization , contries that invest more in education can be the most competent, because the knowledge becomes basic capital and key for progress. In a country where economy is the only uncertainty, knowledge becomes the secured source of real competention. Social and economic development leads to opening new fields of work and new jobs in different fields and vocations. The employees often have to train for new technologies application and process, and the unemployed shoud retrain and gain additional knowledge in order to employ. Analysis of needs for knowledge and skills is made by identifying defferences between what is and what should be.

Analysis of needs for knowledge and skills of the employees is made in 4 phases:

- Work analysis,
- Giving work profile, i.e. definition of knowledge and skills needed for job performance,
- Examination of knowledge and skills
- Comparison of needed and present knowledge.

Establishing of needs for knowledge and skills starts with qualitative analysis of functions and activities of an individual: tasks whaich are part of activities, actions and technical means that are used as well as conditions in which activities are done. Projection of work, i.e. image of its ideal performance, must be calculated in the analysis.

Based on the work analysis we come to the second phase of educational needs – work profile. It consists of stating which knowledge, skills and abilities are necessary for work that was an object of analysis. In the third phase, using standardized procedures, such as series of tasks of objective type, the interrogation of acquired theoretical and practical knowledge is made. Comparison of knowledge and skills given in the work profile phase gives their difference in educational needs in certain working field.

4. PROFESSIONAL ORIENTATION IN CHANGE AND VOCATIONAL STRUCTURE CHOICE

Professional orientation in no longer connected only to helping young people to choose the vocation, but it is now often connected to changes in vocation structure and needs to retrain the employees. From all these reasons, professional orientation includes not only help to choose the vocation, but also it includes the tracking of an individual during his career, either for his needs in adaptation, stabilization on his job and further education or for the need to change the vocation.

The program development starts with complete inspection of the working needs, i.e. professions or concrete jobs, based on the analysis of needs with primary outcomes:

- Professional profile (of jobs, working functions) and
- Profession standards (of jobs, working functions).

When comparing the abilities people do not differ very much. When career choice is in question, we should know that each of us has abilities to perform several vocations. On the other hand, we cannot say

that each of us is capable for all the vocations.
Certain vocations ask for big physical effort, certain ask for great hand skills. For an entrepreneur it is necessary to know good economic conditions and thus to know good job opportunities.
Thus, program development, identification and definition of basic structural program elements in vocational education and adult education is realized in four parallel and inter-depend processes. They are:

- ***job specification*** (vocation, job or individual working functions) that is related to conditions and contents of jobs, i.e. working competence necessary for performing certain jobs and tasks;
- ***learning specification*** – identification of knowledge, skills and competences necessary for vocational work or performing the job, i.e. giving precise aims, outcomes, contents and methods by which preliminary identified knowledge, skills and working competence can be achieved;
- ***condition specification*** and standards that are related to precising conditions (material, technical, personnel) in which educational and learning process is realized
- ***evaluation and mark specification*** that is related to estimation and evaluation of relevancy and success of the program and estimation of learnt program and determination of methods and criteria in order to check learnt contents.

The fact is that people differ in their physical and psychological abilities and characteristic. These differences make different success in jobs and therefore they must be shown to the candidate for what kind of jobs he is to do in order to have larger success to develop his abilities and to develop his career. In professional orientation we have candidate whose characteristics, abilities, skills and knowledge and tendencies we saw and then we should offer him jobs where his characteristics, abilities, skills and knowledge and tendencies can be useful and to make him more content. The person who gives advice on career choice must have in mind characteristics, abilities, skills and knowledge and job needs. The aim of this process in professional orientation is to find quickly jobs on which the candidate will have bigger success. When giving advices, it is necessary to underline jobs that the candidate is not to choose.
Professional orientation has three inter-related aims: professional information, professional advice and tracking of the candidate in school and on his job. Every man finds very important that when working he feels content and happy or at least that job does not make him unhappy. In order to have all this, it is very important for a man to do job where his abilities and tendencies are achieved. Some people are more interested in working with machines and techniques, some in numbers and papers, while the entrepreneur is interested in new challenges and dynamics. Professional orientation includes organized way to see his abilities, to understand different aspects of jobs and all this enables independence and responsibility when choosing the vocation.

5. PLANNING AND EMPLOYEES CAREER DEVELOPMENT

Planning and employees career development has primary aim to connect needs, knowledge and skills of the employees to present and future organization needs. Career development is a dynamic process that lasts for the whole life and that is realized through several phases by means of continuous – permanent education of the young as well as of the adults. Serious approach to employees' career development can provide multiplied effects either for individuals or for the organization itself.
Planning and employees career development can be done by two connected processes:

- Career planning on individual level
- Career management on organization level.

In modern times the role, candidate's responsibility as well as functions and behavior on professional orientation i.e. planning and career development have changed in great deal. Past ideas that included more or less researches of abilities and possibilities of the candidates and their sending to certain vocations opposes to modern concepts , as a very important condition for adequate career choice, that have different attitude i.e. the individual can freely and independently make career choice. Career planning on individual level means that the individual can make freely and independently the decision because he has real view on his abilities, tendencies and characteristics from one point of view and from the other point of view objective possibilities.
Primary professional education in the first professional phase (obtaining first job in career) includes continuous process of understanding subject to work and elements of work from the youngest period and it ends with intensive professional education and obtaining certain vocational career level. Obtained right to work is a potentional readiness to perform several vocations, but it does not mean that vocation is obtained. Vocation is obtained during the working start as a very complex social and andragogical process. During working from normative point of view we obtain vocation, but from social and andragogical point of view, it is a relatively complex process of gaining organizational culture. Professional advanced studying includes process of enlarging and deepening of knowledge and skills when performing jobs and working tasks that have certain complexity in the complexity of certain complexity categories.

Career management is an organizational process of preparation, implementation and control of employees' plans. In order to have successful career development it is necessary to be integrated and supported by all other human resources management activities, for they all together have the same function and that is to coordinate needs of and individual to the needs of the organization.

6. SUMMARY

Social and economic development leads to opening new fields of work and new jobs in different fields and vocations. The employees often have to train for new technologies application and process, and the unemployed should retrain and gain additional knowledge in order to employ. Analysis of needs for knowledge and skills is made by identifying differences between what is and what should be, and analysis of needs for knowledge, and skills of the unemployed, i.e. analysis of needs for knowledge and skills needed on the labour market is a more complex procedure. Identification of knowledge and skills needed on the labour market, i.e. new programs, implies systematic anlysis of organization, local community or sector having in mind social and economic imputs on macro level. Analysis of needs for knowledge and skills should provide information about people who need them, about the jobs they perform or will perform and about the products themselves or about the processes that are results of their r work.

Old knowledge and increasement of needs for new information demands permanent education of the employees. New phase in market economy development asks for well-planned multiplied education, evaluation and promotion system. Modern companies devote more of their resources (money, time, energy, information and etc.) to constant education and permanent training of the employees. Insufficient investments in education and development of the employees are one of the key reasons of losing shares on the market and falling behind the competition. Management understands more and more that permanent education and improvement of employees becomes one of the most efficient ways of competition advantages, entering on market and competing for consumers trust and all that should enable improvement and management of organization performances.

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