UNIVERSITY OF EAST SARAJEVO

FACULTY OF MECHANICAL ENGINEERING

QUALITY FEST 2017

PROCEEDINGS

26th - 28th October 2017,
East Sarajevo - Jahorina, B&H, RS
Hotel Bistrica

University of East Sqarajevo
Faculty of Mechanical Engineering
QUALITY FEST
October 26th-28th , 2017.
Jahorina, RS, B&H

PROCEEDINGS

1st International Conference for Quality Research (B&H)
11th International Quality Conference (Serbia)
11th International Conference ICQME (Montenegro)

26th – 28th October 2017.
East Sarajevo – Jahorina, B&H, RS
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ПАЛЕ

The conference has been supported by:

PREFACE

The Quality fest is being held for the first time in the Republic of Srpska, Bosnia and Herzegovina. In addition to the First National Conference on Quality of BiH, the First International Quality Conference in BiH is being held at the Quality Festival, as well as 44 National Quality Conference of Serbia, 11th International Conference on Quality (Serbia), 21st SQM 2017 (Montenegro) and 11th. international conference ICQME (Montenegro).

At the previous conferences, some important issues of quality, quality management, engineering, environmental management and food safety were discussed. Lectures to be presented at this annual conference include those areas, but thay are also extended to other areas of science on quality, quality management and standardization. The special value of the conference is in a wide aspect of the issues related to the quality of production and the quality of products and services, as well as interdisciplinarity, since many authors from the practice works from the practice, universities and institutes dealt with topics in the field of machine industry, electrical industry, food industry, education ...

The conference program is divided into 3 thematic units: Global Quality, Quality basic, Quality Engineering and Management. Participation at the national conference were reported by 63 authors from the 5 countries with a total of 28 papers, while at the international conference 80 was reported from the 11 countries with 26 papers. In addition, 5 introductory reports will be presented at the conference, and through discussion on two roundtables ("ISO 9001: 2015" and "Quality Infrastructure in BiH") will discuss the current state of arts and opportunities for improving the application of the actually quality standards in the Republic Bosnia and Herzegovina and the countries of the region.

The presence of a large number of participants from the countries of the region, as well as issues wich will be presented at the conference, coincide with the efforts of the countries of the region in the way to EU and European integration.Based on the above, it can be assumed that the presence of scientific workers, researchers and practitioners will represent not only the exchange of knowledge and achievements in the quality of processes, products and services, but also a serious attempt to unify productive work and create new values with economic development and strengthening awareness of the need for quality improvement as a prerequisite for sustainable development and the preservation of the true values of society.

In the name of the Scientific and Organizational Committee of the QFEST 2017, we wish to express our gratitude to all authors, reviewers, institutions and individuals who contributed to the realization of this Conference.

East Sarajevo, October, 26th 2017.

President of the Scientific Committee	President of the Organizing Committee
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INTEGRATIVE AUGMENTATION WITH ISO 10004 IN ENGINEERING EDUCATION

Katharina Astleitner[1], Stanislav Karapetrovic[2]

Abstract: Integrative augmentation of ISO 10001 and ISO 10002 standardized management systems stringed by ISO 10004 and applied in a Canadian university is illustrated. ISO 10001 code and ISO 10002 feedback augmentative systems implemented in two sections of an engineering course taught in 2016 and 2017 by the same professor to 306 students altogether are discussed. The augmentation related to the typo and response guarantees as well as student feedback through the usage of the ISO 10004: 2012 standard is overviewed. Results of ISO 10004 measuring and monitoring of the typo/response code and feedback augmentative system elements through two 2016 and three 2017 student surveys are demonstrated.

Keywords: Customer Satisfaction, Integration, ISO 10001, ISO 10002, ISO 10004

1 INTRODUCTION

A decade since the “Integrative Augmentation of Standardized Management Systems” (IASMS)-entitled presentation [1] at this conference series in Montenegro, related applications with three ISO 10000 Customer Satisfaction Standards (CSSs) are discussed here anew. Two months after that talk in Sveti Stefan, the same number of CSSs, namely ISO 10001 [2] and ISO 10003 [3], appeared. Following on these two and the original ISO 10002 from 2004 [4], the fourth universally-applicable CSS, initially as a Technical Specification in 2010, and then “aligned” with the others through, for example, the incorporation of the “guiding principles” (sub-clause 4.3) and an “interrelationship” flowchart (annex F), specifically ISO 10004, was published in 2012 [5]. Currently at the Draft International Standard (DIS) stage, all four mentioned CSSs are being revised [6].

Apart from this CSS- and IASMS- related standardization, the period since 2007 also saw CSS- and IASMS-associated research. For instance, while [1] mainly looked at the IASMS concept, further studies with engineering education-focused applications were reported in 2010 [7] and in 2017 [8]. Surveys exploring CSSs implementation were conducted in the very neighbourhood of this conference (e.g., [9]), as well as elsewhere (e.g., [10]), with IASMS also covered empirically (e.g., [11]), and conveyed in 2014, 2016 and 2012, respectively.

As described in [1], the overall idea of IASMS is to incorporate augmentative standardized subsystems, e.g., the ones from ISO 10001 or ISO 19011, within other, also augmentative, systems (AUGSs), e.g., ISO 10002. IASMS-related notions (e.g., see

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sub-clause 5.2 in [2] and Annex F in [5]) and examples (e.g., see sub-clauses 8.5 in [4] and 0.4 in [5]) are already given in the CSSs themselves. Furthermore, IASMS can be performed with two or more AUGSs augmenting each other simultaneously, which was demonstrated in, e.g., section 5 of [8], with three AUGSs and thus three bidirectional or six distinct IASMSs. In this paper, however, one-directional dual IASMS by a single AUGS will be illustrated. Specifically, synchronized augmentations of ISO 10001 and ISO 10002 systems, which were used in two undergraduate course sections with more than 300 students altogether over two years, by an ISO 10004 subsystem, are shown.

The following section exhibits IASMS examples with ISO 10001/2 AUGSs through designated ISO 10004 clause-related fundamentals and activities. The subsequent two sections display IASMS undertaken with the main ISO 10004 processes, i.e., ISO 10001/2 AUGSs measurement and monitoring, respectively. Musings on further IASMS conclude the paper.

2 OVERVIEW OF IASMS WITH ISO 10004

The course where IASMS was implemented covers a topic mandatory for engineering students in Canada. Two sections of the course, taught by the same professor in a western Canadian university during subsequent years, namely in 2016 and in 2017, are focused on herein. The sections had 154 and 152 students, respectively. In the first class of each, the professor presented and/or referred to documented explanations of ISO 10001 and ISO 10002 systems applied in the course, as well as the (ISO 10004-enabled) surveys integrated within an overarching project on the implementation of another AUGS.

The ISO 10001- and ISO 10002- related elements of three such surveys are connected to ISO 10004 clauses (in this section) and processes (in the next two sections): the “Initial Survey” (IS) handed out in the first class in both sections, the “Midterm Survey” (MS) distributed around the date of the midterm exam after the term break, and the “Final Survey” completed towards the course end. The ISO 10001 AUGS encompassed two guarantees, specifically for the 24-hour professor email response (e.g., see [12]: “Response Code”) and for no typographical errors in lecture slides and notes (e.g., see [8]: “Typo Code”). On the other hand, student paper-, email-, and course website- provided feedback was handled through an ISO 10002 AUGS (e.g., see [12]).

Examples of using Clause 4 of ISO 10004 [5] for ISO 10001/2 augmentation include *Guiding Principles* 4.3.10 “Commitment” for placing questions on codes/feedback in student surveys and for the related course webpage reporting, and 4.3.6 “Continuity” for administering such questions in all three surveys, as well as the 4.2 *Concept* itself, pertaining to the corresponding codes/feedback analysis. Figure 1 concentrates on some of these ISO 10001 examples, specifically since students were asked in the IS 2017 (bottom bar in Figure 1) if reports regarding professor performance on the two codes would have been useful (ISO 10004, 4.3.10), code awareness was probed in the MS 2016 (middle bar in Figure 1) and thus following an IS in that section (ISO 10004, 4.3.6), while opinions on any code changes needed were sought in the MS 2017 (top bar in Figure 1; ISO 10004, 4.2).

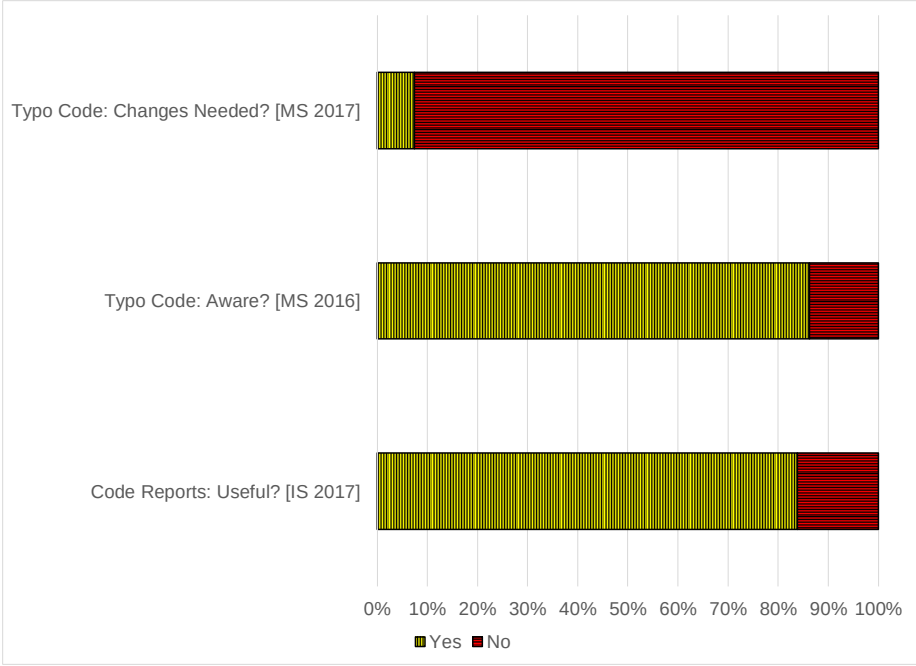

Figure 1. *ISO 10004 – ISO 10001 Integrative Augmentation Examples*

ISO 10004 Clause 5 application is evident, e.g., in the IS 2017, MS 2016, and MS 2017 items from Figure 1 for “planning”, “operation”, and “maintenance and improvement” activities, respectively, which are sequentially referred to and described in the second, third and fourth paragraph of that clause in [5].

The question on code report usefulness and the corresponding result of a positive answer by 26 students (84%) can be related to Clause 6 in ISO 10004, more specifically sub-clause 6.3 [5].

86% of 51 students aware of the Typo Code illustrates a result linked with ISO 10004 Clause 7, particularly, for example, 7.3.2 in [5].

Finally, with respect to Clause 8 from ISO 10004, only 7% of the 27 responding students indicated that changes in the Typo Code were necessary (Figure 1), reflecting nevertheless an application of the guidance from the fifth bullet of the corresponding clause in [5].

Overall, the ISO 10004 clause-related examples of IASMS from the five preceding paragraphs also have an ISO 10001 [2] perspective, with its sub-clauses 4.2, 5.2, 6.3, 7 and 8.4, respectively.

3 ISO 10004 MEASUREMENT FOR ISO 10001/2 IASMS

Figure 2 shows selected results of the ISO 10004 measurement process jointly augmenting ISO 10001 and ISO 10002 AUGSs. The results are from the midterm surveys administered in both the 2016 and 2017 course sections, with the means of responses to the question regarding the usefulness of the two codes (ISO 10001 AUGS elements) and feedback forms (ISO 10002 AUGS elements) presented. Evidently, the students considered the 24-hour response code to be useful (means of 4.26 and 4.14 out of 5 in 2016 and 2017, with 48 and 27 students replying, respectively). This utility was less prominent for the Typo Code, regardless of whether the course was offered in

2016 (mean of 3.57) or in 2017 (mean of 3.63), as well as for the Feedback Forms (e.g., see Annex B in [1]), with a 3.41 mean, i.e., between “useful” and “very useful”.

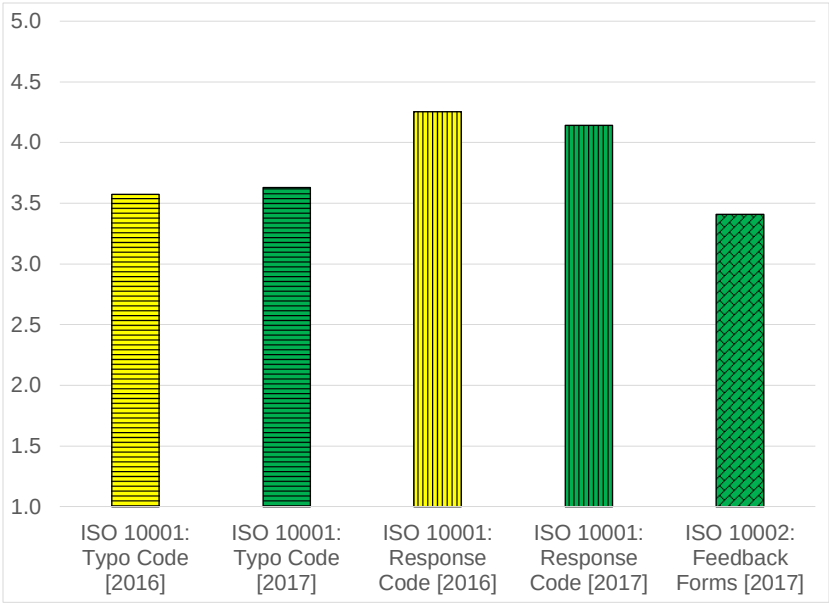

Figure 2. *ISO 10004 Measuring ISO 10001 + ISO 10002 Examples*

Such findings, e.g., for the feedback forms, seem to be not only consistent across the three course surveys, e.g., in 2017, but can also illustrate the outputs of the ISO 10004 measurement activities. For instance, in the 2017 initial survey, 10% less students indicated that these forms would be useful compared to code reports (see sub-clause 7.2 of [5], e.g., 7.2.2, for the related activity). While the ISO 10002-related item from Figure 2 points to sub-clause 7.3 of [5], e.g., 7.3.3, the 2017 final survey result referring to the whole feedback process through “procedures”, rather than just a resource, i.e., form, with the mean of 4.41, can be viewed from the ISO 10004 sub-clause 7.4 [5] perspective, e.g., 7.4.5.

Furthermore, in line with sub-clause 7.5 of [5], by, e.g., posting initial survey results and follow-ups on the course webpage after class #18 in 2017, integrated code/feedback reporting was performed (e.g., see [8]). Such IASMS was also facilitated by integrated open questions and student responses covering multiple AUGSs, for example in a 2017 final survey response that touched upon both codes, while suggesting that the time limit for the response code could have been longer and commenting on the typo code outcome.

4 ISO 10004 MONITORING FOR ISO 10001/2 IASMS

The process for monitoring code/feedback-related student satisfaction (see sub-clause 7.6 of ISO 10004 [5]), although implied in deploying multiple surveys within a single course section, is demonstrated below in 2016 to 2017 section terms, i.e., year-over-year, and using final survey results. Similarly to Figure 2, student responses are illustrated for two ISO 10001 AUGS items and one ISO 10002 AUGS item.

As shown in Figure 3, the 2017 section students agreed more strongly (mean increase of 0.29 compared to the 2016 course section) that the Typo Code was effective,

and a slightly higher mean (by 0.34) was also yielded for the suggestion of introducing additional guarantees in the course. Nevertheless, there was almost no course section difference from 2016 to 2017 regarding the appropriateness of student feedback handling procedures (4.43 in 2016).

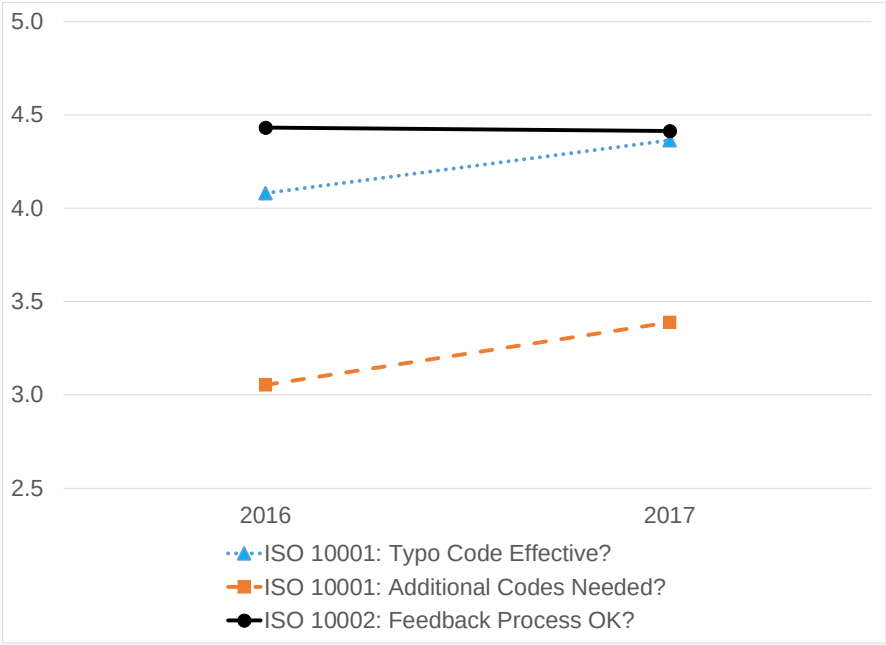

Figure 3. *ISO 10004 Monitoring ISO 10001 + ISO 10002 Examples*

This ISO 10004 monitoring also contributed to the professor's use of ISO 10001/2 AUGSs "maintenance and improvement" sub-processes (see Clause 8 in [2] and [4]). For example, as the "additional codes" line is much below the other two in Figure 3, no further guarantees were set up in either 2016 or 2017. In addition, the professor continued to apply both the response and typo codes in 2017 (e.g., the correlation coefficient between the two regarding effectiveness in the final survey was 0.843 in 2016 and 0.858 in 2017). The surveys had a similar response rate (24% in 2016 vs. 27% in 2017), as both (but also the others) were done in classrooms, with voluntary class attendance, and all response sheets had to contain two checkmarks for student confirmations of consent- and withdrawal- related, i.e., ethics, statements.

5 CONCLUSION

Although we began with reference to the 2007 precursor conference, researching on the IASMS (and on its integration counterpart, as discussed in the first QFEST opening plenary speech) has been running for more than the 2007-2017 decade. IASMS practice, as illustrated here with engineering education examples, and with new AUGSs, will continue. This paper demonstrated an IASMS application with ISO 10004 augmenting ISO 10001 and ISO 10002 AUGSs in two engineering courses taught within the last two years, namely in 2016 and 2017. However, it was limited to only a few IASMS aspects (e.g., single direction and ISO 10004 augmentation) from a much larger number studied (e.g., with respect to ISO 10001/2/4), with the purpose largely for illustration at

the Jahorina conference. Analysis of additional ISO 10004-related items (e.g., with reference to CSSs) and further statistics (e.g., for the current AUGSs), and over more engineering courses (e.g., sections) will follow.

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CERTIFICATION IN SERBIAN AGRI-FOOD INDUSTRY

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Abstract: More recently certification has become a very important issue in agricultural and food industry. A growing number of problems related to food safety results in a growing number of demands for safe products at the international market, which leads to development and practical implementation of lots of standards referring to this kind of production. The paper aims to provide an overview of standards related to food safety and food quality, which can be an important matter for agricultural manufacturers and processors in food industry so that they can consider the key factors influencing the achievement of full exporting potential.

Keywords: Competitiveness, Supply chain, Agriculture, Standards.

1 INTRODUCTION

Serbia's potential to export food is much larger than the one being achieved nowadays, so it can be assumed that its future level of export and development rate of export depend primarily on competitiveness of agri-food industry, which surely includes certification of products and processes. Larger food export can be achieved by establishing the efficient system of food safety control in order to provide licenses to export to EU, increasing competitiveness, improving the market chain and consolidating offers, understanding the export market and implementing the standards.

2 TYPES OF STANDARDS AND THEIR REQUIREMENTS

Standards are basically divided into public and private standards in terms of standards makers. These standards can also be divided in mandatory and voluntary standards (Table 1) [2].

Public standards can be set by international and national authorities or by EU. They can be mandatory (HACCP) because they are related to national and international laws and regulations. Noncompliance with these standards leads to the prohibition of the sale of products or services in a given market. Public standards can also be voluntary standards which usually support preservation of distinguished products of an area (products with geographic indication) or which relate to the

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production aiming at improving production in accordance with ecological requirements and requirements for the preservation of human health (organic production).

Table 1. *Division of standards in terms of standards makers*

	Public	Private
Mandatory	Laws, regulations, rule books, DPP, DHP (HACCP)	HACCP
Voluntary	PDP/PGI, Organic production, IP/IPM	ISO, Global G.A.P., BRC, IFS

Private standards can be set by customers, market chains, suppliers, institutions for standardization, institutions for inspection and certification, or nongovernmental organizations. They are not mandatory by law; instead, they are voluntary. There are some cases, however, showing the cooperation between public and private standards, where private standards are adopted by national authorities and defined either as mandatory (e.g. HACCAP system) or voluntary (e.g. organic production).

Standards can also be divided on the basis of [3]:

- Focus of certification: standards for process certification, standards for product certification, or standards focused both at product and process;
- Aims of standard: meeting minimal requirements (meeting minimal requirements for food safety, food quality, environmental protection) or product differentiation (making a product which presents a group of differences in order to be distinguished from other competitive products);
- Target communication: communication with business partners (B2B) – in most cases it is forbidden to put the logo on the final product; or communication with consumers (B2C) - in this case it is allowed to put the logo on the final product;
- Part of supply chain: standards for production, processing and distribution. One standard can cover several parts of supply chain, too.

Table 2 shows the division of standards, on the basis of the classification above, which are mostly implemented in our market.

Table 2. *Classification of standards implemented in Serbian market [5]*

	Standards makers	Legal obligation	Goals	Communication	Log on the product	Supply chain
IP/IPM	Private/ Public	No	Differentiation	B2C	Yes	Production
Global G.A.P.	Private	No	Minimal requests	B2B	No	Production
Organic	Private/ Public	No	Differentiation	B2C	Yes	Production/Processing
HACCP	Private/ Public	Yes	Minimal requests	B2B	No	Production/Processing /Distribution
ISO	Private	No	Minimal requests	B2B	No	Production/Processing /Distribution
BRC	Private	No	Minimal requests	B2B	No	Processing/Distribution
IFS	Private	No	Minimal requests	B2B	No	Processing/Distribution
PGI/PDO	Private/ Public	No	Differentiation	B2C	Yes	Production/Processing
Halal	Private	No	Differentiation	B2C	Yes	Processing/Distribution
Kosher	Private	No	Differentiation	B2C	Yes	Processing/Distribution
Cost-P.	Public	Minimal requests	Minimal requests	B2C	Yes	Production/Processing

3 THE MOST IMPLEMENTED STANDARDS

3.1 ISO 22000:2007

ISO 22000:2007 is a private standard set by the International Organization for Standardization (ISO). After success of ISO 9001, a standard for quality management system which has been successfully applied in more than 700,000 companies worldwide, there was a need for an international standard in food industry. The aim was to harmonize national and private standards and to include management system from ISO 9001. ISO 22000 (Food Safety Management System) was developed along with integration of Prerequisite Programs (PRP1) and principles of Hazard Analysis and Critical Control Point (HACCP) system. The first version was issued in September 2005 [7]. This standard is applicable to all organizations, regardless of their size, which are involved in any part of supply chain. The standard is intended for communication between business partners (B2B) and not intended for communication with final consumers so logo cannot be placed on the final product.

The standard contains the principles of quality management and HACCP system and it is used for development, maintenance and steady enhancement of food safety management system.

HACCP (Hazard Analysis and Critical Control Points) is a food safety system based on analysis and control of potential biological, microbiological, chemical and physical hazards the raw materials are exposed to, potential hazards during handling, production, distribution and consumption of final products. HACCP is adjusted to all types of food products and all types of food production and food handling.

3.2 Organic certificate

Intensive agricultural production present at global market today and increased use of fertilizers and pesticides have resulted in excessive pollution of agricultural land which covers a large proportion of our planet. Thus it was necessary to organize an alternative way of production which could provide sufficient supplies of healthy food whose production and demand would overcome current conventional way of production.

It is mandatory to use the land which has not been treated with chemical fertilizers for several years (three years and longer). It is necessary to:

- avoid a large number of chemical substances (e.g. fertilizers, pesticides, antibiotics, additives, rodenticides, and fungicides), genetically modified organisms, and water treatment agents,
- record detailed data on production and sale of organically made products,
- physically separate organic production from conventional production,
- regularly inspect and monitor production in the course of production process.

The country which has made the biggest enhancement and development of organic production is Denmark which achieves 25% of total agricultural production with BIO certificate. Our companies having Organic certificate are: Midi Organic, Zadrugar, Beli Stonovi, Sirogojno, Suncokret, Albox, Foodland, Fungo Jug, DMV, etc.

3.3 GLOBAL G.A.P.

Global G.A.P. is a standard primarily created to ensure the buyer that the food produced on a farm has a minimal detrimental effect on environment, that it is produced with reduced chemical inputs, and that responsible approach to welfare and safety of people and animals is provided. The standard does not refer directly to final consumers, but it represents the communication between business partners (B2B). Consequently, Global G.A.P. logo has a limited application and cannot be set on the final product. The standard does not cover the entire supply chain; it is focused on primary agricultural production instead.

Every agricultural manufacturer can apply for Global G.A.P. certification with the following two options:

Option 1: an individual manufacturer applies for the sertification and he/she is the holder of certificate, or

Option 2: a group of manufacturers applies for certification as a legal entity, and it becomes the holder of certificate.

The principles of Global G.A.P. are:

- limited and controlled application of all types of agrochemicals;
- hygienic treatment during production and manipulation of agricultural products;
- providing instructions and recording all activities with the provision of traceability;
- unique rules which allow for impartial verification (confirmation that everything is done properly);
- mutual communication and exchange of opinions between producers, traders and consumers;
- care for the environment protection and sustainable development;
- responsible treatment of employees working on the farm;
- care for the welfare of animals on the farm.

3.4 BRC - Global standard for food safety

The British Retail Consortium (BRC) standard is developed to help traders and brand owners to ensure food safety and food quality. Apart from this purpose, the standard is used by many companies as a pattern for evaluating suppliers and for evaluating production, too [4].

The standard offers suppliers an opportunity to satisfy criterions of various traders by a single certificate, which makes supplying expenses lower on the one hand, and makes traders reduce the expenses related to supplier control [4].

BRC standard is not intended for communication with final consumers; it is intended for communication with business partners (B2) instead. The standard refers to the part of supply chain which includes food processing, or to the part which includes preparation of primary products / raw materials for supplying catering firms, restaurants or processors.

3.5 International Featured Standard (IFS Food)

The BRC standard is used as a basis for this standard while the structure is taken from ISO 9001:2008. Unlike BRC which has a specific structure, IFS has the same structure of ISO 9001:2008: responsibility of the management, management system, resources management, production, control and enhancement. The only difference in the order can be found in the fifth chapter, i.e. the part on management responsibility precedes the part on quality management (food safety) which is usually the first part of ISO standards.

After that, in cooperation with French trade group, the standard for food quality and safety was created and named International Food Standard (IFS). It aimed at providing unique approach to evaluating suppliers in comparison to the food quality and safety system. The standard became internationally approved in 2005 when Italian trade group joined. The cooperation between these three groups resulted in the fifth version of the standard published in August 2007. Requirements of IFS standard cover the system of management, process control and hygiene.

Compliance with the standards for food safety and quality and EU regulations is a long and expensive process, so in some cases considerable investments by manufacturers and companies are needed in order to enhance production and/or process capacities. Since producers and processors are responsible for establishing their own system for food safety and quality control, they have to define appropriate strategy for standard implementation complied with their practice. In the process of defining the strategy for standard implementation, as well as the certification itself, there are some steps to be taken: definition of sale strategy, selection of voluntary standards, implementation, and certification.

4 CERTIFICATION COSTS

Certification costs depend on several factors: type of activity (production) being certified, scope of activities for standard adjustment, the number of employees, the number of locations to be visited in the course of certification, etc.

The costs of standard introduction are divided into: a) the costs of production adjustment to the standard (standard introduction), and b) the certification costs.

Manufacturers have two options to apply for Global G.A.P. certification. Option 1 implies that an individual manufacturer applies for Global G.A.P. certification. In this case the holder of certification is the manufacturer himself/herself. Global G.A.P. Option 1 (individual manufacturer) usually lasts for one consulting day on condition that

the crops have simultaneous period of ripening and picking. Otherwise, it is necessary to make several visits, which surely has influence on certification costs.

Table 3. *Annual certification costs for ISO, BRC and IFS standards*

	Small/medium-sized enterprise (1-100 employees)	Large enterprise (more than 100 employees)
ISO 22000	EUR 2,000-2,500 for the first certification and EUR 1,500-1,700 for certification renewal	EUR 3,000-3,500
BRC	EUR 1,750-2,500	about EUR 3,500
IFS	EUR 1,750-2,000	about EUR 3,500

Option 2 implies that a group of producers applies for Global G.A.P. certification. In this case a group of manufacturers, as a legal entity, is the holder of Global G.A.P. certificate.

Table 4. *Costs of registration*

Covered production		Uncovered production	
Size of land	Annual amount	Size of land	Annual amount
< 0.5 ha	5 EUR	< 0.5 ha	2 EUR
0.5 – 1 ha	10 EUR	0.5 – 2 ha	4 EUR
1 - 1.5 ha	15 EUR	2 - 5 ha	10 EUR
1.5 – 5 ha	30 EUR	5 – 15 ha	15 EUR
5 – 10 ha	50 EUR	15 – 100 ha	30 EUR
10 – 30 ha	80 EUR	100 – 1000 ha	70 EUR
30 – 100 ha	150 EUR	1000 – 5000 ha	150 EUR
100 – 500 ha	300 EUR	5000 – 10000 ha	300 EUR
> 500 ha	500 EUR	> 10000 ha	500 EUR

Table 5 presents a basis for calculating the certification costs which have to be paid by manufacturers to obtain Global G.A.P. certificate from the certification auditing body.

Table 5. *Certification costs for Global G.A.P. (without inspectors, travel expenses and VAT)*

Fixed costs of certification		300 - 400 EUR
Costs related to the land size	< 50 ha	450 – 550 EUR
	50 – 100 ha	700 – 750 EUR
	> 100 ha	950 – 1100 EUR
Covered crops		200 – 300 EUR
Costs for individual manufacturers in a group (Option 2)		40 – 60 EUR
Costs for individual manufacturers per audit (Option 2)		250 EUR
Manipulation on a farm		200 – 300 EUR

Calculation of annual certification costs, if the same daily wages are used by Certification body, would likely be as presented in Table 6.

Besides certification costs, the manufacturers have to pay the registration costs and standard implementation costs, too. These costs depend on requirements of the standard. The biggest investments during standard implementation are made for compliance with hygiene requirements.

If we take Global G.A.P. standard as an example, some of the largest costs are: costs of land and water analyses, tests of pesticide residue for each product, traceability on small farms, proper storage of chemicals, equipment/machines for spraying, calibration of equipment, water filters, protective clothes, toilets on lots, etc. If standards are ranked in terms of the cost of implementation and certification, starting from the most expensive to the cheapest one, the order would look like this: BRC, IFS, Global G.A.P. Option 2, ISO 22000, Global G.A.P. Option 1.

Table 6. *Annual costs of Global G.A.P. certification*

	Individual farmer (one visit)	Individual farmer (several visits)	A group of manufacturers (Option 2)
Global G. A. P.	1200 EUR	1500 EUR	2500 EUR

5 CONCLUSION

The paper shows fundamental information on voluntary standards which are usually required by trade chains, and on the process of defining the strategy for standard implementation and certification in compliance with agricultural and food production. Implementation and certification of standards on food safety and quality enable manufacturers and processors to better position themselves at the market, to provide greater competitiveness and productivity and thereby easier sale at international market.

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DESIGN AND MENAGMENT OF URBAN WASTEWATER TREATMENT PROCESSES

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Abstract: The role of process modeling and analyzing of wastewater treatment facility for treatment of wastewater from urban areas was studied. For this purpose wastewater treatment facility in "OHIS" Skopje was observed, originally designed for treatment of industrial wastewater from chemical industry. Respectively to this system, another is designed in process simulation software SuperPro Designer, where based on the constant and variable parameters several simulations were taken and optimal operating conditions of the wastewater treatment plant was defined. Analyzed system represents a bioseparation process composed of primary and secondary treatment observed as a continuous system with completely mixing and sludge recirculation stream. The system is tested for amount of inlet material from 100 to 400 m3/h and air consumption needed for aeration from 1.257 to 2.569 m3/h. System responses are obtained selecting the effluent in to the second and third category for wastewaters which are fulfilled the environmental standards of Republic of Macedonia. For optimal flow of 400 m3/h, the wastewater treatment plant reaches its maximum capacity of 27.428 people equivalent based on BOD and 27.611 people equivalent based on the hydraulic capacity. For the actual flow, plant capacity is set at 6.239 people equivalent based on BOD and 6.171 hydraulic people equivalent. Based on the sludge analysis, simulations are obtained for sludge treatment with incineration. From these simulations optimal conditions are obtained for heat recovery setting this process in group of green processes with zero emission.

Keywords: wastewater treatment, sludge treatment, process simulations, process modeling, SuperPro Designer

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1 INTRODUCTION

The global industrial development requires environmental technologies aimed to reduce environmental impact and increase efficiency. The problem of modeling environmental processes becomes a big challenge. Today, process simulators are big engines which can be used in each phase of the development of the project, and together with including of the engineer intuition we can get the right solution for one process. During process development, process simulation software is used to perform material and energy balances, estimate the size of equipment, calculate demand for utilities as a function of time, asses the environmental impact, etc [1]. The purpose of this study was to develop a simulated process scheme that will follow up the simulated process scheme for remodeling of the wastewater treatment plant “AD OHIS” in Skopje for treatment of wastewater from combined sources.

Process adjustments are commonly required when a new process is moved into an existing facility whose equipment is not ideally sized for the new process. The simulation model is used to adjust batch sizes, figure out cycling of certain steps and estimate recipe cycle times. In most cases, waste water treatment plants are operated without optimization [2]. It is normally considered that optimization is unnecessary as the system is already designed to meet our requirements. Design always has some operating margin for taking care of performance degradation [3]. Further, waste water treatment plant design is based on the results obtained for a set of samples collected for short-time duration. The quality of waste water being treated may be significantly different from the design, and it is always essential that any wastewater treatment facility is optimized after successful commissioning of the plant. This ensures that all the machines do perform well so that the treated water quality is to the expected level. [4]

2 DESCRIPTION OF THE PROCESS

The main aim of the development of this problem is to make environmental processes analysis transparent and easy for modeling. We are focused on the process of wastewater treatment in an already existing wastewater treatment plant in city of Skopje with already defined equipment dimensions (Figure 1).

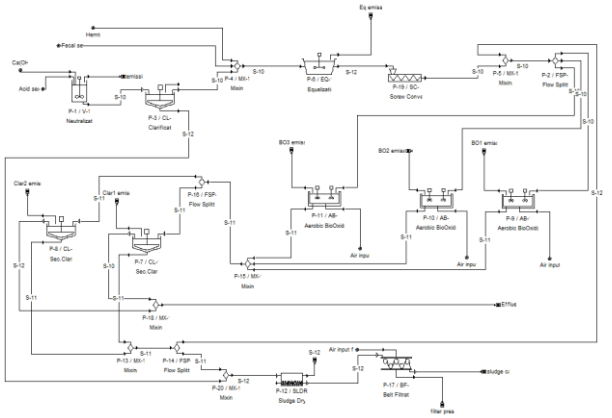

Figure 1. *Process in SuperPro Designer for scheme for described wastewater treatment plant*

Figure 1, for instance, displays the wastewater treatment plant in Skopje, described as follows. The flow sheet is developed by putting together the required unit procedures, and joining them with material flow streams. This continuous process starts with feeding from two feed streams, which represent acid sewer with industrial wastewater and fecal sewer with fecal wastewater from the near town.

This wastewater treatment plant was projected for industrial wastewater from the industrial complex, and fecal wastewater from the near town. After increasing the number of inhabitants and significant changes in the wastewater quality and quantity, this simulation study presents the step forward in optimization of the wastewater treatment plant. After neutralization with CaO, the wastewater from acid sewer with 5 m3/h water flow continues in the equalization tank (P-6/EQ-101) where it is mixed together with the fecal wastewater with quantity of 105 m3/h. After equalization procedure, the wastewater is transported to three parallel bioreactors with dimensions of 1013 m3 each (P-9, 10, 11/ AB- 101, 102, 103) where the process of aerobic bio oxidation takes place and operates under constant air flow inside the reactors. This process is characterized with sludge flow of 3.7 m3/h, generated by the treated wastewater. Sludge has content of 4% solids and 96% water. Detailed sludge non-volatile content is showed below in Table 1, and Table 2.

Table 1. *Sludge non- volatile content percent*

Sludge non-volatile content (%)					
Al	Ca	Fe	K	Mg	Na
0,15	27,5	2,4	0,02	0,27	0,08

Table 2. *Sludge non- volatile content mass concentration*

Sludge non-volatile content (mg/kg)											
As	Ba	Cd	Cr	Cu	Li	Mn	Ni	P	Pb	V	Zn
<10	120	<1	32	103	1	90	22	775	57	7	232

3 RESULTS AND DISCUSSION

In this environmental process, the key parameters that are important to manipulate in SuperPro Designer for accruing optimal operating results are sludge residence time, air stripped, sludge recirculation percentage, and wastewater quality and quantity. Process simulation tools enable users to readily experiment with options that have the potential of increasing the efficiency and reducing the resources. The base case process already operates at its maximum efficiency (imposed by the bioreactors). Consequently, the only option to increase efficiency is by reducing the air stripped inside the bioreactors, which influences the biological reactions rate, and decreasing the energy consumption for the blowing pumps as biggest energy consumers. The simulations are done on constant wastewater flow based on the real system, and variable air flow calculated on wastewater flow base (m3Air per m3Liq/min)(Table 3).

Table 3. *Simulation results after air requirement manipulations*

Inflow (m^3/h)	COD effluent (mg O/L)	SRT (days)	Air req. (m3/h)	Work. volume
100	50	11.6	1257	90%
100	**20**	**7.5**	**2619**	**90%**
100	33	5	5035	90%
100	25	2.4	10071	90%

For the standard stabilized sludge feed obtained from the wastewater treatment plant at "AD OHIS" Skopje, process simulator was operated in calculated mode, and optimal size of heat exchangers was calculated, and the optimal amount of cold water as well, Table 4. Further, for constant heat exchanging area and constant size of equipment, optimal amount of cold water, optimal heat exchange area, and maximum stabilized sludge feed was achieved.

Table 4. *Heat exchangers main parameters, simulated values*

	Sludge flow 188 kg/h
Heat exchanging area	11,805 m^2
Quantity of cold water supplied; temperature	1 m^3/h; 20ºC
Quantity of heated water; temperature	1m^3/h ; 182 ºC
Utilization of flue gas heat	61%
Flue gas quantity; temperature	0,429 m^3/h; 1000 ºC
Heat transfer coeficient (specified for incineration flue gas)	100 Watt/m^2K

After these results, we can conclude that with increase of the air quantity the wastewater is treated well and fast, which leads to low utilization of the plant, while low quantity of air flow leads to decreasing of effluent quality. Depending on the plant purpose, we can choose the optimum solution (Figure 2).

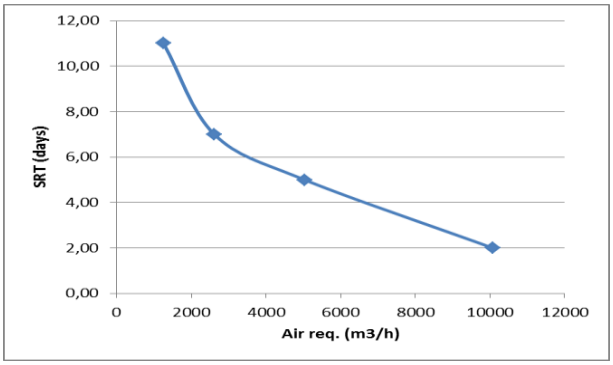

Figure 2. *Air requirment/ Sludge residence time dependency graph*

After these results, we can conclude that with increase of the air quantity the wastewater is treated well and fast, which leads to low utilization of the plant, while low

quantity of air flow leads to decreasing of effluent quality. Depending on the plant purpose, we can choose the optimum solution. In the next simulation we can discover for which wasterwater flow with constant quality, and constant air flow the plant operates in its optimum (Figure 3).

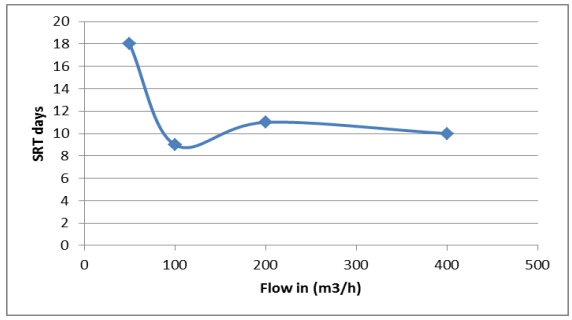

Figure 3. *Inlet flow/ Sludge residence time dependency graph*

From the Figure 4, and Figure 5 showed below, for optimal heat exchange area for serial connection of heat exchangers can be considered 121 m2 and 3500 kg/h supply of cold-water and for parallel connection of the heat exchangers optimal heat exchanging area can be considered 137 m2 and cold-water supply of 3700 kg/h. In this case exit temperature of the flue gas after the heat exchangers is 120 ^{0}C, comparing with the serial exchangers where exit temperature of gas is 170 ^{0}C. In the following Table 4 is described the material balances of the waste streams.

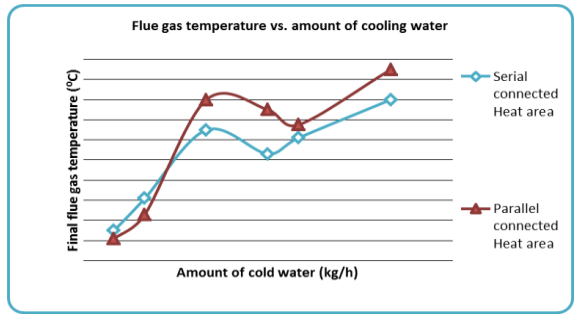

Figure 4. *Optimal amount of cold water and optimal heat exchange area*

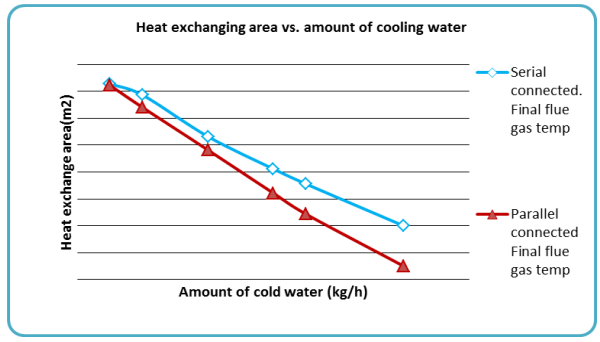

Figure 5. *Optimal amount of cold water and optimal heat exchange area*

4 CONCLUSION

Process simulation software can play an important role during process development, and can significantly make the progress faster. From the simulations done we can conclude that the wastewater treatment plant reaches optimum results operating in the flow range of 100- 400 m3/h. Manipulating with the air flow needed for the aerobic bioreactors, we set the optimum air requirement from 1257 to 2569 (m3/h). In this range the sludge residence time is in the range of low to normal utilized wastewater treatment plants, and the effluent water quality is in the range of second or third category for wastewaters, which meet the ecology standards in Republic of Macedonia. From the simulations done we have obtained an optimal exchanging area for the cooling of the flue gas and obtaining a clean energy with minimizing energy loses. At the end we have simulated one green energy process which can be further optimized for the future needs. Optimum heat exchange area is obtained for the lower value at the lower amount of cold water that need to be used for cooling of the streams, and optimum value for the cold water is obtained at a value for amount that will exchange more heat.

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QUALITY DEVELOPMENT ACTIVITIES IN FOOD LABORATORIES AND THEIR CONTRIBUTION TO FOOD SAFETY

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Abstract: At all stages from food production to consumption, food analysis laboratories provide testing and analysisservices and play an important role in determining food quality and safety. For the food laboratories to respond to the needs of the food industry; they should be equipped with equipment suitable to the technological conditions, renew the test methods, develop the standard working procedures, direct the resources correctly, give accurate and timely results, strengthen the subordinate structures, should be supported by developed manpower and develop future oriented quality improvement strategies in accordance with the international standards.In order to ensure and maintain food safety; the application of food safety and quality programs, the use of an effective control mechanism, and the contribution of all units involved in the food chain are important. It is determined and approved by laboratories that the production is made according to the appropriate quality standard, as required by the marketing of the food. By examining the accurate and reliable results from the analyzes applied to food, it is possible to determine from where the faults are derived, hazards can be minimized and the food losses can be reduced. In addition, the ability of laboratories to provide accurate and reliable results as a result of quality improvement activities, will increase the chance of enterprises receiving service from these laboratories, to compete with other enterprises at the same level.

Key words: Food laboratory, food safety, quality activities

1 INTRODUCTION

In general, industry all over the world is looking for a better solution for work needs to be done in today's global economy [1]**.** As citizens of the modern world and consumers in a comfortable society, we expect the highest quality standards in all areas of our lives [2]. As a result of the rapid developments in food industry and food trade today, new techniques are being developed for the production of foodstuffs. Therefore, there are increases in product formulation and variety. Safe production of foodstuffs in a high quality and not harmful to consumer health and enforcement of the current legislation for this purpose is possible only if large scale laboratory work is carried out effectively [3]. In order to make the vitality of the economy permanent, it is necessary to use the means of production more intensely and to organize it in a way appropriate to

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the new world structure[4]. Conceptually food safety is the elimination or reduction of hazards and risks that are likely to be formed or are likely to occur in food, in other words to ensure consumer health [5]. Food safety refers to all those hazards, whether chronic or acute, that may make food injurious to the health of the consumer. It is not negotiable. Quality includes all other attributes that influence a product's value to the consumer. Food control is defined as: ….a mandatory regulatory activity of enforcement by national or local authorities to provide consumer protection and ensure that all foods during production, handling, storage, processing, and distribution are safe, wholesome and fit for human consumption; conform to safety and quality requirements; and are honestly and accurately labelled as prescribed by law. The foremost responsibility of food control is to enforce the food law(s) protecting the consumer against unsafe, impure and fraudulently presented food by prohibiting the sale of food not of the nature, substance or quality demanded by the purchaser [6]**.**

Food analysis laboratories have been established to carry out hygiene and quality control of raw and auxiliary materials used in the production of foodstuffs, semi-finished and finished foodstuffs, food additives, and packaging materials that contact with foodstuffs.Laboratory tests are an important process based on scientific analysis to identify problems with food products. The aim of quality control is to determine the contaminants in the raw material or contamination after a product is produced and before it is released to the market. In addition, laboratory tests are important for the search and development of new products, including components or selection of components, food processing design, shelf life studies, and sensory evaluation of products. Another benefit of laboratory testing is compliance with regulations for the importation of food products into different countries as well as exportation. Food regulations are designed to protect public health and the safety of consumers [7]. The results of the scientific research are believed to be objective "real" through advanced knowledge and reliable testing methods. Regulatory science is not different in this context.Abuse and carelessness in research significantly affect human health and the environment [8]. It is important to apply quality assurance systems in addition to using only the right science in scientific research [9]. In the testing laboratory, quality is interpreted as compliance with specifications. Therefore, quality means that the laboratory results meet the customer's expectations and are accurate and defensible. To ensure that the final laboratory results are correct, the QA program incorporates those planned and systematic laboratory activities that guarantee the accuracy and defensibility of testing results. Besides thorough documentation of all procedures and processes, the laboratory also needs to choose the correct methods for testing and establish protocols to detect errors and initiate corrective actions. Validated methods are at the technical core of laboratory testing. To determine whether methods are fit for their intended purpose, the selected methods must have established accuracy, precision, calibration and limits of detection and quantification [10]. An effective national food control system takes into account current situations and develops a national food control strategy to enable the country develop an integrated, coherent, dynamic and effective control. Situations differ from country to country therefore the programmes to achieve the objectives of the food control strategy are country specific. Important components of a food control system include: policy and institutional frameworks; food legislation and regulations; food inspection and monitoring; laboratory services and dissemination of information to all stakeholders [11]**.** Food laboratories provide substantial support to the food industry,because it is in relation to producers or organizations, it serves the industry at every stage of sector. Laboratory tests provide the basis for food safety and support public health and international economy. Consumers attach importance to information that companies place on food packages when choosing reliable food and making informed purchasing decisions. The

food industry must have traceability in businesses to provide safe food and accurate nutrition information to consumers. It is safe, public health and food trade is at risk without a healthy food supply. Labs managed not well, insufficient staff, fake reports, incomplete data, results approved by unauthorized persons, non-calibration devices and inadequate archives are problems encountered occasionally. Effective control and auditing is one of the most important steps in ensuring food safety. Poor records, disorganized reports, a lack of understanding of recording and reporting techniques may turn a customer away. Conversely, performing testing in a safe and accurate manner through validation and ongoing best practices and techniques can result in a higher level of confidence that the programs employed by the manufacturer will produce high quality and safe products.In this article, during the application of laboratory activities in food laboratories quality improvement activities and contribution to food safety will be emphasized.

2.1 Good Laboratory Practices

Good Laboratory Practice (GLP) is concerned with the processes and conditions under which the organization, laboratory work is conducted. Laboratory activities are planned, conducted, monitored, recorded and reported. GLP data is prepared to improve the quality and validity of the test data [12]. We can define good laboratory practices as a quality system for planning, conducting, monitoring, archiving and reporting health and environmental safety studies rather than clinical trials [13]. The main goal of GLP is to aid the laboratories to ensure the reliability, reproducibility, controllability of analytical results and the international recognition of the laboratory [14]. Today, the GLP is strict standards for government registration and regulatory research facilities. [15, 16]. GLP defines a set of quality standards for study conduct, data collection, and results reporting [17].

2.2 Accreditation in Laboratories

Laboratories; should provide reliable, accurate and on time results-oriented service in accordance with today's technological conditions.Quality studies are a requirement for Laboratory and Calibration laboratories and TS EN ISO / IEC 17025 "General Requirements for Qualification of Laboratory and Calibration Laboratories" Standard means competence in this field.Laboratories that will be accredited according to the standard; fulfillment of management, organization, settlement and technical requirements is a necessity [18]. Accreditation is the main condition for ensuring the reliability of measurements made in an experimental laboratory.Accreditation ensures that technical barriers are removed in commerce by ensuring that internationally recognized measurement results are obtained [19]. Acceptance of test and calibration results between countries is only possible if the laboratories comply with this standard and are accredited by the accrediting bodies, who make mutual recognition agreements with equivalent institutions in other countries by using this standard. Use of this standard will lead to co-operation between laboratories and other organizations, and will assist in the mutual exchange of knowledge and experience, and the harmonization of standards and procedures [20]. Accreditation was initially a voluntary quality infrastructure, but as a commercial strategy it became a competitive factor over time, and it has also been made mandatory in some areas by legal regulations [21]. The main aim of all the standards used in the accreditation of conformity assessment bodies is to increase the reliability of the documents and reports issued and to facilitate trade by facilitating international acceptance and avoiding multiple applications [22]. Accreditation is a quality infrastructure established to support the reliability and validity of the work carried out by conformity assessment bodies and the conformity confirmation documents they have formed as a result of these studies (test and inspection reports, calibration certificates, management system documentation, product documentation, personnel documentation etc.) [19]. In the future, laboratory accreditation in food testing will be the trend for both regulatory agencies and industry, given that accreditation is a good practice to gain consumer confidence and increasing international trade has expanded food safety into a global business. Such movements will continue to drive the market for high-quality lab testing. Eventually, the maturity of the laboratory quality system in the food industry will depend upon market, trade and regulatory needs [10].

2.3 Quality Standards in Laboratories

It is possible for businesses to clearly see and control the costs they have to bear to ensure high quality by measuring quality costs. This gives great opportunities to

businesses, it will also make them strong in their sector [23]. Scope of analysis in accordance with quality system, determination of conditions of personnel and device/equipment, conditions of laboratories, determination of responsibilities, calculation of costs, drawing of road map, creation of system structure, management and technical requirements, control of quality indicators, accreditation application and approval are vital quality findingsdetermined by experiences [24]. It is important to balance the tools used to achieve quality and safety objectives and to understand how systems contribute to the overall quality of the product [25]. While security is not seen as a totally independent direction in quality, the relationship between quality and safety is complex. The complexity of both concepts necessitates the need to manage them separately. In fact, the reason for distinguishing food safety from the quality is the need to place the concept of safety above all other quality elements[26]. System and standard requirements are fulfilled by establishing the infrastructure in accordance with standards, ensuring the necessary support of the management, making the quality documentation, implementing the system, quality control studies for the scope of the work, auditing the system, solving determined problems and overall evaluation of the system [27, 28]. A food analysis laboratory should use appropriate methods and procedures for all experiments within the context.These methods or procedures should include measurement uncertainty calculations as well as statistical techniques used for sampling, transport, storage, preparation of materials to be tested, and analysis of test data.

The laboratory may use test methods present in international, regional or national standards, as well as methods developed by laboratories on condition that they are validated [29]. Successful implementation of food quality and safety management systems is a necessity today [26]. Standards provide consistency in terms of safety and quality measures for laboratory applications, and recommend improvement strategies, present available and best practice.

3 CONCLUSION

It is known that the quality management system, which is made actual in the food industry, is a tool that ensures continuity and growth in trade. Permanent reliable food production is part of a quality.It is possible to prove that the intended use of the food is appropriate and safe with analyzes to be made.The food sector is constantly being renewed and changing, and new food products are introduced every year. Since this change has also altered the food analysis and testing methods in parallel, food laboratories must adapt to be able to respond to the needs of the industry. As a result of quality development activities in food laboratories; adequacy proven methods with international validity and updated according to current conditions must be used. The desired service can be provided by working with calibrated devices and systems that give fast, reliable and precise results. By putting into practice quality control programs, they should contribute to the training of personnel in order to improve performance in the service. Analytical procedures should be started as soon as possible effective service is ensured by giving accurate and reliable results in laboratories by providing sample and safety of report. Food companies will go to the measures to decrease the error shares in the direction of the test and analysis results applied to their products. Reports that show the status of the laboratory products will contribute to increase the competitiveness of the companies in terms of increasing the prestige and reliability and to develop reliable new products.

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ENVIRONMETAL IMPACT OF SOLAR SYSTEMS – CASE OF SERBIAN RESIDENTIAL BUILDING WITH SOLAR COLLECTORS AND PV PANELS

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Abstract: In the recent years, solar energy became the most common renewable energy source, because of its abundance and small pollution of environmental. In this paper, it is analyzed the environmental impact of installed solar system at Serbian residential building. The building has gas space heating or electric space heating and PV panels and solar collectors installed on the roof. Installed solar systems emit a certain amount of carbon dioxide in the atmosphere when generating electricity and heat. The investigations in this paper were carried out with the aim of determining the optimal size of solar systems, in which the minimum consumption of primary energy is realized. The residential buildings with variable types of PV panels are investigated. For optimal size of solar systems, emissions of carbon dioxide and emission payback-time (EPBT) are calculated. The buildings are simulated in EnergyPlus environment. Open Studio plug-in in Google SketchUp was used for buildings design, Hooke-Jeeves algorithm for optimization and GENOPT software for software execution control.

Key words: Building; Solar systems; carbon dioxide emission; emission payback-time.

1 INTRODUCTION

The rapid population growth on Earth causes a steady increase of energy needs. Therefore, humanity is in constant researching of new energy sources that would cover the growing energy needs. The world currently covered their energy needs with conventional energy sources, mainly fossil - nonrenewable energy sources, which have a large number of negative impacts, especially on the environment. The currently available way to reduce the levels of use of fossil fuels and thus reduce their harmful effects (greenhouse effect, climate change, the phenomenon of acid rain, global warming, etc.), is the development of new technologies using renewable energy sources. However, at present there is no completely ecologically clean way of using energy, so the use of the renewable energy sources, in addition to a series of benefits and

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advantages, has some negative impacts on the environment, though considerably less and in a milder form.

Solar energy is the most capable of the alternative energy sources and it is considered an attractive source of renewable energy that can be used for electricity generation and domestic water heating in residential buildings. Photovoltaic (PV) technology is an attractive option for clean and renewable electricity generation because it represents the direct conversion of solar radiation into electricity. Solar water heating systems are the cheapest and most easily affordable clean energy available to homeowners that may provide most of hot water required by a family. Using photovoltaics and solar collectors together, represent a great opportunity for reducing the consumption of primary energy in residential buildings [1].

This paper reports investigations of the environmental impact of solar systems (PV panels and solar collectors) installed on the building roof. The major aim of investigation was determining the optimal size of solar systems, in which the minimum consumption of primary energy is realized. The residential buildings with electric and gas space heating are analyzed, with variable PV cell efficiency. The investigated building is located in Kragujevac, Serbia. Generated heat energy is used for domestic hot water heating. Electricity generated by the PV may be used for space heating, cooling, lighting, and electric equipment.

The buildings are simulated in EnergyPlus environment. Open Studio plug-in in Google SketchUp was used for buildings design, Hooke-Jeeves algorithm for optimization and GENOPT software for software execution control.

2 SIMULATION SOFTWARES AND WEATHER CONDITIONS

2.1 Simulation softwares

EnergyPlus software simulates the energy use in a building and energy behavior of the building for defined period. In this study, the version 8.1.0 was used. EnergyPlus is made available by the Lawrence Berkley Laboratory in USA [2].

Open Studio plug-in in Google SketchUp software is a free 3D software tool that combines a tool-set with an intelligent drawing system [3]. The OpenStudio is free plug-in that adds the building energy simulation capabilities of EnergyPlus to the 3D SketchUp environment.

GenOpt is an optimization program for the minimization of cost function evaluated by an external simulation program. It can be coupled to any simulation program that reads its input from text files and writes its output to text files. It has a library with adaptive Hooke-Jeeves algorithm [4].

Hooke–Jeeves optimization algorithm is used for the optimization, and it is direct search and derivative free optimization algorithm [5]. In this algorithm, only the objective functions and the constraint values are used to guide the search strategy. The main advantage of this algorithm is reducing the compute time.

2.2 Weather conditions

The investigated residential building was located in the city of Kragujevac, Republic of Serbia. Its latitude is $44^0$10 N and longitude $20^0$55 E. In the city of Kragujevac summers are very warm and humid, with temperatures as high as 37^0C. The winters are cool, and snowy, with temperatures as low as -12 ^{0}C. The EnergyPlus uses weather data from its own database file.

3 MODEL OF THE ANALYZED SERBIAN BUILDING

The modeled residential building is shown in Figure 1. The building has the south-oriented roof with PV array and solar collectors installed on the roof. The building has two floors and 6 conditioned zones. The total floor area of the building is 160 m^2 and total roof area 80.6 m^2. The windows are double glazed. The concrete building envelope, roof, and the floor were thermally insulated by polystyrene. In this investigation, the polystyrene thickness was 0.15m [1].

Electricity is consumed for heating (case with electric space heating), lighting, domestic hot water (DHW) and appliances. In the case of gas heating, the main part of electricity was consumed by appliances.

The PV system consisted of the PV array and an inverter. It was an on-grid system. The life cycle of PV array was set to 20 years, and the embodied energy of PV panels to 3.75 GJ/m^2 [6, 7] and embodied CO_2 emission of PV array was 40 g/kWh of generated electric energy [8]. It is analyzed the PV array with variable cell efficiency. The first case is the PV array with 12 % of cell efficiency, the second case is the PV array with 14 % and the third case is PV array with 16 % of cell efficiency.

The life cycle of solar collectors is also set to 20 years, the embodied energy of solar collectors is set to 1.85 GJ/m^2 [11], and the embodied CO_2 emission of flat plate solar collectors was 300 kg/ m^2 of solar collector area [8].

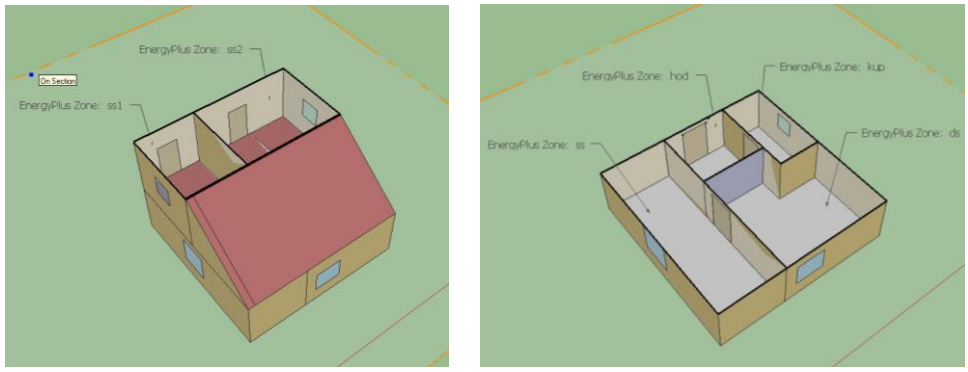

Figure 1. *Analyzed building with intersections*

4 ENVIRONMENTAL IMPACTS OF SOLAR SYSTEMS

When we talk about environmental analysis and adverse impacts on the environment, all analyzes are primarily related to carbon dioxide emissions. Carbon dioxide is a gas that is very low in the earth's atmosphere (0.037 %), but in addition to methane, nitrogen dioxide and other harmful gases, it is most commonly found in the structure of greenhouse gases as much as 83 %. About 98 % of CO_2 emissions come from combustion of fossil fuels, while the rest is emitted by combustion of waste, cement and lime production, in various technological processes, etc.

Installed solar systems discussed in this paper emit a certain amount of carbon dioxide in the atmosphere when generating electricity and heat. Regardless of the fact that they are systems that have minimal harmful effects on the environment, their carbon dioxide emissions are calculated according to the following equation:

$$S_{CO_2} = S_{CO_2,PV} + S_{CO_2,KOL} \quad (1)$$

where:

S_{CO_2} – CO_2 emission (kg/GJ annualy);

$S_{CO_2,PV}$ – CO_2 emission from PV array (kg/GJ annualy);

$S_{CO_2,KOL}$ – CO_2 emission from solar collectors (kg/GJ annualy).

Carbon dioxide emitted from the PV array, according to [9], is 50 g of CO_2/kWh of generated electricity, and carbon dioxide emission from solar collectors amount to 72 g CO_2/kWh of generated heat [10].

Total carbon dioxide emission is the sum of the carbon dioxide emission of installed solar systems and the incorporated (embodied) carbon dioxide emissions emitted from the production of analyzed solar systems. The total carbon dioxide emissions are calculated according to the form

$$S_{TOT,CO_2} = S_{CO_2} + S_{CO_2,PV,emb} + S_{CO_2,KOL,emb} \quad (2)$$

where:

$S_{CO_2,PV,emb}$ – embodied CO_2 emission from PV array (kg/GJ annualy);

$S_{CO_2,KOL,emb}$ – embodied CO_2 emission from solar collectors (kg/GJ annualy).

Embodied carbon dioxide emissions from photovoltaic array and solar collectors are given in [8].

An important parameter which shows the effect of solar systems on the environment, is their emission payback time – EMPB.

Emission payback time is defined as the time during which the emission is avoided due to the use of solar systems and is equal to the ratio of emissions generated during the production and use of the installed solar systems (PV array and solar collectors).

5 RESULTS AND DISCUSION

In this paper it is analyzed the influence of solar systems on the environment, through energy optimization of yearly building energy consumption. This optimization had the major goal to determine the optimal size of PV array and solar collectors, which will yield the minimal primary energy consumption of the building. In this calculations, the embodied energy of solar systems and building insulation was taken into account. In the reference case, the photovoltaics cell efficiency was 12%.

Figure 2 shows the consumption of final and primary energy for a reference building with two heating systems - electrical and gas space heating.

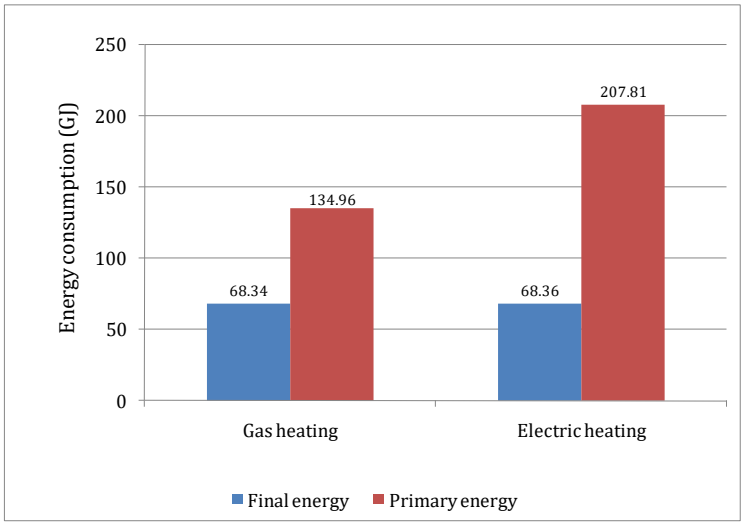

Figure 2. *Final and primary energy consumption in building with different heating systems*

Primary energy consumption is less for the building with gas heating system, because of great value of primary conversion multiplier for electricity (3.04), compared to the primary conversion multiplier for gas.

According to the energy optimization, building with electrical space heating has optimal ratio of PV array on the roof of 91.25 %, which means PV array area of 73.6m^2 and solar collector area of 7 m^2. Building with gas heating system has optimal ratio of PV array on the roof of 91.88 %, which means PV array area of 74.1m^2 and solar collector area of 6.5 m^2. These data means that in the case of building with electric heating, the annual carbon dioxide emission of solar systems is 11.86 kg CO_2/m^2 of solar installation, while in the case of a gas heating building, the annual emissions of carbon dioxide of solar systems is 11.57 kg CO_2/m^2 of solar installations. Total amount of CO_2 emissions of solar systems for a building with electric heating is 44.6 kg CO_2/m^2 of solar installation, and for the building with gas heating, total CO_2 emissions amount is 42.5 kg CO_2/m^2 of solar installation. The graphical representation of the results is given in Figure 3.

The parameter that shows the influence of solar systems on the environment is the emission payback time (EPBT). For analyzed buildings with electric heating system, the emission payback time is 2.8 years, and for the building with gas heating system, the emission payback time is slightly less - 2.7 years.

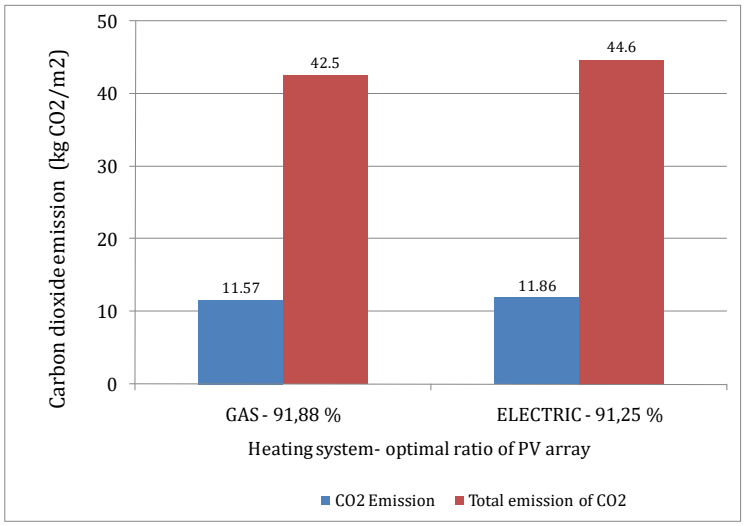

Figure 3. *Emission and total emission of CO_2 for energy optimized building with different heating systems and 12 % of PV cell efficiency*

With the PV cell efficiency of 14 % and 16 %, in all buildings, regardless of the heating system, optimal ratio of PV array on the roof is 92.5 % (PV array area of 74.6 m^2, and solar collectors area of 6 m^2) and 93.13 % (PV array area of 75.1 m^2, and solar collectors area of 5.5 m^2), respectively.

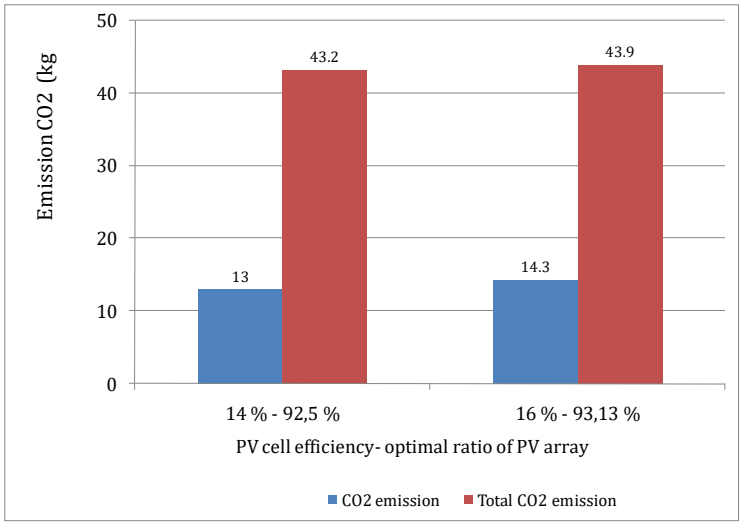

Figure 4. *Emission and total emission of CO_2 for energy optimized building with different heating systems and different PV cell efficiency (14 % and 16 %)*

In the case of PV cell efficiency of 14 %, the annual carbon dioxide emission of solar systems is 13 kg CO_2/m^2 of solar installation, while the total amount of CO_2 emissions of solar systems is 43.2 kg CO_2/m^2 of solar installation.

In the case of PV cell efficiency of 16 %, the annual carbon dioxide emission of solar systems is 14.3 kg CO_2/m^2 of solar installation, while the total amount of CO_2 emissions of solar systems is 43.9 kg CO_2/m^2 of solar installation (Figure 4).

Emission payback time for analyzed buildings with 14 % PV cell efficiency, regardless of the heating system, is 2.3 years. For 16 % PV cell efficiency, the emission payback time is 2.1 years, also regardless of the heating system. With the increase of PV cell efficiency, the emission payback time decreasing due to the increase in the amount of generated electricity.

6 CONCLUSION

The major aim of this investigation was analyzing environmental impact of solar systems (PV panels and solar collectors) through energy optimization on serbian building. With energy optimization, the optimal size of solar systems is determined, and after that, the carbon dioxide emission and total CO_2 emission is calculated. Investigated buildings has gas space heating and electric space heating.

Primary energy consumption is significantly less for the building with gas heating system.

With the increase of PV cell efficiency, the emission payback time decreasing due to the increase in the amount of generated electricity.

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NOMENCLATURE

S carbon dioxide emission, kg/GJ

EMPB emission payback time, -

Subscripts and superscripts

CO_2 carbon dioxide
emb embodied
KOLL solar collector
PV photovoltaic (PV)
TOT total

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ELV RECYCLING INFLUENCE MODEL ON SUSTAINABLE DEVELOPMENT

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Abstract: Vast amount of materials used by the automotive industry may lead toward environmental degradation. Thus ELV recycling management is of great importance in sustainable development. The increase in the recyclability rate, preservation of raw materials and energy resources, environmental protection and reuse of spare parts are also significant factors of sustainable development. This paper presents an influence model of ELV recycling equipment, and entities in ELV waste management in the Republic of Serbia. Also, short recapitulation on the sustainable ELV recycling and quality of life is introduced, defined by the economy, society, science, technology and ecology.

Key words: Development, ELV, Recycling, Sustainability

1 INTRODUCTION

The waste generated by end-of-life vehicles (ELV) is a growing concern; the global car production has increased by 37% from 2000 to 2013 [1] and this trend is projected to continue. It is estimated that more than 2 billion vehicles will be in use worldwide by 2050 [2].

In the process of sustainable development automotive recycling and thus generated resources become a significant factor. EU Directives oriented toward ELV recycling through processes of reuse of used parts and the recycling of materials present sustainable activities to be introduced in Serbia in next years. Quality approach requires quality and sustainable market. [3].

The problem of sustainable development management is getting more attention than ever in past decades. There are numbers and different engineering, business,

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environmental and social factors which impact to sustainable development and presented in [4]. It can be said that production and consumption of products, primarily, end-of-life vehicles (ELV) have the highest influence on the sustainable development in developed countries as well as in developing countries. ELVs are hi-tech products composed of different recyclable materials and used in numbers of industries as automobile industry, information technology industry, steel industry [5-6].

Recycling ELV and reuse of ELV parts, and metal recovery can lead to reducing the consumption of natural resources, reducing waste and increasing environmental protection and at the same time increasing effectiveness of many industries.

2 ELV RECYCLING IN THE FUNCTION OF SUSTAINABILITY AND QUALITY OF LIFE

Quality of life has become the ultimate success formula functioning of the institutions of the state and all social substructure. [7].

Quality of life can be measured through various economic and noneconomic parameters. Which leads that the approach to the concept quality of life depends not only on indicators of materials life standard but also on the variety subjective and objective factors which affect on quality of life [8].

Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life. The strategy for sustainable development aims to promote harmony among human brings and between humanity and nature. The satisfaction of human needs and aspirations in the major objective of development. [9].

ELV recycling presents essential contribution to the reduction of several different influences on the environment. Besides this aspect, the effective usage of existing resources contained in ELV and raw materials as recycling outputs reduce the rate and velocity of natural resources exploitation. Through latter process various material are obtained and part of energy is recovered, also the amount of waste materials for landfill is significantly reduced. This may contribute to the reduction of landfill places, soil recultivation and negative influences of landfill to soil. [10].

3 INFLUENCE OF THE ELV RECYCLING ON THE SUSTAINABLE DEVELOPMENT

Research in the project of technological development is defined by the model of integrated and sustainable recycling of motor vehicles at the end of the life cycle in Serbia, which are set basis for the development of new industries, thus creating real conditions for intensive employment in the business of recycling. These activities include collection and transportation of waste motor vehicles, dismantling them, selection of components and materials, recovery of components for reuse, crushing shells and chassis, the separation of materials, recycling materials, disposal of final waste. [11].

The ELV recycling influences the sustainable development in several manners, of which the most significant ones are:

- Application of regional sustainability model,
- Application of ISO 9004:2008 standard for the sustainabilitiy of the process,
- Application of balanced success cards,
- Application of LCA method,
- Application of simulation models.

The sustainable development is based on the modes that satisfies socio-

economic norms and interests of citizens in a quality manner and simultaneously eliminates or reduces significantly influences that present threats or negative influences on the environment and natural resources. [12].

4 MODEL OF ELV RECYCLING EQUIPMENT INFLUENCE ON THE ENVIRONMENT

ELV recycling equipment may influence on the environment in three manners:

Using material and energy for the production of components and equipment in generas, Using resources during life cycle and by recycling of ELV components (Figure 1).

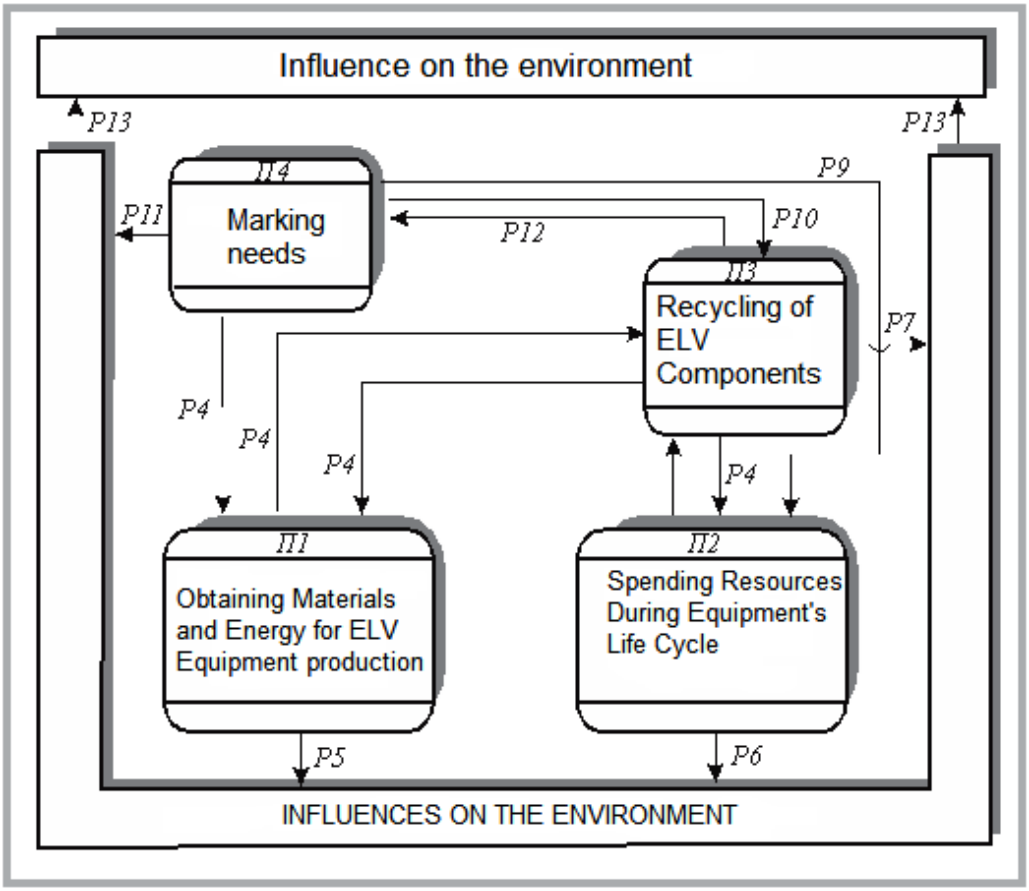

Figure 1. Basic model of influence on the environment

The first process (П1) treats production processes of materials and energy for the production of ELV recycling equipment. In the relation P5, the amounts of material and energy for the production of recycling equipment obtained through marking needs through relation P8. This process (П1) is connected to the relation P1 with the process П3 that relates the connection of the recycling equipment and characteristics of ELV components for recycling. The return relation P2 relates the correlation of type and amount of materials, depending on the recycling capacities and type of material in ELV components.

The second process (П2) treats the spending of resources during the life cycle of the ELV recycling equipment. This process П2 is connected to the process П3 by the relation P3 that relates the intensity of the equipment usage as well as to the usage of other resources during the life cycle of the recycling equipment. The return relation P4 relates the intensity of the recycling of ELV components. Besides the latter, there is the relation P9 which defines spending resources during the life cycle of the recycling device. The relation P6 defines the influence on the environment.

The third process П3 relates the recycling of ELV components based on the marking needs (relation P10). Connections of this process to other processes are already described. Relation P7 presents the influence of this process to the environment and relations P12 regulates needs based on the conditions in the ELV recycling components.

The fourth process (П4) is marking recycling needs, that is realized through the needs of society and other stakeholders (manufacturers, investors, importers, market of materials and parts, etc.). In this process resources are also used, that influence the environment (Relation P11).

In the next step, based on the resources spending the influences on the environment are determined, and thus their influence to the environment. Description in details is presented in the next chapter. [13].

4.1 Levels of ELV recycling entities in the Republic of Serbia

Waste management process, in Serbia faces a period of rapid and radical changes. Managing the European legislation and needs for the improvement of environmental quality, subjects that generate waste face the necessity of finding sustainable methods in the management of waste generation, resource exploitation and reduction of hazardous waste generation. In general, the waste has to be managed so the presence is hot being harmed and the future is kept healthy. Which is one of the basic principles of sustainable development. This approach demands significant changes in the current attitude towards waste through the acceptance of responsibility of each individual and the conscience development that there is no one else to keep our environment if not ourselves [14].

Conceptual model of ELV management has to gather entities at macro, mezzo and micro level.

The macro level entities are:

- European Union (EU),
- Neighbouring countries primarily Bosnia and Herzegovina,
- Recycling technologies,
- New products.

Entities at mezzo level are:

- Municipalities,
- Landfills of waste,
- Network of location of waste generators,
- Competition,
- Population,
- Eco system.

Micro level entities are:

- Outputs of recycling technologies,
- Business innovations,

- New innovations,
- Resources.

Entities are mutually connected and each is consisted of sub-elements. The Republic of Serbia as an entity consists of regions, political and economical situations, legislative acts, resources, strategies, infrastructure for waste management etc. Recycling technologies are available at global market with sub-entities. This way of defining entities is similar at mezzo and macro level.

5 CONCLUSION

ELV recycling has multiple influence on the environment. A part of the model of influence of ELV recycling device on the environment is presented in the paper through four processes:

- Obtaining material and energy for the production of recycling equipment,
- Spending resources during life cycle of the recycling equipment,
- ELV component's recycling,
- Marking needs.

Listed processes present the "inventory" of influences on the environment.

Detail determination of the ELV recycling infrastructure, improvement of the sustainability model with the research of relations among variables in different models, as well as larger inclusion of reziliens factors and productivity of the recycling process along with leadership model of sustainable recycling are only some directives in which the research in the ELV recycling may be oriented.

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COMPARATIVE OF THE DISTRICT HEATING SYSTEM OF COUNTRIES IN TRANSITION

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Abstract: During the second half of the last century in Europe, district heating systems (DHS) have been built intensively to supply cities and settlements with heat energy. Taking into account that energy prices at that time were low, there was an economic justification for the construction of expensive infrastructural distribution systems. After the first oil shock of the seventies of the last century, there was a review of the consumption of petroleum products (mainly oil) as fuel in the heat sources of the DHS. The European Union, as well as Bosnia and Herzegovina, in the heat energy sector has long-term goals that are aimed at increasing the DHS to 30% by 2030, or 50% by 2050, in that of the current DHS of 12%. The present (current) state of the district heating system in Bosnia and Herzegovina (Republic of Srpska and Federation BiH) is presented. The paper covers the technical, technological, supply, distribution, environmental, economic and market parameters of DHS in BiH. The institutional and legislative framework is presented in the previous paper, the comparison of parameters was made in relation to the cities of other countries in transition. The main conclusions are that in the cities of BiH (in the RS and FBiH) the small utilization of the district heating system is outdated, Investing in new ones requires significant investment funds, there are small movements in the application and introduction of renewable energy sources such as biomass, and in this connection, there is a small impact on CO_2 emission reductions, large losses in heat distribution have been identified, and a market situation that is distinguished still high energy prices and pricing of heat service dominantlly is based on the surface of the space.

Key words: District heating systems,Comparation, Countries in transition.

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1 INTRODUCTION

After changing the political and economic system 1989/90 the transition countries of central and Eastern Europe focused on joining the European Union, which among other things also meant the transition of the energy sector. These countries are the Czech Republic, Estonia, Hungary, Poland, Slovenia, Bulgaria, Latvia, Lithuania, Romania, Slovakia and Albania. The countries that emerged from the disintegration of the former SFRJ also belong to this group, but went into transition after the war. The energy sector transition is a complex process that requires solid preparation that includes: adoption of relevant legislation, restructuring, market liberalization, privatization, foreign capital. In the last decade of the twentieth century in most transition countries [1], DHS have collapsed in most cities, and the causes for this situation are almost identical. Some of them are: plants that are at the end of their working lives, obsolete technology, inefficient production of heat, high cost of energy used and problems with their security, energy business entities burdened with a large number of employees, uninsulated, old, energy-inefficient buildings, costs that exceed revenues have significantly influenced the increase in the cost of heating and, consequently, the reduction in consumption The purchasing power of the buyers has weakened, making district heating very sensitive to sociological and political issues. Certain number of energy companies has ceased to provide partial or complete delivery of heat supply services.

2 MOTIVATION AND OBJECTIVE OF WORK

The main motivation for the emergence of this work is: What is the state of the DHS in the cities of BiH (FBiH and RS), and where they are in relation to cities DHS in other countries in transition. The aim of the paper is to obtain qualitative data and relations between the mentioned parameters, taking into account that such comparisons are mostly given at the level of the state.

3 THE STATE OF CITY DHS IN BOSNIA AND HERCEGOVINA

In Republica of Srpska (RS), thermal energy is mostly produced in heating plants, around 94%, and the rest in Ugljevik Thermal Power Plant. [2] Primary energy sources used in this sector are fuel oil and coal. Fuel oil is the most represented, with a 42% share in heat production, but its consumption declined from 2011 to 2015 by an average annual rate of -10.4%. Coal, with a share of 31%, is the second energy source in terms of its share in the sector, and in the period from 2011 to 2015, the true production of thermal energy from that energy source was maintained. A large increase in the production of thermal energy from biomass was recorded in the same period, as a consequence of the commissioning of a new heating plant in Prijedor, with an average annual growth rate of 31.2%. Natural gas is slightly represented, with a share of 4%, and is used only in Zvornik, and in the following period in Bijeljina [2].Unlike the Republic of Srpska, the Federation of Bosnia and Herzegovina (FBiH) supplies heat from the nearby thermal power plants, energy or industrial capacities. Primary energy in the FBiH is natural gas (53.5%), coal (31.5%) and fuel oil (10.8%). [3]. Biomass is inactive, with 4.2% [3]. Thermal energy in the Republic of Srpskais mainly used in households, accounting for around 76% of the final consumption of heat, while this amount in FBiH is 78%. Thermal energy in both entities is exclusively supplied for space heating and there is no supply of hot water. In the Republic of Srpska, there are currently 11 companies that are engaged in theproduction, distribution and supply of heat energy customers. They are

all publicly owned and are located in: Banja Luka, Doboj, Prijedor, Gradiška, Pale, Istočno Sarajevo, Brod, Sokolac, Čelinac, Bijeljina and Zvornik. In FBiH, companies that distribute heat energy are not its producers and ownership is different. In the continuation of the work, technical, technological, supply, distribution, ecological, economic and market parameters of some of them are given.

3.1 Technical-technological parameters

In Appendix A, Table 1.shows technical-technological parameters [4,5,6].The four generations of heat distribution are defined in the paper [7]. With each new generation of the DHS, the temperature of the heating medium fell: for the first generation it is characteristic that the medium was a temperature of 300 ° C, in the second generation a hot water temperature of 130 ° C, in the third generation of hot water temperatures of 80 ° C, and in the last fourth generation the medium is low temperature water temperature 50ºC. Observing the production side, in the first generation as a fuel, fuel oil, which in the second generation expanded to natural gas, and cogeneration plants on gas and coal, was used in the third generation, biomass, industrial surpluses and waste incineration. In the fourth generation of district heating, cogeneration plants or independent gas and coal plants are no longer used, but cogeneration plants for waste incineration, industrial surpluses, biomass and biogas co-generations, wind surpluses from wind, geothermal and solar The main characteristic of the fourth generation is that heat will be distributed at lower temperatures than in the third generation. The distribution network can distribute heat produced from various energy sources, of which industrial surpluses, heat from cogeneration to biofuels, geothermal energy, solar energy, and electricity surpluses (especially RES such as wind power plants, which are energy is deposited by storing heat energy in both daily and seasonal warehouses). In order to achieve these objectives, the challenge will be to balance supply and demand for energy, for which they are very suitable heat storage facilities.

3.2 Supply parameters

In Appendix A, Tabela 1.shows supply parameters [3,4].

3.3 Production and distribution parameters

In Appendix A,Table 1.shows production and distribution parameters [4,5,6], and part related to reconstruction can be found on [6].

3.4 Environmental parameters

In accordance with the legislation in the field of air protection, in 2016, BiH continued to monitor emissions of pollutants in the air from thermal power plants - sulfur dioxide (SO_2), nitrogen oxides (NOx), solid particles, and carbon dioxide (CO_2). In accordance with the legislation in the field of air protection, in 2016, BiH continued to monitor emissions of pollutants in the air from thermal power plants - sulfur dioxide (SO_2), nitrogen oxides (NO_x), solid particles, and carbon dioxide (CO_2). Emissions of polluting substances into air and CO_2 emissions from TPP Tuzla and TPP Kakanj [6,9], for 2016 are given in [6] In Appendix A,Table 1.shows the CO_2 emissions in the building sector in BiH city [9].

3.5 Economic parameters

In the financing of the district heating sector of the RS and the FBiH, three basic models can be used:

- Public funding, Private financing and Mixed financing (partnership between the public and private sectors)

In the public financing model, the public sector (central government, local and regional self-government, public companies, funds and agencies) has a dominant role. Private funding is widespread due to the disparity between rising energy needs and the costs of building energy infrastructure on the one hand and limited financial opportunities public sector and public sector. The public and private sector partnership as a model of mixed financing for the development of the energy sector is being implemented within the various ownership and management structures. By sharing risk, the partnership provides a range of benefits to both the private and the public sector.

3.6 Market parameters

In Appendix A Table 1.shows average heating price for households in BiH and the period in which the service is paid [6]

4 THE SITUATION OF DHS IN THE CITY OF COUNTRIES IN TRANSITION

Below are some parameters of several cities in Estonia (Tallin, Haapsalu, Jõgeva, Keila, Kärdla, Rapla, and Valga) and Latvia (Riga).

4.1 Estonia

In Estonia there are 226 local units, of which 151 are using DHS. The annual consumption of heat energy in Estonia is about 4.6 TWh [7]. In Appendix A,Table A. shows shows technical-technological parameters, production and distribution, supply parameters, emission of CO_2 in building sector and market parameters [8,9,10, 12,13]. Most of the plants in Estonia operate in the cogeneration regime. The heat produced in the plant is sold to district heating networks or to industrial consumers located near the plant. The following table contains a list of operational plants for the production of cogeneration with its own thermal (MWt) and electrical capacity (MWe). 60% of households use DHS.Waste incineration plants-Iru Power Plant, since 2013, a modern and efficient waste incineration unit that produces heat and electricity from mixed municipal waste.Characteristics of the plant:
The amount of waste burned is 120 000 - 220 000 tons per year,• nominal electric power 10-18 MW, Heat capacity 25-50 MWt, Output power of electricity per year 70-140 Gwhe, heat output 200-310 GWht per year. The construction of the factory cost 1-1.5 billion krona.

4.2 Letonia

Latvia (Letonia) is one of the leaders in the EU for multi-story residential buildings served by district heating. As a result, district heating is an important segment of the Latvian economy, with a total of 74 district heating systems. The main district heating market is within the nine largest cities, covering 75% of the total market. The Latvian capital Riga, with a population of nearly 700,000, accounts for approximately half of the district heating market share.The heat energy for sale produced in 663 boiler houses and132 cogeneration plants having generated 7.46 TWh. The graph below

demonstrates that 30% of the residential heat demand in 2015 was supplied through district heating. During the last decade, district heating in Latvia experienced continuous shift towards renewable energy and the domination of natural gas has been diminished by wood chips and other renewable energy products. In 2015, the share of natural gas, oil products and coal consumption in the district heating boilers (excluding CHP) compared to 2008 has decreased by 26.5%, 2.6% and 0.28% respectively. In the meantime, the share of RES has increased by 28.9% [11]. In Appendix A, Table 1. shows technical-technological parameters, production and distribution, supply parameters, emission of CO_2 in building sector and market parameters [11,12]. With a view to improving energy efficiency, JSC "Rīgas siltums" has implemented a number of measures in the heat sources two of which are of major importance and as best practice examples have been recommended for transfer to other heat supply systems and summarized in the proposal "Recover of heat from flue gas and cooling flows in energy production plants" included in the ecatalogue "Best practice projects for a smart city" prepared by the municipal agency REA in 2013 The examples of good practice are given in [9].

5 RESULTS OF COMPARATION OF THE DHS PARAMETERS

According to Lukosevicius [1] in transition countries, especially in those in the cold climate, district heating and the use of large cogeneration plants are of great use. This changed significantly at the end of the twentieth century when there was a significant drop in the number of consumers. Old plants, high energy prices, energy users burdened with a large number of employees, uninsulated and old buildings, significantly influenced the increase in heating prices and, consequently, the reduction in consumption.

The state of the district heating system in BiH based on the comparison of DHS parameters in the cities of Estonia and Latvia can be described as follows: Age and low efficiency of production capacities, Outdated technology, Age and large losses in hot water and heat networks, Difficulties in measuring, calculating and collecting the delivered heat energy for individual entities, High prices of fuels (coal, oil and natural gas), The energy products used are mainly from imports,• Inadequate collection of services leads to a direct incentive to invest in the sector. An additional problem of such systems is that the focus is placed on production and technical work, not on the needs of consumers [13].

The technical and economic situation of the companies for the production and distribution of heat is difficult due to the work "below the cost of coverage", due to the application of prices, i.e. Tariffs that do not cover all costs. Such a state does not allow the modernization of existing systems, lack of incentives, strong political influence, unpredictable regulations, poor economic viability and low competitiveness refuse private investors from investing in the district heating sector, high energy consumption in buildings with poor insulation, without the ability to regulate heat consumption and low purchasing power of most end customers, which made district heating barely accessible, systematic planning for the development and construction of local energy infrastructure is still rare, the renovation of buildings (thermal insulation for the purpose of energy savings) is carried out very slowly, high maintenance costs for larger plants with a small distributed amount of energy in a large network system and greater losses in percentage over a larger amount of potentially delivered energy, leading to accumulation of losses, small diversification of energy sources in production plants, especially small share of RES, lack of cogeneration on biogas, geothermal and solar energy, unused use of residual heat of waste water, heat of combustion of waste and political decisions or new

obligations for the district heating sector are often not accompanied by the necessary financial.

6 CONCLUSION

In BiH, district heating systems are positioned in larger cities. DHS in BiH city are very different considering different aspects. From the aspect of the energy source used, Sarajevo and Zvornik use natural gas. The reason for this is the location of these cities along the natural gas network. Banja Luka and Brod are using oil fuel, which for many years was the most expensive source of energy for heating. Then, a large number of district heating systems use coal as the main energy source (Doboj, Tesanj, etc.). Renewal of existing biomass systems (Sokolac and Pale) has recently been carried out, as well as the transition of some systems (partly or completely) to biomass (Prijedor and Banja Luka). The special group consists of district heating systems that use heat from the power and industrial plants (Zenica, Kakanj, Tuzla and Lukavac). These district heating systems are viable mainly due to the low heat prices they receive from the cogeneration plants. The largest parts of the district heating companies are public companies that finance local communities in which there is a district heating system. This means that these companies are responsible for municipal and city assemblies. The problem of all DHS is predisposition (the facilities are dimensioned for a much larger number of users than they are now supplying). In addition, the method of calculating heat needs in these systems was based on the fact the system can adequately heat objects at extremely low temperatures.

Taking into account that most DHS mainly deliver heat only for heating purposes, the plants work full capacity by only 20% at year level. An additional problem is the low energy efficiency of objects. Taking into account the tariff system (in most of the district heating systems the payment is done per m^2 of heated space), the low energy efficiency of the facilities has a very negative impact on the sustainability of the district heating system. District heating in most BiH systems is in poor condition. In addition to high heat losses, the problem is water leakage losses due to leakage. Almost all district heating systems with the aim of increasing the use of available capacities make the expansion of the district heating network. There is also a trend of transition from coal to biomass due to the trend of coal prices for district heating, and on the other hand, there is a gradual development of the biomass market, whose costs are lower than coal. The basic barrier for the development of district heating projects is the old infrastructure or the complete absence of infrastructure and the cessation of the heat supply plants that were mainly from the wood processing industry (such as in Milić, Vlasenica, Olovo, Kladanj, etc.).The demand for heat energy in some transition countries has started to grow again. This is proof that trends are changing, at least in those countries that have been more efficient (more actively) in reforming the district heating sector in recent years. Future demand trends will largely depend on the decisiveness and clarity of district heating regulations [14]. Clear and coordinated policies can ensure equitable participation of district heating in comparison with other heat sources in the energy sector (for example, liberalization or subsection in other sectors can significantly influence the remote heating system. A quality strategy in the field of energy can certainly contribute to better [15], which is a key component of successful energy reform in the whole of the world, as well as in improving the management of DHS.

Due to all of this, there is a need to invest in district heating systems by investing in the reconstruction, revitalization and modernization of existing district heating systems and the establishment of new sustainable district heating systems, using local energy sources and increasing RES but cities do not have the possibility to finance such projects

due to insufficient and underdeveloped capacities for the preparation and implementation of such projects as well as due to the impossibility of debiting with regard to existing operational debts.

Over 80% of the housing stock that is supplied with heat from the district heating system, the energy costs pay flat, or per m^2 of heated space. Businesses for the supply of heat energy operate according to the principle of production and supply of energy (MWh), and the tariff system of KM/m^2 collection. Approximately 20% of the residential sector in BiH on district heating, energy is paid on the expense where individual heaters have their own tariff attitudes. The precondition for motivating end-users to save energy is to enable payment by payment, which is clearly defined in EU directives. Paying the downloaded energy per expense does not mean that it will be paid less, than the downloaded/consumed amount of energy will be paid.

APPENDIX

The technical details that need to be included are put in to the Appendix. Appendices are marked: Appendix A.

Appendix A-Table 1. Technical-technological parameters, supply parameters, production and distribution parameters, environment parameters and market parameters of the district heating system in cities countries in transition [3,4,5,6,8,9,10,11,12,13]

	Technical-technological parameters										Supply parameters				Supply parameters							Production and distribution	Environment parameters	Market parameters	
City	Number of objects supplied by heat from DHS		Technology	Primary network (Bar, °C)	Secondary network	Length of the hot water	Distribution network	Number of thermal substatio	Heat capacity (MW)	Annual consumption of	Energy source	Import energy source		Annual	energy consumption for DHS							Year of construction	CO2 emission in the building sector	Average heating price for household in BiH	Payment period for months
	residential	business												Natural gas (Sm3)	Heavily fuel oil(t)	coal (t)	Fuel oil (l)	pellets (t)	briquette (t)	wood chaff (t)					
Banja Luka	21730	1030	Heating plant (4 boiling water boilers) +2 district boiler	130/73DN 13 bar	90/70	90	220	230	232+6+16	209	Heavy fuel oil, biomass	yes	no	0	17000	0	0	0	0	16000	1979	58.46	0,84	12
Prijedor	3500	1500	Thermal plant +CHP on biomass	130/73	90/70	10	3,5	43	50+ 20MWt and 250 MWe	42.539	biomass	-	no	0	500	0	0	0	0	24000	1971	11868	0,89	6
Zvornik	1800	330	Heat plant (Boilers with combined burners for gas and liquid fuels)	110/80	90/70	4	0,5	53	23,1	16702.77	natural gas	yes	-	1700000	0	0	0	0	0	0	1984	3.931	0,72	12
Tuzla	19075	2066	Thermal power plant Tuzla, block 3 i 4	145/75, DN 25	90/70	10	132	847	221	172.246	coal	-	no	0	0	3.811.800	212,75	0	0	0	1983	370.275	0,43	12
Zenica	12900	600	High temperature hot water boiler	130/70	62/50	150	120	548	174	201.011	coal	-	no	0	0	126.700,00	0	0	0	0	1967	79035	0,72	6
Kakanj	3035	290	Thermal power plant Kakanj block 6 i 7	150/75, NP 40	90/70	20	125	19	36	43.142	coal	-	no	0	0	1.916.684	0	0	0	0	1986	15.273	0,51	12
Tallin Haapsalu, Jõgeva, Kelia, Kardla, Rapla, Tallinn, and Valga, AS Utilitas Eesti	165000	9473	8 Heat plants+ CHP+	130/75	90/60	480	4220	1004+49M Wt+25MW e+Hreserve 295	23,5+49M Wt+25MW e+754+res erve 296	23200 +16 0000 el. energy++4 00000 heat energy+17 07000	natural gas, fuel oil, wood chips and chopsticks	yes	no	110026873	0	0	380	0	0	156000	2009 & 2016CHP, I Boiler heat 1963, II Boiler heat 1973, III Boiler heat 1982	325.000	74.15 € /MWh	12
Riga	23035	529	Heat plants to biomass, 2 CHP to natural gas and biomass	130/75	90/60	860+95	40+5,5	3458	CHP-1: (144 MWel, 493 MWt) CHP-2: (662 MWel, 1347MWth)	1,130.000	natural gas, wood chips	yes	no	132407	0	0	0	0	0	198.096	1971	4.295	55.55 € /MWh	12

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DIGNIFIED LIFE OF PEOPLE IN THE THIRD AGE

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Abstract: The discourse of this paper is to enable the quality and the dignified life of people in the third age considering the impact of the increase of the aging population. The question of the social importance of aging in our country and in the world is gaining ever greater public awareness. The authors are explaining the reason for this through two aspects as the fundamental origin: the opportunities that aging provides or the burden that it imposes on the people in the third age to change their place and the importance in the society. By focusing on the growth of the senior citizens population worldwide and the statistical indicators in the Republic of Croatia, it also includes its impact on the health aspect of the population. For the purpose of improving the quality of life of senior citizens, a solution is provided through a model that represents a transition period towards a life in a retirement home, which presents their contribution to society through personal knowledge and experience. The paper will present the results of the research conducted on 100 inhabitants of the Republic of Croatia, showing that the activity of senior citizens contributes to the quality and dignity of their lives and health. Additionally, the views of the younger and older population will be highlighted by such a model of spending time which clearly implies the quality of life of all involved.

Key words: quality of life, model of quality of life of senior citizens, increase of age, change

1 INTRODUCTION

The subject of this study will be the influence that the increase in our ageing population exerts in relation to quality and dignified life of people in the third age and presentation of opportunities for its implementation. The aim of this study is to give a short overview of the increase in aging population in the world and in Croatia, including its influence on health. A general hypothesis is that the activity of the retired population contributes to their health as well as their relationship with the environment and that people in the third age are in demand for this form of spending free time.

Firstly the theoretical background is given on the increase in ageing population and the ways it affects different spheres of life on a larger scale. The sections 3 and 4 give different views on the aging process, approaching it as a burden or an opportunity in order to spend that time of life in a quality and dignified way. It provides solutions based on the research, on how life in the third age can be organised to improve the lives of that population.

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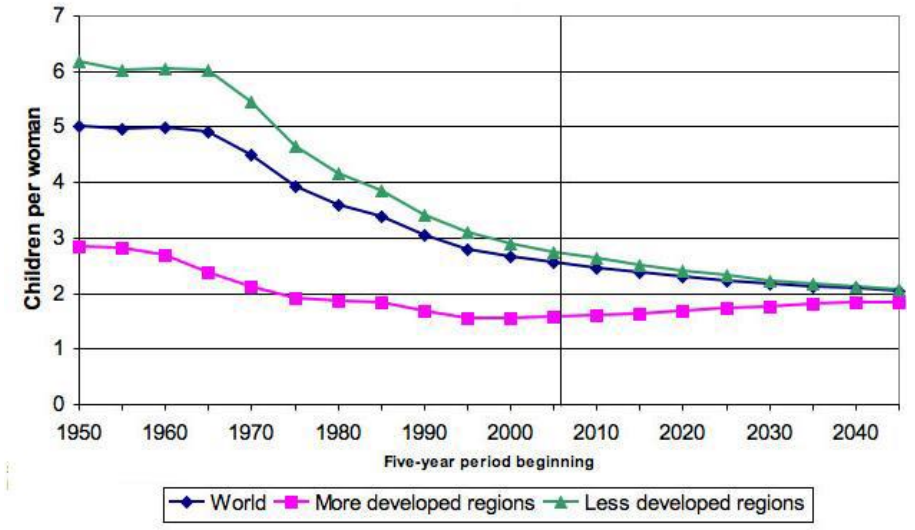
The method used for this research was the questionnaire carried out in Zagreb in 2017 on the specimen of 100 respondents including young and older population. Out of 100 questioned, 50 of them were between 20 and 65 years of age (children of retired people) and 50 respondents were between 66 and 80 years of age (pensioners).

2 THEORETICAL BACKGROUND

According to the UN [1], demographers are predicting dramatic increase in cultural diversity of the world population until mid-21st century, which will also have an impact on the increase in ageing population. A current ratio of older population is larger in the developed countries, but the biggest increase in ageing population is present in the less developed countries. It is expected that between 2006 and 2030 the increase in the number of older people in less developed countries will escalate to 140% in relation to the increase of 51% in developed countries. A key feature of ageing population is progressive ageing. The forecasts of the increase of older population over 75 years of age in the next 20 years will result in the increased demand for health care, housing and pensions for older population, so tackling this issue is of crucial importance for the governments and politicians in all countries. A forecast on the global level is predicting the increase of ageing population at the age of 85 and older for 151% in the period between 2005 and 2010, compared to the increase of 104% of the population of 65 years of age and older and 21% increase of the population under the age of 65. At the same time, in western cultures including Croatia, under the influence of globalisation and strong political and economic changes a new trend is emerging of less children in a family. The parents are planning less children so that their children could have more opportunities in life. The world today is very competitive and one must have a good foundation in life and be protected by parents to succeed. Graph 1 shows constant drop in fertility rate.



Graph 1 Fertility rate in the world [1]

A proportion of young people compared to people in the third age is visible. The data for the world mentioned above are the same as the data for Croatia. Following the demographic trends in Croatia [2], it is clear that there is economically active population and increase in population older than 65 years of age. The prolongation of life expectancy to 80 years of age for women and 73 for men leads to increasingly ageing population. The average age of 30.7 sixty years ago has increased to 41.7 years of age today. Almost one fourth of population in Croatia (24%) is at the age of 60 and older and fifty years ago that ratio was 12%. The data mentioned above show a clear tendency of a lack of working force in future as well as older employed population on average.

That is why it is emphasised that the health status of population and its distribution is determined by the number of population, individual level of health risk and healthcare system. Direct effects include the influence on healthcare system through the international markets, including Croatia, as stated in the WTO agreement on trade and services i.e. agreement on the price of medicines. It is necessary to emphasise the effects of national economy especially on trade liberalisation and financial flows, crucial for research in the healthcare sector. Today, the world is changing fast and at the same time has numerous options which enable us to make decisions about our personal health. The knowledge and medical achievements of the twentieth century made the prolongation of life in industrialized countries possible – some illnesses are almost eradicated, and standard of health is relatively high when compared to other parts of the world. Besides development of healthcare system, a direct influence was made through improved standard of living the results of which were increased spending on healthcare protection and consequently a prolongation of life expectancy. A realistic presumption is that the medicine will continue to be successful in developing efficient ways of treatment and thus permanent improvement of public health.

3 AGING - AN OPPORTUNITY OR BURDEN

During the time when the studies of ageing and old age were carried out in different scientific fields (biology, medicine, sociology, psychology etc.), the need to compile the results of these studies into one scientific discipline – gerontology (Greek: gerontos – old man, logos- science) grew proportionally. This integrative scientific discipline has wide interests and activities and its task is to make old age an attractive and pleasant period of life and use adequate measures to prevent chronic and degenerative diseases, disability and premature death as well as to disable premature loss of capacity for active and independent living.[3]

There are two contradictory processes in the focus of gerontology. On one hand, older people have lower status and less power than in pre-modern societies where it was considered that age brought wisdom and where the oldest people were making key decisions in the community. On the other hand, today's society is going through constant changes and young people don't perceive the knowledge of older people as a worthy source of wisdom, but rather something dated.

Today, older people have more difficulties to accept aging as an inevitable physical process. The advancement of medicine and nutrition showed that aging, which was before considered inevitable can today be prevented or slowed down – and on average people live longer than hundred years ago. As mentioned before, a demographic data showed that almost all developed countries would experience ageing of population in the coming decades. Today, every seventh person in the developed world is older than 65 and in the period of thirty years it will be every fourth person. In Australia, by 2030, there will be 33% people older than 65 and in Germany 55%. A discussion is going on about "aging of older population": in the next five hundred years,

there will be six times more people older than 85 than there is today. This will increase demand on social services and healthcare and the increase of life expectancy will indicate that the pensions will be paid for a much longer period than it has been the case until now.[4]

Vodopivec and Dolenc studied perceptions of aging in some countries and cultures. Canadians see older age as time for rediscovering themselves, time for fulfilling their ambitions and achieving close relationship with friends and family. Americans look at their older age as time of opportunity, new career, spiritual fulfilment, but they are less focused on family or health than people in other countries. French people see older age as time of fulfilling their dreams and aspirations, but also a period of anxiety and fear of the possibility that they might be a burden to their families. British people view old age as time of self-sufficiency, independence and personal responsibility. They do not expect that the state or family will take care of them when they grow older. Brazilians perceive old age as time to slow down, relaxation, opportunity to spend more time with family, relatives and friends and they expect to receive considerable support from their children. Mexicans perceive that period as continuation of work and hard-earned financial stability. In China, younger generations perceive pension as possibility for a new life, but also continuation of career while older generations prefer to stop working and start enjoying themselves. Chinese see family as an important source of happiness and support. The respondents from Hong Kong consider that old age is the time to have a rest, to relax and enjoy accumulated wealth which for them is the corner stone of prosperity. For people in India the old age is time for living with a family which will take care of them. People in Japan are looking forward to old age because they perceive it as time of good health, respect in the family and time fulfilled with work.[5]

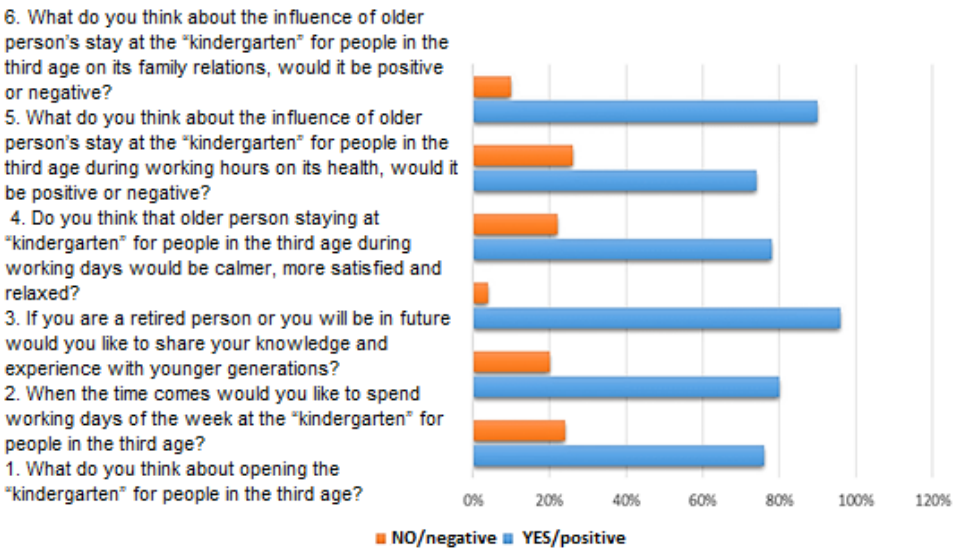
Today's society is clearly dominated by tendency to characterise young and old people by age and not their features, capabilities or goals. Young people should be ready to take care of old people and old people should be prepared to be in the service of future generations. Are these goals realistic in a society that suffers from lack of respect and does not perceive ageing as bringing wisdom? Several facts speak in favour of this assumption. Today old age lasts longer than before. The ratio of old people in population is considerably bigger than before which makes older people socially more visible. Their more intense inclusion in labour market and in community should be directly connected with younger generations. Finally, these two groups: younger and older generations should unite, get rid of classification and work together not only in the interest of their own positions in a society, but also in the interest of majority employed people thus redirecting the consumer winds in the society.

Aging is often associated with loneliness and as such it plays an important role and has an influence on personal feeling of the quality of life.[6] Due to the increased growth rate of people in third age, the authors' express view that aging should not be perceived as a series of life crisis following each other, but as means for advancement full of new opportunities and challenges which require making an effort to create quality time which would enable people in the third age to have a more dignified life. Furthermore, they will show the opportunities that could contribute to quality life of people in the third age.

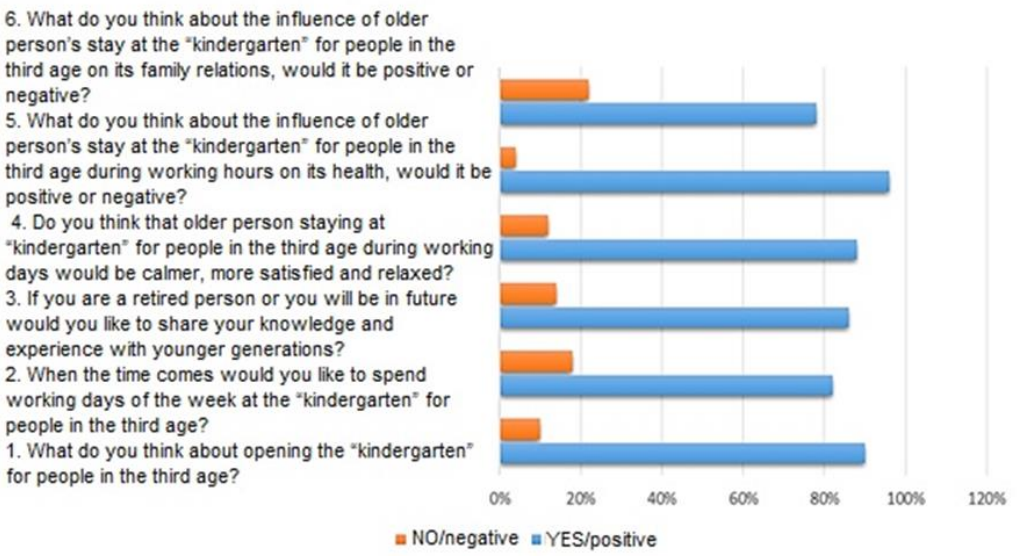
4 QUALITY LIFE OF PEOPLE IN THE THIRD AGE

Quality of life is a complex and multi-layered structure that requires complex approach. The research has shown that common use of both indicators conisiderably contributes and enriches the awareness of the quality of life of population in a certain area.[7] Petz sees the quality of life as a complex process of evaluating the satisfaction with life within the environment in which the individual lives.[8] Therefore, there is a clear need to improve the quality of life for people in the third age. People in the third age are vulnerable, in the risk of social exclusion and open to prejudices. Changes hat the process of aging brings such as retirement, functional inability, increased risk factors for diseases and disability, financial dependence, social inclusion or losing people due to these changes result in the need for family and community support, but also active measures offered by local and wider community and developed network of support and system of care for older people.[9] For that reason and based on everything mentioned in previous chapters, it is clear that new models need to be created for people in the third age whose representation in our society is increased and to connect them with young people on joint projects. When a person is not going to work every day, it has free time which needs to be filled. While relaxing can be satisfying for the first few weeks of retirement many “new” pensioners prefer productive and exciting activities to fill their retirement years. They have a lot to give to others.

Based on what was described above the authors propose a model of “kindergarten” for people in the third age during transition period towards the retirement home. In the “kindergarten”, people of the same age would come together and do activities. The time they spend together would enable them to come up with new ideas. What is emphasised here is the contribution that people in the third age can give to people in their surroundings offering their knowledge and experience, thus focusing on quality life. In order to recognise the relevance of this model, a research was carried out on the importance of quality life for people in the third age. The research was carried out in Zagreb in 2017 on the specimen of 100 respondents from younger and older population. Out of 100 questioned, 50 of them were between 20 and 65 years of age (children of retired people) and 50 respondents were between 66 and 80 years of age (pensioners).



Graph 2. Results of the questionnaire on opening the "kindergarten" for people in the third age involving respondents between 20 and 65 years of age (children of retired people)



Graph 3. Results of the questionnaire on opening the "kindergarten" for people in the third age involving respondents between the age of 66 and 70 (retired people)

People who enjoy social support show reduced feeling of loneliness and increased feeling of life satisfaction.[10] There is a visible support for this model on a sample questionnaire which confirms the hypothesis that the activity contributes to the health of retired people and their relationship with their surroundings. The specified research indicated the existing interest among the target population. It is time to realise the importance and the necessity to pay attention to the way people in third age spend their time. It will not only take the burden of social services and healthcare system, but it will help older and younger people to connect. Older people with years of experience can help younger people to cope with obstacles in life.

5 CONCLUSION

The large proportion of older people in most developed countries opened numerous questions on how to ensure the quality social welfare for people in the third age. The retirement often implicates inability so no wonder that many people after retirement lose their self–esteem because according to social belief the old age begins at the age of 60 or 65. The time limit gives aging a new meaning which besides inability alludes also to the feeling of redundancy, worthlessness and meaninglessness of the new chapter in their life in general. Such attitude needs to change - we should aim to abolish the fixed retirement age. Older people should be treated as resource and not a problem. Their oldest age can become the best age. It is supported by the results of this study and the proposed model. Connecting the two generations, instead of creating a generational gap, can only contribute to the quality of life of everyone involved. We cannot choose the way we age, but we can choose how we are going to spend our older age.

Based on this research further research will be focused on raising the awareness of different possibilities of spending quality time for people in the third age. There are people in the third age who live in a dignified and quality way, but there is little information about them available publicly so they cannot be used as a role model. The way the old age is perceived should be changed on a larger scale.

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HIGHER EDUCATION POLICY IMPACTS ON THE QUALITY ASSURANCE IN MACEDONIA

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Abstract: Bearing in mind that the main objectives set out by the Bologna Declaration and the policies developed in the subsequent years respect the differences, it is obvious the organisation of the national educational systems depends on the European countries themselves. Significant actions in higher education of Macedonia, such as opening new higher education institutions, dispersed studies; numerous changes of Law of Higher Education [1] were undertaken in the last ten years. Most of them, excluding several activities related to the Board of Accreditation and Evaluation, resulted in complex functioning of national higher education system, with negative impact on the processes of quality assurance. This paper presents a focused analysis of the current higher education system in Macedonia. Following the opinion of experts and the personal experience of the paper authors, some activities, that can help the overcoming the current situation and continuous implementation of the European directions, are recommended.

Key words: Higher education, Policy, Quality assurance

1 INTRODUCTION

Joint declaration of the European Ministers of Education, signed in Bologna in 1999 [2], provided base for building the European Higher Education Area, oriented towards openness and mutual trust. In order to achieve the mentioned goal, many activities, as well as policies have been developed over the past two decades. So, bearing in mind and respecting the uniqueness of national education systems, languages, cultures (as a basic principle of Bologna Declaration), setting up the European dimensions in higher education, promotion of co-operation in quality assurance, strengthening students' and university staff mobility, were, and still are, the basic directions for creation of the European Higher Education Area.

The Bologna Declaration is signed by the minister of education and science of Republic of Macedonia in 2003. The Bologna process acceptation meant implementation of numerous activities in the form of national policy at the beginning (setting up the university autonomy and academic freedom, developing an independent national quality assurance system, implementation of the European Credit Transfer

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System, developing a three – cycle degree system, adoption of Diploma Supplement, etc.).

But, the application of some activities included in the national policy of higher education in the last ten years, resulted in complex circumstances for functioning of the national higher education system with negative impact on quality assurance processes.

The current national higher education system in Republic of Macedonia is in this paper focus. The paper aim is proposing the activities which, we hope, will improve the situation in the area of national higher education system in line with the European dimension.

2 CHALLENGES FACING CURRENT EUROPEAN HIGHER EDUCATION

In accordance with the newest documents for recent developments in European higher education [3-4], it's obvious that Europe is facing the need of more inclusive, qualitative and responsive higher education system. The actions directed towards ensuring equal access for students regardless gender, geographical and socio-economic origin, institutional development of innovations in the surrounding society, as well as, the higher level of compliance between actual and required skills of graduated students are needed.

Namely, there is interdependence between process of globalisation and higher educational environment. People, goods and information free flow, the increase of the number of diverse population and workforce, as well as, demand for different forms of higher education and for institutions that will meet these demands, enhance the competition among the institutions. It means, the various types of internationalisation (student mobility, academic cooperation) strengthen the role of higher education in today's society. This particular contributes to increasing the global attractiveness of European universities. Additionally, it means that it is necessary to respect the social and democratic dimensions which are reflected through equal access and adequate study conditions for the whole spectrum of population.

Building a culture of innovation, means moving to a more – competency based higher education system. This will enable a creation of environment for continuous improvements, sharing and applying scientific achievements in many aspects of today's constantly changing society. Each higher education institution has its own path to innovation. It depends on its structure and its capacities in education, teaching and learning (type of applied innovative methods, the way of their application – teacher's ability, institution's capacity for adequate response to the demand for different types of skills).

The value of higher education is measured by the obtained skills while minimizing the differences between what the labor market needs and what the graduates actually posses. Building the right skills (meaning the ratio of qualifications and their quality) consists of: developing relevant skills through lifelong learning, mobility, adopting skills policies; skills enhancement while practicing on the labor market; creating a better match between the obtained and required skills and increasing the demand for high-level skills.

Choosing the most appropriate model for sustainable financing is significant for achievement the effective and efficient higher education system. Depending on the specifics of each country, the ways of funding include cost sharing, cost – efficient modes of delivery, improving governance practices and institutional leadership.

3 STATISTICS OVERVIEW AND ANALYSIS OF MACEDONIAN HIGHER EDUCATION

3.1 Quick Overview of the Statistics Affecting Higher Education in Macedonia

The higher education in Macedonia has been expiring vivid, rapid and, sometimes, not easy to predict, changes in the past decade. These situations, most of the time, are not in line with the strategic plans for quality assurance and enhancement that universities managements desire to acquire.

To justify the above mentioned statement, data from the relevant sources are presented.

First, there is an evident number increase in both public and private higher education institutions (faculties and vocational schools) over the last 10 years. So, if there were only two public universities and none private in 2002, just in 2008 there were 4 public, 1 semi-public/semi-private and about 5 private universities or higher education institutions. Today, there are 6 public (plus one without clear status), 1 semi-public/semi-private and 11 private universities. In addition to these figures there are 7 private faculties, institutes or higher vocational schools. If only number of faculties is to be presented, the image would be as following - 78 higher education institution in 2008 and 135 higher institutions in 2017.

Not only has the number of newly opened higher education institutions affected the higher education in Macedonia. Going deeper into the structure, the expansion of dispersed studies (study programs delivered in other places than the main one) is noticeable over the perceived time period [5].

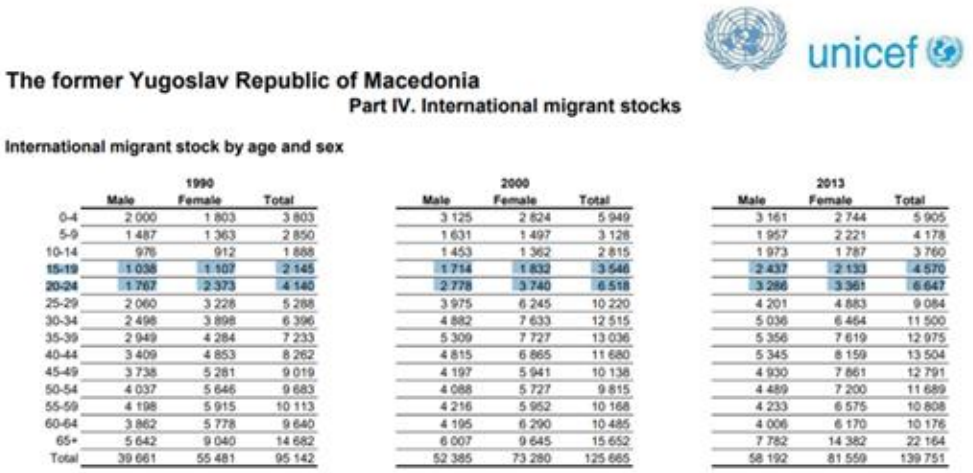
The number of higher education institutions and dispersed studies increase was a result of a, so-called, populist national higher education government policy for making the higher education more accessible to less fortunate people.

The things are getting more complex if the starting figures are put in correlation with the statistic data of the declination in number of students in high schools over the last seven years, see Table 1 below [6]:

Table 1. *Time series: Number of students in high schools*

Year	***Number of students***
2016/2017	*76 394*
2015/2016	*80 295*
2014/2015	*83 522*
2012/2013	*88 582*
2011/2012	*91 167*
2010/2011	*92 848*
2009/2010	*94 284*

Additionally, the data showing migrant rates (Figure 1), especially for the age range 15-19 and 20-24 are not promising considering the higher education situation



The former Yugoslav Republic of Macedonia

Part IV. International migrant stocks

International migrant stock by age and sex

	1990			2000			2013		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	2 000	1 803	3 803	3 125	2 824	5 949	3 161	2 744	5 905
5-9	1 487	1 363	2 850	1 631	1 497	3 128	1 957	2 221	4 178
10-14	976	912	1 888	1 453	1 362	2 815	1 973	1 787	3 760
15-19	1 038	1 107	2 145	1 714	1 832	3 546	2 437	2 133	4 570
20-24	1 767	2 373	4 140	2 778	3 740	6 518	3 286	3 361	6 647
25-29	2 060	3 228	5 288	3 975	6 245	10 220	4 201	4 883	9 084
30-34	2 498	3 898	6 396	4 882	7 633	12 515	5 036	6 464	11 500
35-39	2 949	4 284	7 233	5 309	7 727	13 036	5 356	7 619	12 975
40-44	3 409	4 853	8 262	4 815	6 865	11 680	5 345	8 159	13 504
45-49	3 738	5 281	9 019	4 197	5 941	10 138	4 930	7 861	12 791
50-54	4 037	5 646	9 683	4 088	5 727	9 815	4 489	7 200	11 689
55-59	4 198	5 915	10 113	4 216	5 952	10 168	4 233	6 575	10 808
60-64	3 862	5 778	9 640	4 195	6 290	10 485	4 006	6 170	10 176
65+	5 642	9 040	14 682	6 007	9 645	15 652	7 782	14 382	22 164
Total	39 661	55 481	95 142	52 385	73 280	125 665	58 192	81 559	139 751

Figure 1. *International migrant rates*

An extensive consideration, also, should be given to the statistics showing the total number students by year of studies (see Table 2 below) [8]. The total number of students is quite stabile over the period, but the most noticeable figures are those of final year students, presenting the indicative lowering number of students who complete the higher education and increasing number of students dropping-out.

Table 2. *Total number of students by year of studies*

Academic year	***Students***							
	total	***year of studies***						
		I	***II***	***III***	***IV***	***V***	***VI***	***final year students***
Faculties and higher vocational schools								
2009/2010	*57 894*	*17 942*	*13 704*	*12 430*	*6 975*	*517*	*163*	*6 163*
2010/2011	*63 250*	*19 805*	*15 322*	*14 937*	*8 055*	*529*	*91*	*4 511*
2011/2012	*58 747*	*18 152*	*14 041*	*14 700*	*7 052*	*422*	*113*	*4 267*
2012/2013	*56 906*	*17 213*	*12 850*	*14 559*	*7 564*	*381*	*123*	*4 216*
2013/2014	*57 746*	*19 173*	*12 427*	*13 435*	*7 811*	*584*	*190*	*4 126*
2014/2015	*59 359*	*18 942*	*13 278*	*13 286*	*7 303*	*723*	*219*	*5 608*
2015/2016	*59 865*	*17 952*	*14 040*	*14 582*	*8 551*	*750*	*241*	*3 749*

The previous statement could be supported, also, by the statistics showing the flow of graduated students' number in the period between 2009 and 2015 in Table 3 [6]:

Table 3. *Time series: Number of graduated students - first cycle studies*

Year	***Number of graduated students***
2015	*8 458*
2014	*9 863*
2013	*9 480*
2012	*10 392*
2011	*9 802*
2010	*9 944*
2009	*10 232*

The data indicating the number increase of teachers are in favour of higher education in Macedonia, but the factors that could be worrying are the decreasing number of full-time professors, as well as supporting staff, as shown in Table 4 [8]:

Table 4. *Teachers, supporting staff and students at public and private tertiary education institutions*

	Teachers		***Supporting staff***	
	total	***full-time***	***total***	***full-time***
Faculties and higher vocational schools				
2009/2010	*2 057*	*1 693*	*1 407*	*1 241*
2010/2011	*2 276*	*1 804*	*1 585*	*1 251*
2011/2012	*2 240*	*1 837*	*1 422*	*1 283*
2012/2013	*2 207*	*1 793*	*1 223*	*1 082*
2013/2014	*2 301*	*1 921*	*1 053*	*973*
2014/2015	*2 453*	*1 998*	*1 163*	*904*
2015/2016	*2 801*	*904*	*1 179*	*771*

3.2 Analysis of Higher Education Implications in Macedonia

Back in 2008 the need for higher education reconstruction in Macedonia was more than obvious. The European perspective was pushing the officials forward to beginning the complying process with the European standards.

It started with the new Law on Higher Education introduction. But, soon the European higher education perspective out sailed into a Governmental higher education policy's for easing the access for the less fortunate people. It sounded as a good idea at that point. But, the good intention, without serious research, already tested impacts and with ignoring the experts' opinion, led to inevitable failure and, opposite to the expectations, lowering the quality of higher education provisions.

In fact, increased number of higher education institutions and dispersed studies and stable number of enrolled students during the perceived period mostly affected the biggest, oldest, most comprehensive public universities, in the way of decreasing the number of newly enrolled students. While searching various ways for preserving some critical student number level, these universities were unavoidably pushed to alter the enrolment criteria. This means that they have accepted students with lower average grade then previously. The situation is not promising and is getting even more serious when statistics and time series for high school students (perspective students at university level) and the statistics for migrant rates are being observed.

Additionally, not having a clear vision and well-grounded ideas of how to achieve the populist higher education policy resulted in numerous changes and amendments of Law on Higher Education (over 20 since its introduction). These changes included dismissing university supporting staff (so called assistants), alternation of criteria for professors' election, modifying financial support provisions (meaning less finances for public universities), and limitation on students' study fee by governmental decision and many more. Also, some other decisions had direct impact on the public universities functioning. The biggest and most important one was joining the Agency for evaluation and the Board for accreditation of higher education into one body. That created a very unstable and unfavorable position for universities' managements when it comes to reasoning the future strategic plans and actions. Having on mind that quality assurance is kind of umbrella that shelters every aspect of the university functioning, it is obvious that the public universities, under these circumstances, could not retain the quality level.

Even the decisions that were not criticized by the experts, such as compulsory obligation for setting up a University Student Career Centre, did not reached its main

goal, in part because of the improper way of its imposing and in part because of already higher education shaken grounds.

What could be pointed out as a positive thing is the creation of some rulebooks (working programs, methodologies…) for functioning of the Board of Evaluation and Accreditation of the higher education. These rulebooks comply with the European principles for quality assurance, but, at the same time, respect the uniqueness of the national higher education. So, that means defined clear directions and achievable actions for universities that want to undergo a self-evaluation procedure. The unclear and questionable provisions in these rulebooks are related to the external evaluation procedure.

4 CONCLUSIONS AND RECOMMENDATIONS

Higher education system in Republic of Macedonia works in complex conditions, as a result of national policy over the last ten years.

The content of the National Law on Higher Education, frequently changed, the articles contradiction, limits, in great extent, the practical applicability of the law. Additionally, the number of higher education institutions (135 in 2017), the expansion of dispersed studies (with, in most cases, inadequate working conditions), comparing with the declination in number of students and high rate of youth migration, make the functioning of the institutions even more challenging.

Despite of some activities of the Board of Accreditation and Evaluation, which have raised the level of quality when it comes to self-evaluation and working assessment according to European standards, the above mentioned activities have direct negative implications on the processes of quality assurance.

Based on extended experience of experts and paper authors, these are the recommendations, which will facilitate functioning of the institutions in national higher education:

- New Law on Higher Education, in compliance with the European higher education standards and guidelines. It should bring more restrict provisions when it comes to opening and re-accrediting the higher education institutions; new realistic and practical model of public universities financing; allow wider university autonomy related to Governmental interfering into defining study fees and student quotas; define clear and achievable election criteria for professors; re-establishing the university supporting staff (assistants) as a sound ground for future professor profession; splitting the Board for Accreditation and Evaluation into separate bodies.
- Passing of National Strategy for Higher Education, based on the Law on Higher Education.
- After successful fulfilment of the first two steps, the universities should revise their strategic plans based on the more stable ground that would secure its applicability and durability, ensured by the new law and strategy.

At the moment, a working group for New Law on Higher Education preparation is already formed by the national Ministry of Education and Science. The procedure is started with wide debate that has been going on the university expert level. It is a good starting point and, at the same time, it is a commitment to the quality assurance beneficial impact of the higher education in Macedonia.

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ISO 10004-BASED MEASUREMENT IN A HEALTH CARE CONTINUUM

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Abstract: This paper investigates an application of ISO 10004:2012 in integrated health care. An emergency and inpatient care continuum within a Canadian hospital was investigated by interviewing nurses and managers. The service encounters with patients were identified and the existing measurement activities studied. Steps for customer satisfaction measurement along the continuum of care were defined. Sources to determine patient expectations were identified and the measurement activities, such as specific items in a survey encompassing all stages within the care continuum, were developed. Research participants were interviewed again to verify the usefulness of the developed measurement activities. This paper shows one of the first examples of an ISO 10004:2012 application, and of the integrated use of ISO 10004:2012, ISO 10001:2007 and ISO 10002:2004, in health care.

Key words: Customer satisfaction, Emergency department, Inpatient care, Integrated care, Patient centeredness,

1 INTRODUCTION

Health care integration is attracting a great deal of attention from both practitioners and researchers as a means for providing patient-centered care [e.g., 1-6]. Health care customers can include patients and the general public [7-8], as well as patient families and friends [9]. Integrated care combines physicians, hospitals and medical services [10] and intends to provide coordinated and comprehensive care to the patients, acknowledging their diverse needs and expectations and involving them in care-related decisions [3]. It is “an organizing principle” intended for improved care through better coordination of services provided [11]. Care is provided as a continuum of services, from the initial contact between the patient and the care provider to the end of the care and its follow-up, encompassing primary to tertiary care, as well as “community and ambulatory services to institutional services” [3].

Traditional measurement of outcomes within each stage of the care may not focus on the patient’s experiences along the continuum [3], because stand-alone surveys and feedback-handling activities can only provide individual snapshots of the patient’s experiences at each care stage. Moreover, traditional instruments such as

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SERVQUAL may not capture the customer's perception of service quality [12]. One of the tools to address these two challenges is ISO 10004:2012, an international standard that is yet to be widely applied in health care, barring one example reported in [13].

This paper reports on the development of patient satisfaction measurement activities in integrated care by applying ISO 10004:2012, and also on an example of integrative augmentation of ISO 10001- and ISO 10002-based systems. An emergency and inpatient care continuum in a Canadian hospital is assumed as an integrated care case. As an example of a direct measurement tool, a patient satisfaction survey is constructed. Verification of the survey is performed through interviews of caregivers from the continuum and experts involved in patient satisfaction measurement. Finally, suggestions are made on the implementation of the measurement activities.

2 METHODOLOGY

ISO 10004:2012, through ISO 9000, defines "customers" (sub-clause 3.2) as the recipient of a "product", which is a "result of a process" (sub-clause 3.1). In this paper, patients are the "customers" and the received care is the "product". Because different care continua can have diverse and unique attributes, the measurement activities need to acknowledge and address this difference. As a real case of integrated care could not be found within the constraints of this research, an emergency and inpatient care continuum in a Canadian hospital was considered as an example of an integrated care case. Out of the integrated care principles discussed in the literature [e.g., 4], only patient experience along the "continuum of care" and "patient centeredness" were focused on, because of their importance and relevance to the measurement of patient satisfaction. Instead of investigating a patient's care experiences at different stages (e.g., emergency and inpatient care) in isolation, the entire continuum was considered as a system of care services, just as a patient experiences it. The patient focus was maintained by identifying their expectations and needs (e.g., ISO 10004:2012, sub-clause 7.2).

The research involved studying the care continuum, determining the existing measurement activities, and then developing the measurement activities based on ISO 10004:2012, followed by verifying the developed survey [14]. To obtain an understanding of the hospital's care activities, service encounters and existing measurement activities, internal documents and publicly-available reports were studied and interviews of caregivers and experts involved in feedback-handling activities were performed. Subsequently, the measurement activities were developed, which included a patient satisfaction survey consisting of items focused on the integrated care, as well as items on the emergency and hospital care adapted from the HQCA [15] and HCAHPS [16] surveys, respectively. The survey also included two sets of items related to patient satisfaction on an implemented promise and a feedback handling system, respectively. Details of the establishment and implementation of an ISO 10001-based customer satisfaction promise are reported in [17 and 18, respectively], while the development and verification of an ISO 10002-based feedback-handling system is illustrated in [19]. Further information on the measurement aspects of the work is available in [14].

To verify the survey feasibility and usefulness, a group of caregivers and experts that included one Program Manager, three Unit Managers, four Registered Nurses from the emergency and inpatient care and two personnel involved with data analysis were interviewed using a semi-structured interview guide to assess the usefulness, improvement and feasibility of survey items. The approach taken was iterative in that as each participant was interviewed, the resulting feedback was used to

modify the survey, and the next participant would be asked to comment on the modified tool.

3 RESULTS

3.1 Investigation of the care continuum

Through interviews of research participants, care flowcharts were developed, detailing which activity is performed at what stage, what personnel are involved, how patients proceed from one activity to another and what the service encounters are. For each care activity, the "SIPOC" elements, i.e., "Supplier-Input-Process-Output-Customer" [20] and caregivers were identified to focus on the patient's care experience and service encounters, as well as connections among the care stages.

3.2 Determination of the existing measurement and monitoring activities

The emergency care of the hospital is evaluated in an emergency patient experience survey by the HQCA that is performed every three or four years [15]. Each year, the provincial HCAHPS survey is conducted to evaluate hospital care, and about once every three years an urban hospital such as the one in this research is selected for the survey [16]. Therefore, an evaluation of the inpatient care of this hospital may performed once every three years, at best. For handling unsolicited feedbacks, a department of the provincial health provider has an established system that encompasses all health care facilities within the province. Moreover, the hospital makes no formal promise or guarantee to patients regarding the services offered.

3.3 Development of the measurement activities

As already identified, the existing measurement activities within the hospital currently focus on the individual care stages in an isolated and disconnected way, without consider the patient's experience along the continuum. Therefore, in this research, the measurement activities were designed to provide "a broad overview" [7] of patient satisfaction within the continuum of care, as well as "reduce fragmentation" [5] in the measurement activities. The activities are described below, including the corresponding ISO 10004:2012 clauses in parenthesis.

3.4 Determination of patient expectations (ISO 10004:2012, 7.2, 7.3 and Annex B)

A number of sources from which information on patient expectations can be obtained, such as existing reports and results from the provincial health care provider, as well as analysis of the care process flowcharts, were identified first [see 14]. The inventory of sources provided in [14] is not exclusive, and is based on guidance on "customer groups" in the second paragraph of sub-clause 7.2.1 of ISO 10004:2012, on the list of "requirements and desires" in the first paragraph of sub-clause 7.2.2 in the same standard, and on the list of "sources" in the first paragraph of sub-clause 7.3.2, also from ISO 10004:2012.

3.5 Identifications of aspects related to patient satisfaction (ISO 10004:2012, 7.3.1)

Six care aspects connected with the two integrated care principles mentioned above were focused on in the measurement activities, as illustrated in Table 1 [14]. These aspects have impacts on patient satisfaction according to the literature [e.g., 21-25] and the hospital's internal reports. Table 1 also illustrates the number of items from the survey that are related to each specific care aspect. Since some items are related to multiple care aspects, the total number of related items (36) is higher than the number of distinct items in the survey (28).

Table 1. *Aspects of care selected for measurement (adapted from Khan, 2016)*

Aspect	Related integrated care principles	Number of related items in the survey
i) Communication between the patient and care provider [21,24,26, 27-28]	Patient centeredness	12
ii) Patient involvement in decision making [4]	Patient centeredness	2
iii) Quality of service encounters [21,29]	Patient centeredness Continuum of care	11
iv) Handing off and discharge [21,30]	Continuum of care	3
v) Existence of a feedback handling process [31]	Patient centeredness	4
vi) Existence of a customer satisfaction promise [32-33]	Patient centeredness	4

While it is evident that aspects i) and ii) represent patient-centeredness [e.g., see 4 and 21, respectively], aspect iii) can be broken down into multiple sub-aspects because the service encounters can be complex when all of them are considered [e.g., 34]. Patient transfer from one stage to another (aspect iv) is a point of potential problems and complaints [29]. Aspect v) provides the means for patients to communicate concerns and recommendations, thus emphasizing patient-centeredness [31]. As for aspect vi), a well-designed and implemented promise enhances customer loyalty [32-33] and satisfaction [33,35], by communicating to patients what to expect and the organization's commitment to meeting those expectations [32-33, 36]. Therefore, such a promise is related to patient centeredness. Aspects v) and vi) are also connected to ISO 10002:2012 and ISO 10001:2007, respectively.

3.6 Measurement of patient satisfaction (ISO 10004:2012, 7.3.3)

As ISO 10004:2012 suggests, qualitative methods such as interviews and focus group discussions involving patients and the staff can be performed to measure patient satisfaction. However, considering the resource scarcity and feasibility of such methods, it was decided that a patient satisfaction survey focused on the six selected care aspects and two chosen integrated care principles would be developed as an example of a measurement instrument for the care continuum. The survey was divided into six parts with a total of 28 items, including 14 items adapted from the [15] and [16] surveys (see Table 2). The benefit of this adaptation is that the items are already validated, are familiar to the users and allow the possibility of comparison of results. Parts A to D follow the patient's journey along the continuum, while parts E and F

relate to feedback-handling activities and promises made to patients, respectively. Table 1 above already showed the number of items for each selected aspect, while Table 2 below details the adapted and new items in the survey.

Table 2. *Organization of the ISO 10004:2012-based survey f care selected for measurement (adapted from Khan, 2016)*

Part	Total number of items	Number of items adapted from the HQCA survey [15]	Number of items adapted from the HCAHPS survey [16]	Number of new items
A. In the Emergency Department	9	6	1	2
B. Move from emergency department to hospital	1	0	0	1
C. At the hospital	8	2	5	1
D. Discharge from hospital	2	0	0	2
E. Feedback-handling process	4	0	3	1
F. Customer satisfaction promise	4	0	0	4

Part A, which relates to the emergency department and includes closed-ended questions only, starts with potential service encounters with the EMS (Emergency Medical Services) and security personnel at the entrance to the emergency department. It is important to investigate these initial encounters, in which patient satisfaction may not be measured otherwise. For example, the HQCA survey [15] does not have items specific to such encounters. Four questions regarding a patient's encounter with the nurse and the doctor were adapted from the HQCA survey. In addition, the survey has these two caregivers separated, which helps in differentiating their performance. A patient may have service encounters with a number of other support personnel, such as various technicians, bed coordinators, volunteers and porters. Hence, an item was introduced to explore those encounters. Additionally, two items adapted from the HQCA survey relate to the sharing of information with patients and their involvement in decisions. An item on the overall rating of the emergency care was adapted from the HCAHPS survey [16].

Part B relates to patient handing-off from the emergency to the inpatient care and includes one open-ended question: *"Did you experience any problems in getting a hospital bed? Please specify."* Therefore, additional information can be obtained on waiting time and patient expectations.

Part C is related to the inpatient care and follows the same pattern as Part A, with items on doctors and nurses, information sharing, patient involvement and overall hospital care. An item is included on service encounters with other inpatient personnel, such as therapists, people who deliver food, cleaning and housekeeping, social workers, volunteers and porters.

Part D includes two items, asking patients what problems they faced during and after their discharge from the inpatient care. These items are kept open-ended to obtain additional information on patient expectations.

Part E relates to a patient feedback-handling process [19]. Items include asking patients if they knew about the existence of such a process and about their experience of leaving feedback, as well as their overall satisfaction with the process.

Part F relates to a patient satisfaction promise. An inpatient unit of the hospital promises that its nurses will identify themselves to the patient and explain their role in the care process. The promise with its supporting activities is based on ISO

10001:2007 and was implemented [see 17-18]. Items in part F include one close-ended question on the existence and usefulness of the promise and feedback on the promise, as well as three open-ended questions on the promise and its improvement.

Two items on the overall measures of patient satisfaction within the emergency and inpatient care are included, but they are not directly related to the selected care aspects. Additional parts can be added to the survey if patients experience additional care stages (e.g., rehabilitation).

The complete survey and details regarding its construction are available in [14].

3.7 Verification of the survey

Suggestions, obtained by interviewing the research participants explained above in the methodology that were incorporated in the survey, are:

- The reading level of the items was kept as low (7.4, Flesch-Kincaid Grade Level, Readability Statistics, Microsoft Word 2010), taking into account patient abilities.
- The survey was kept fairly short with 28 items (initially, there were more than 40).
- Transition from one stage of care to another was made distinct (by providing proper titles of the care stages and their contexts).
- Some of the terminology was clarified and further explained. For instance, “Dietary staff” was replaced by “People who deliver food”, “People” was used instead of “Personnel”, and “Porter” was explained by “someone who pushed your wheelchair”.

4 CONCLUSION

Patient satisfaction measurement in integrated care has not yet been explored, [37] being the only example to date. The presented work helps in addressing this gap by applying ISO 10004:2012 as the conceptual framework for the measurement, as well as in defining the measurement activities. As ISO 10004:2012 is not specific to integrated care, new activities and additional concepts were introduced, along with the existing standard guidance. For instance, the first two of the four steps mentioned in the methodology (i.e., studying the care continuum and determining its existing measurement of customer satisfaction) are not included in the standard. Similarly, in the survey, some items were adapted from two currently-administered surveys, although the standard does not suggest such adaptations.

The presented work should be applicable in other organizations with minimal modifications, as the selected continuum is common in any hospital. The steps followed in developing the measurement activities, as well as the applied principles (e.g., patient centeredness) and approaches (e.g., following the patient’s experience along the continuum and the “SIPOC and care provider” analysis) are all generic, and therefore should be replicable in other continua. For a totally different continuum, such as maternal health or chronic disease management, the survey items might be substantially different. However, the measurement activities are generic and should be very similar.

The survey, when administered, should hopefully help in providing an overview of patient satisfaction along the continuum. Adaptation of items from existing surveys demonstrates streamlining the work by looking into current activities and picking their useful components. This approach should hopefully reduce fragmentations and discontinuity seen in traditional measurement activities. The HQCA and HCAHPS

surveys [15-16] did not include specific items related to the support staff (e.g., the therapist and dietary, cleaning and security personnel), all of whom were identified in the "SIPOC and care provider" analysis and included in the developed survey as part of investigating the service encounters.

The paper shows how the measurement of patients' care experiences, the performance of a feedback-handling process and promises made to patients can be brought together in one instrument. This serves as one of the first examples of integrative augmentation of ISO 10001 and 10002-based systems using ISO 10004:2012 in health care, helping to conceptualize a comprehensive patient satisfaction framework for integrated care.

Not all of the integrated care principles were met in the selected care continuum because the care was not actually "integrated". The developed survey was only partially validated, and conducting the survey on patient samples would aid in further development of the tool. The ISO 10004:2012 guidance on monitoring customer satisfaction had not been included because the actual implementation of the survey was not performed. In future research, a study can be undertaken by involving patients in validating the survey, which should be useful in further investigating the appropriateness and feasibility of the survey items. It should be interesting to investigate the applicability of the developed measurement activities, especially administering the survey on a sample of patients in a real integrated care case.

The findings contribute in advancing the theories of patient satisfaction measurement in integrated care and integrative augmentation of standardized management systems.

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THE RESEARCH ABOUT THE USE OF STATISTICAL TOOLS AND METHODS IN MANAGEMENT SYSTEM

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Abstract: The paper represents the research about the use of statistical tools and methods in organizations of metal- processing industry. Those organizations have coordinated their business and management system with the requirements of International Standards for quality, environment and safety. The summary of extensive research about the possibilities of applying the modern business methodology improvement, "Six Sigma" is represented. Research results show that the oldest and the simplest methods are the most popular and the most used methods in practice. There are few organizations that apply statistical tools and methods proposed by professional and scientific literature and others don't use it. Reasons for that are various and they are represented in this paper.

Key words: Management systems, improvement, statistical tools and methods

1 INTRODUCTION

In addition to being "the first", it is very important to have a greater quality product due to competition and to meet demands, needs and expectations of customers. The main difference between succesfull and less succesfull organizations is that the first one recognizes and respects consumer needs and demands. Accordingly they improve their processes and put product quality on the first place [2,5]. Organizations have to plan and apply processes of control, measurement, analysis and improvements to be able to continuously elevate efficiency and effectiveness of management system. This is also a reason for issuing ISO/ TR 10017 as a guide for organisations in defining statistical techniques that can be useful during implementation, application, sustaining and improvement od management system.[1]. The knowledge about statistical techniques and their proper application are huge. Evidence for that can be seen in bussines strategy "Six Sigma" or "Lean Six Sigma" that is focused on development and production of products and services. This strategy is close to perfection and it is based on the use of statistical techniques [3,4].

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2 REASONS FOR DOING IMPROVEMENTS

The goal of every improvement is rationalization. By combining rationalization and targeted investments, the best efficiency can be achieved. The goal is to achieve a better quality product and service by using fewer material, energy and other resources as possible. Improvement of any process in the organization and overall system is inevitable. If this is not achieved, even the best organization are condemned to failure. Accordingly, even the best structured management systems must be subjected to a continuous improvement process. Only in this way, all preconditions for quality products and services can be ensured. This creates conditions for meeting customer requirements, their needs and expectations. The final result is to satisfy all interested parties (customers, suppliers, owners, workers, subcontractors, employees, local communities, investors, etc.). For example from the aspect of continuous improvement, achieving quality cannot be a fixed goal. Quality can be compared with automatic stairs in the supermarket. They're in a constant move and going up. The same is with quality. I constantly has to be advanced in the sense of being better, bigger, stronger, safer, reliable, adequate, cheaper, etc. To achieve that organization has to take a continuous improvement path not only from the aspect of products or services that are final outputs, but it has to encompass all phases of main and logistic processes which lead to that very output, while respecting the proper environmental standards, work safety, energy rationalization and other demands during the whole process. Basically, improvement actions can be observed through gradually and "breakthrough" improvements based on the PDCA cycle principles. Those actions all called in literature "Quality Improvements – QI". Figure 1 represents application of continuous improvement in gradual and "breakthrough" way of improvement [12].

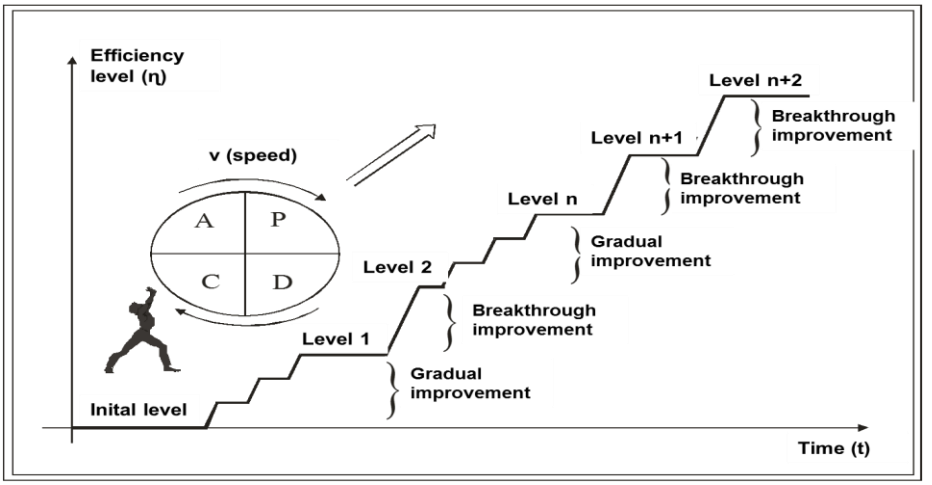

Figure 1. *Continuous improvement*

3 PLACE AND ROLE OF STATISTICAL TECHNIQUES IN IMPROVEMENT PROCESS

Only companies that strive toward business excellence and consider improvement process and business improvement their obligation can successfully use modern improvement methods. Their application is not excluded at lower organizational levels (organization in terms of development and business results). Some researches show that simpler methods and tools are used at lower levels, and more complex ones on higher organization levels. As an instrument, statistical methodology, has found its application in organizations thanks to quality management system development. For successful application of statistical techniques in all organization processes, full management commitment to management systems (primarily quality) is required. This commitment starts with top management and runs through all management structures. The goal of every management systems is achieving the expected or required quality by reducing disturbances in business processes. The emphasis is on processes rather than on products or services. This approach enables variability control, and moreover prevents creating product and service nonconformance. A series of mathematical and statistical techniques are used in quality management and other systems, but on the other hand, specific requirements and quality management problems, environment problems and others impose the need to improve existing ones and develop new, more efficient mathematical and statistical decision-making techniques.

There are only few managers or employees in Japan who are not familiar with the seven traditional quality improvement tools. Those are techniques from descriptive statistics, known as "seven tools" [5]. Today are more often mentioned seven new methods of statistical process quality control. In "Management for Quality Improvement: The 7 QC Tools," Mizuno mentions seven new management tools for statistical quality control, which are the result of research done all around the world by the Japanese Society for Quality Control Technique development. Definitely, organizations are not limited with those 7 + 7 techniques. There are many other methods, simple and complex that deserve to be used or applied in specific conditions. It is also difficult to imagine an organization that does not need any of the techniques and methods in their business [6].

4 RESEARCH ABOUT THE APPLICATION OF STATISTICAL TECHNIQUES

Regarding the cognition and significance about the benefits of using statistical tools and methods, many indicators show that companies in practice do not use them often as they should. The research was conducted in Croatian engineering companies in three Counties. Surveyed companies had their quality management, environment and work safety systems according to International Standards for Quality ISO 9001, ISO 14001 i OHSAS 18001. Research goal was to determine the condition of statistical-methods usage in business and possible reasons of insufficient levels of methods usage.

The assumption for not using statistical techniques in everyday business were several reasons: cultural, insufficient level of knowledge, inefficient management, size of the company, ownership structure, business activity, non-harmonized criteria of certification houses, etc. Research results have been used to make proposal for more efficient and effective use of statistical methods in companies in order to increase the efficiency and efficiency of their management systems. Survey was conducted by using questionnaire that was sent to targeted companies.

Table 1 shows companies categorization according to employees number. Total amount of surveyed companies was 59.

Table 1. *Categorization of surveyed companies by the number of employee's*

Company category	SIZE (due employees number)	Number of Companies -FREQUENCY			
		County 1	County 2	County 3	∑
O1	<50	11	8	6	25
O2	51-100	8	6	6	20
O3	101-200	3	4	3	10
O4	201-300	1	0	1	2
O5	>300	0	1	1	2
Total		24	20	15	59

4.1 Survey results display

On a survey question: "Do you use statistical techniques?" respondents have answered YES or NO. The results are shown in Table 2.

Table 2. *Respondents answers about the use of statistical techniques*

Respondents answer	Company size					∑
	O1	O2	O3	O4	O5	
YES	2	4	7	1	0	14 (24%)
NO	23	18	4	0	0	45 (76%)

The respondents who use statistical techniques (14% of respondents) had to answer which of specified techniques they use and in which situations they use them more frequently: process input, process output, in the process of product or service realization, in every phase and for problems solving in management systems (figure 2) [9,10].

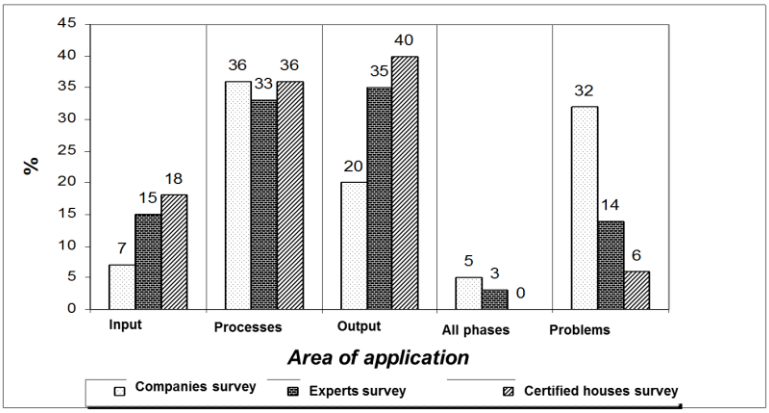

Figure 2. *Use of statistical techniques according to the area of application*

Respondents who use statistical techniques are asked to answer which of technique that are mentioned they really use. Due to comparison, the results of surveyed experts and certification houses were also given.

Table 3. *The results of companies' usage of the above mentioned statistical methods*

No.	Techniques or groups of statistical techniques according to ISO /TR 10017:2003	Company size				Σ
		O1	O2	O3	O4	
«Seven Tools».	Cause and effect diagram	2	4	6	1	13
	Histogram	1	3	5	1	10
	Scatter diagram	0	0	0	1	1
	Paretov diagram	2	4	7	1	14
	Control charts	0	0	0	1	1
	Flow chart	2	4	7	1	14
	Content sheet (ispitni list)	2	3	5	1	11
«The 7 QC Tools»	Matrix diagram	0	0	1	1	2
	Relationship diagram	0	0	0	1	1
	Matrix analysis	0	0	0	0	0
	Arrow shape diagram	0	0	0	1	1
	Process maps	0	0	0	0	0
	Tree diagram	0	0	1	1	2
	Casual diagram	0	0	0	0	0
15.	Experiment plan	0	0	0	0	0
16.	Hypothesis testing	0	0	0	0	0
17.	Measurement analysis	1	1	2	1	5
18.	Process ability analysis	0	0	1	1	2
19.	Regression analysis	0	0	0	1	1
20.	Reliability analysis	0	0	0	0	0
21.	Sampling	0	1	5	1	7
22.	Simulation	0	0	0	0	0
23.	Control Charts (SPC)	0	0	0	1	1
24.	Statistical Tolerance	0	0	0	0	0
25.	Time series analysis	0	0	0	0	0

Table 4 represents respondent's opinion about the utility from using statistical technics in business.

Table 4. *Utility from using statistical techniques*

No.	Utility from statistical technique application	Company size					%
		O1	O2	O3	O4	O5	
1.	Without significance	1					7,1
2.	Moderately useful	1	1				14,3
3.	Useful		1	4			35,7
4.	Significantly		2	3	1		42,9
TOTAL ANSWERS							

Respondents who answered negatively on question about the use of statistical techniques were asked to indicate three reasons why they are not using mentioned techniques. Their reasons are showed in table 5.

Table 5. *The reasons for not using statistical techniques*

No.	The reasons for not using statistical techniques	Number of respondents who don't use statistical techniques (45 x 3 answers = 135)	Percentage (%)
1.	Branch type	10	7,41
2.	Individual production	4	2,96
3.	Lack of knowledge	33	24,44
4.	Inadequate management engagement	25	18,52
5.	Cultural reasons	5	3,70
6.	100% control is better	11	8,15
7.	Size of the company	30	22,22
8.	Poor IT support	13	9,63
9.	Nobody demands it	2	1,48
10.	Combination of the above mentioned reasons	1	0,74
11.	No adequate reason	1	0,74
TOTAL ANSWERS (45 x 3 – each respondent could mention three reasons for not using statistical techniques)		135	100

5 SHORT COMMENT ON SURVEY RESULTS AND CONCLUSION

Research data showed that two thirds of respondents who use statistical techniques have learned those techniques by them self, without supervision and training that was organized by their employer. In that sense, management has a great responsibility for suporting their stuff to learn and share knowledge.

- Research showed that few organizations (only 24% of respondents) from the metal processing industry are using statistical tools and methods that are currently proposed in the literature, especially in ISO / TR 10017: 2003.
- Statistical descriptive techniques are commonly used in practice.The most used techniques are Seven Tools: Pareto diagram, Ishikawa diagram and Flow chart. The 7 QC Tools are used only in three organizations and they use only Matrix chart and Tree diagram. The main reasons for that is lack of knowledge (24% of respondents). Similar situation is also with other techniques mentioned in ISO/TR 10017:2003.
- Figure 2 represents percentage of organizations that use statistical techniques due to area of application. More than half of respondents (58%) use these techniques in processes and are able to solve various types of problems. Only few organizations use these techniques at process input or process output. In this paper due to comparison are also given the results of survey done by quality experts and certification houses.
- More than 70% of organizations considers utility from using those techniques useful or significant.
- Application of statistical techniques is related to the size of an organization. The results show that bigger organizations in relationship with small ones, use various tools and they use them more frequently.
- Research has shown that form of ownership has an influence on the application of statistical techniques. Most organizations who use techniques are Ltd. companies or Joint Stock Companies. The influence of ownership structure has been excluded from future research.
- Data showed that region's where organizations are registered don't have direct influence on the use of statistical techniques and as a previous factor is excluded from further research.

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AS/EN 9100:2016, TRANSITION PROCESS, KEY CHANGES

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Abstract: The new issue of standard EN 9100:2016, which are based on ISO 9001:2015 (replaced issue ISO 9001:2008), specify requirements for establishing, implementing, maintaining and continually improving a QMS for any organization in aviation space and defense industry. Main target of this revised standard is to add clarity and enhance ease of use while addressing industry and stakeholders needs. Every company with version AS/EN 9100:2016 will be able to: introduce and integrated approach with other management system standards, bring quality and continual improvement into the heart of organization, increase involvement of leadership team and introduce risk and opportunity management in quality management system. This paper is talking about key changes of new version of AS/EN 9100:2016, as more agile

Key words: new issue, standard AS/EN 9100:2016, transition, key changes

1 INTRODUCTION

The International Aerospace Quality Group (IAQG), who operate the AS/EN 9100 series of quality management standards have decided to continue to base the series on ISO 9001 with some additional enhancements. All ISO management system standards are subject to a regular review under the rules by which they are written. Following a substantial user survey the ISO 9001 committee decided that a review was appropriate to maintain its relevance in today's market place. The new standards will help organization to:

- Ensure inclusion to the Online Aerospace Supplier Information System (OASIS) database
- Integrate with other management systems
- Provide an integrated approach to organizational management
- Reflect the increasingly complex international environment in which organizations operate in this industry
- Ensure the new standard reflects the needs of all potential user groups
- Enhance an organization's ability to satisfy its customers and continually improve

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2 WHAT IS AS/EN 9100:2016 STANDARD

AS/EN 9100 encompasses ISO 9001, with additional requirements for quality and safety relevant to aerospace, and defines the quality management systems standard for the industry. All major aerospace manufacturers (original equipment manufacturers OEMs) and suppliers worldwide endorse or require certification to AS/EN 9100 as a condition of doing business with them.

The AS/EN 9100 series International Aviation, Space and Defense Quality Model has approximately 105 additional requirements beyond ISO 9001, including (picture no.1.):

- Configuration Management,
- Risk Management,
- Special Requirements,
- Critical Items,
- On Time Delivery,
- Project Management,
- Supplier Scope of Approval.
- Objective of AS/EN 9100 standard are:
- Establish commonality of aviation, space and defense quality systems, “as documented” and “as applied”,
- Establish and implement a process of continual improvement to bring initiatives to life,
- Establish methods to share best practices in the aviation, space and defense industry,
- Coordinate initiatives and activities with regulatory/government agencies and other;

Figure 1. *What is AS/EN 9100 standard? [6]*

Why does AS&D have their own standards? Many reasons for that, some of them are following:

- High risk products,
- High cost products,
- Tightly controlled industry requirements (Statutory, Regulatory, Customer),
- Safety is a must,
- Quality s required,
- Failure is not an option, [2].

2.1 Key Benefits of introducing AS/EN 9100 requirements

The aircraft and aerospace industries have embraced AS9100 as a critical tool for improving quality and on-time delivery within their supply chains. Most of the major aircraft engine manufacturers require AS9100 certification for their suppliers.

Benefits of certification to AS9100 global industry standards include:

- A qualification to supply major aerospace manufacturers,
- Easy integration into existing quality management systems as the AS9100 standard is based on ISO 9001, with additional, industry critical criteria,
- Access to the best practices of the aerospace industry for quality and traceability to help reduce operational risk,
- Enhanced marketability of products and services through third-party proof of company commitment to deliver high-quality products and services,
- A focus on customer satisfaction: performance objectives must be aligned to customer expectations
- Access to global markets through internationally recognized certification [1].

3 CONTEXT, INTERESTED PARTY EXPECTATIONS AND OBJECTIVES

3.1 Context

"Context" is a term that has been hot in business circles during the last few years. Context, or "contextual intelligence," has been associated with setting company strategy. The argument has been that companies need to consider the context of the organization when they design their strategy, goals, and objectives [8].

Context, then, has entered into our lexicon from a business perspective. An organization's context, both internal and external, will influence the policy, objectives, and processes of the quality management system (QMS). ISO 9001 says that an organization needs to identify the internal and external issues "relevant to the purpose and the strategic direction and that affect its ability to achieve the intended result(s)." In a note, ISO 9001:2015 suggests that both internal and external issues must be developed when determining the context of the organization. The external context needs to consider issues from legal, technological, competitive, market, cultural, social, and economic environments, whether international, national, regional, or local. Internal context needs to consider issues related to values, culture, knowledge, and performance.

Figure 2. *A quality management system with context [7]*

The organization then identifies not only customer expectations, but also interested-party expectations. ISO 9001:2015 scopes interested parties and their requirements to those that are relevant to the QMS. Once the issues related to the context as well as interested-party expectations and requirements are identified, what's next for the organization?

The organization uses the context and the strategic direction to formulate the quality policy and objectives (5.1.1 b). The organization also uses the context and the interested-party expectations to determine the risks and opportunities, and subsequently, the actions to address them (6.1.1 and 6.1.2). Strategy is defined as planned activities to achieve an objective (3.3.5), and hence, strategic direction can be thought of as the mission and vision that define the quality policy and objectives (figure 2.).

3.2 Risk based thinking

Many aerospace organizations thought that sub-clause 7.1.2 "Product realization risk" in AS 9100 Rev. C would suffice for meeting the requirements of ISO 9001:2015. However, ISO 9001:2015's risk-based thinking is more comprehensive; clause 6.1 is about planning risk or the risk and opportunities of not meeting "intended outcomes."

Risk based thinking is a way how to organization understand it's context and determine risk as a base for planning. In that way, key purpose of QMS is to to act as a preventive tool, hence no separate clause on preventive action. Risk based thinking has enabled some reduction in prescriptive requirements and greater flexibility. There is no requirement for formal methods for risk management.

Within aviation, space and defense, risk is expressed as a combination of severity and likelihood of having a potential negative impact to process, products, services, customer, or and users. Due to the complexity of AS&D processes, products and services and the severity of potential consequences of failures, a formal process to manage of operational risk is required.

3.3 Leadership

Another big change found in AS9100 Rev.D is the expectations and accountability of top management. Even though responsibilities can be delegated, accountability is with top management. Top management is responsible for AS9100 performance, ensuring that senior management perform their responsibilities and that AS9100 is functioning satisfactorily. In short, top management is in for a major surprise if they think that it's "business as usual."

Top management might be surprised to learn that the standards hold them accountable for the effectiveness of the QMS or the EMS. This expanding role in management system accountability is considered by some to be the biggest change in the standards, and the biggest challenge for compliance. Top management must be involved in organizational improvements, working with others to make this happen. Top management is also asked to play an important role in promoting a process approach, risk-based thinking, and customer focus.

Some of the new and expanding responsibilities of leadership include:

- Accountability for the effectiveness of the QMS and EMS;
- Rethinking the quality and environmental policies;
- Integrating QMS and EMS requirements into the business processes via an IMS:
- Promoting process approach, risk-based thinking, and customer focus.

The purpose of this requirement is to demonstrate leadership and commitment,

from the top.

Top management now have greater involvement and responsibility in the management system and must ensure that requirements of it are integrated intro the organization's process and that policy and objectives are compatible with strategic direction of the organization.

4 BENEFITS AND APPLICATION

When an company implemented and managed new issue of AS/EN 9100:2016 requirements, can improve:

- produce and continually improve safe and reliable product,
- meet or exceed customer and regulatory requirements to ensure satisfaction,
- processes necessary to conduct day-to- day business are defined ans managed,
- documentation accurately reflect the work to be performed and action to be taken,
- focus on the complete supply chain and stakeholders,
- fewer customer unique documents,
- recognized by regulatory authorities.

Also, implementing this standard requirements can improve next organizational elements, which are basic for QMS management:

- Establish commonality of aviation, space and defense (AS&D) QMS requirements,
- Takes into account new requirements form AS&D and other QMS standards,
- Incorporates stakeholders feedback,
- -Provide a common baseline with ISO 9001:2015 which benefits:
  - Supplier with dual certification requirements,
  - Sub-tier suppliers who only needs ISO 9001,
  - Commonality enhances both auditor flexibility and reduced training.

With the 2016 versions of AS/EN 9100 company will be able to:

- Introduce an integrated approach with other management system standards
- Bring quality and continual improvement into the heart of the organization
- Increase involvement of the leadership team
- Introduce risk and opportunity management

They will be much less prescriptive than the previous versions and can be used as more agile business improvement tools. This means that you can make the new standards relevant to the requirements of your organization to gain sustainable business improvements.

One of the major changes to the AS/EN 9100 series is that it brings quality management and continual improvement into the heart of an organization. This means that the new standard is an opportunity for organizations to align their strategic direction with their quality management system. The starting point of the new version of the standard is to identify internal and external parties and issues which affect the QMS. This means that it can be used to help enhance and monitor the performance of an organization, based on a higher level strategic view.

All customers tell that they get multiple benefits as a result of implementing and adopting a system that meets the requirements of the AS/EN 9100 series. The new versions will continue to do this and provide additional value [7].

Major Target Dates	Activities
October 2016	Publication of 9100/9110/9120:2016 and 9101:2016 Standards.
June 2017	CBs must have completed transition to ISO 17021:2015 and revised their accreditation scope to include 9100/9110/9120:2016 All future audits must be to the 9100/9110/9120:2016 standard using 9101:2016 audit process. CB transition to ISO 17021:2015 must be completed. Any CB not transitioned will be withdrawn from ICOP scheme.
September 2018	Transition complete all 9100/9110/9120:2009 certificates are no longer valid.

Figure 3. *Transition timeliness [7]*

5 CONCLUSIONS

Business needs and expectations have changed significantly since the last major revision of ISO 9001 in the year 2000. Examples of these changes are ever more demanding customers, the emergence of new technologies, increasingly more complex supply chains and a much greater awareness of the need for sustainable development initiatives. This conclusion has been base reason for decision established regarding to new issue of AS/EN 9100:2016 standard.

Key changes, regarding to new issue of this standard, are part of leadership, top management role in QMS, as strategic process of organization development. Also, risk based thinking has bigger influence on all organizational process, which exclude preventive actions as a part of continual improvement.

There is also a greater focus on the top management to enhance customer satisfaction by identifying risks and opportunities that could affect this. In the same context, they need to have grasp of the organization's internal strengths and weaknesses and how these could have an impact on delivery and conformity of product and services, which has main organization target.

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IMPACT OF CHANGE IN ENTRY TEMPERATURE OF HEATED FLUID ON TERMIC CHARACTERISTICS OF OPOSITE DIRECTIONAL HEAT EXCHANGER „BEAN OF PIPES IN A SHELL“

Dragan Cvetković[1], Aleksandar Nešović[2]

Abstract: Although the most simple type and despite the fact there are more efficient heat exchangers, those of a type “pipe and a shell” are used often. Goal of this paper is to show how change in temperature in heat fluid on the entrance into the heat exchanger affects its thermal characteristics. Object of research is opposite stream heat exchanger “flux of pipes in shell.” Role of working fluid on the side of primary has water, as on side of secondary. Research is conducted numerically and commercial software ANSYS Workbench 15.0 was used.

Key words: heat exchanger, ANSYS, heated fluid, heat transfer, mean logarithmic temperature difference.

1 INTRODUCTION

Heat exchanger “pipe and shell“is the oldest group of heat exchangers. Although they have lower percentage of usefulness when compared to other heat exchangers, they are used frequently in different process systems. Reason for their frequent use is simple construction, easy installation, easy cleaning and maintenance. Main representative of this group of heat exchangers is „beam of pipes in a shell“ [1] [2].

With this kind of construction, beam of pipes is placed in a bigger pipe which represents a shell. Heat exchange is done between a fluid that streams inside beam of pipes and a fluid that streams between beam of pipes and a shell so that active surface for heat exchange is defined by number of pipes which are part of the beam, by its outer diameter and by its length [3] [4].

Within this subgroup of heat exchangers there are different constructions. Beam can contain straight pipes, „U“ shaped pipes or spiral ones. According to direction of stream, these heat exchangers can be one directional or opposite directional. As for number of passes of fluids that take part in heat exchange, there are heat exchangers with one, two or more passes. Also, one or two fluids can take part in heat exchange. Fluids that take part in the exchange can ne in fluid or gas phase [3].

There are many scientific papers which present research results in relation to „pipes and shall“ heat exchangers.

B. Jayachandriah and K. Rajasekhar examined [5] how choice of materials that were used to make beam of pipes impacts exit temperature of working fluids that are

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used for heat exchange in heat exchanger " Pipes and shell." Impact of copper and steel pipes has been examined through the experiment.

Vindhya Vasiny Prasad Dubey and others [6] examined impact of choice of materials on coefficient of heat passage and exchanged heat flux in heat exchanger, while materials of shell and pipe are changed. Materials used in this analysis are steel, copper and aluminum.

Impact of Reynolds number on pressure fall and coefficient of heat exchange and the exchanger were examined by Rehman [7]. Research has been conduced numerically (ANSYS Workbench) and experimentally.

Objective of this paper is to see how change in temperature of fluid on the entrance of heat exchanger impacts exit temperature of heat fluid and mean logarithmic difference of temperatures. Also, it will be shown that exit temperature of primary from every pipe inside beam is not the same, despite the entry temperature is the same.

2 OBJECT OF RESEARCH

2.1 Construction of heat exchangers

Object of research is opposite directional heat exchanger „beam of pipes in a shell" with one passage of primary hear fluid and one passage of secondary heat fluid. (Figure 1, Figure 2).

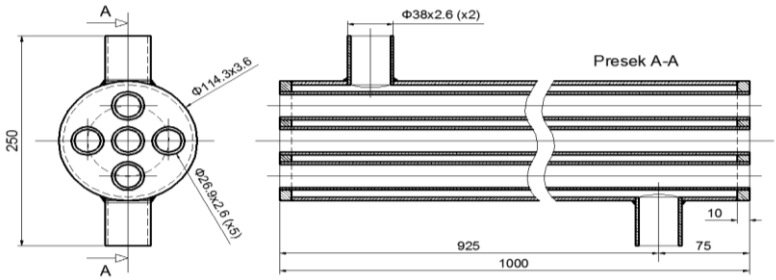

Figure 1. *Opposite directional heat exchanger „beam of pipes in a shell"*

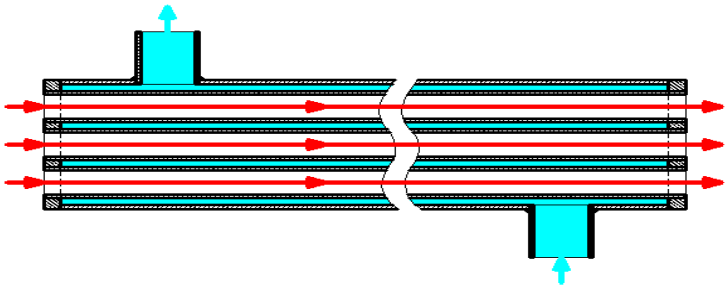

Figure 2. *Electric streams of working fluids inside of analyzed heat exchanger (primary – red colored, secondary – blue colored)*

As it can be seen (Figure 1) total length of heat exchangers is 1000 mm. Beam consists of 5 straight pipes, each with diameter of ∅26,9x2,6 mm. Secondary both enters and departs the heat exchanger through pipe with diameter of ∅38x2,6 mm. Diameter

of shell is ∅114,3x3,6mm[8].

Complete heat exchanger is made of custom steel pipes, which can be seen in the following table below (Table 1).

Table 1. *Characteristics of custom steel pipes from Ansys Fluent*

Size	Sign	Unit	Value
Density	ρ_c	[kg/m^3]	8030
Specific heat	c_c	[J/kg K]	502,48
Heat conductibility	λ_c	[W/m K]	16,27

Water has the roles of primary and secondary so that heat exchanger is classifies as „water-water. “

Physical and chemical characteristics of water are provided in the table below (Table 2).

Table 2*. Physical and chemical characteristics of water from Ansys Fluent*

Size	Sign	Unit	Value
Density	ρv	[kg/m3]	998,2
Specific heat	cv	[J/kg K]	4182
Heat conductibility	λv	[W/m K]	0,6
Dynamic viscosity	μv	[kg/s m]	0,001003

2.2 Thermodynamic calculation of heat exchangerslets

Power of heat exchanger is determined by formula (1)[1] [4].

$$Q = A_{ak} \cdot U \cdot \Delta T_m \quad (1)$$

where is:

Q	[W]	- power of heat exchanger;
A_{ak}	[m^2]	- active surface for heat exchange of heat energy;
U	[W/m^2 K]	- coefficient of heat passage;
ΔT_m	[K]	- mean logarithmic difference between temperatures.

Active surface for heat exchange is in this case determined on the following way (2.2.2) [4].

$$A_{ak} = n \cdot d_s \cdot \pi \cdot L_{ak} \quad (2)$$

Where is:

n	[-]	- number of pipes contained in a beam;
d_s	[m]	- outside diameter of pipes in a beam;
L_{ak}	[m]	- Length of pipes that take part in the exchange actively.

To calculate coefficient of heat passage, this formula is used (3). Mean logarithmic difference of temperatures (with opposite directional heat exchanger) is determined by formula (4) [9].

$$U = \frac{1}{\frac{1}{h_1} \cdot \frac{d_s}{d_u} + \frac{\delta_c}{\lambda_c} \cdot \frac{d_s}{\left(\frac{d_s + d_u}{2}\right)} + \frac{1}{h_2}} \tag{3}$$

$$\Delta T_m = \frac{(T_{1u} - T_{2i}) - (T_{1i} - T_{2u})}{\ln \frac{(T_{1u} - T_{2i})}{(T_{1i} - T_{2u})}} \tag{4}$$

Where is:

h_1, h_2	[W/m^2 K]	- coefficient of heat passage on the side of primary (on side of secondary);
d_u	[m]	- inside diameter of pipes in the beam;
δ_c	[m]	- thickness of pipe's wall in the beam;
λ_c	[W/m K]	- heat conductibility of pipe in the beam;
$T_{1u}, T_{1ı}$	[K]	- temperature of the primary on the entrance (on the exit);
$T_{2u}, T_{2ı}$	[K]	- Temperature of the secondary on the entrance (on the exit).

Coefficient of heat passage (5) depends from the *Nusselt*'s number (N_u) of hydraulic radius (R_h), and heat conductibility of primary and secondary, in this case water (λ_v) [1] [4].

$$h = \frac{N_u \cdot \lambda_v}{R_h} \tag{5}$$

Where is:

N_u	[-]	- *Nusselt*'s number;
R_h	[m]	- hydraulic radius;
λ_v	[W/m K]	- Heat conductibility of fluids (water).

For the case of forced convection, *Nusselt*'s number determined by size in expression (6) [10].

$$\mathrm{N_u} = \mathrm{c} \cdot \mathrm{R_e^n} \cdot \mathrm{P_r^m} \cdot \mathrm{G_r^r} \cdot \left(\frac{\mathrm{P_r}}{\mathrm{P_{rc}}}\right)^{0.25} \tag{6}$$

Where is:

R_e	[-]	- *Reynolds* number;
P_r	[-]	- *Prandtl's number*;
G_r	[-]	- *Grashof*'s number;
P_{rc}	[-]	- *Prandtl*'s number of pipe's wall;
c, *n*, *m*, *r*	[-]	- Coefficients that depend from stream direction.

2.3 Method of final volumes

Method of final volumes (Figure 3) j is one of the most applied methods in modeling of fluid streams. First of all, calculated volume is exchanged with certain number of controlled volume. After that laws of preservation are applied on every controlled volume [11].

Goal of this method is to translate differential equations that describe every control volume to algebra equations by applying integrals. After translated, they are to be solved [11].

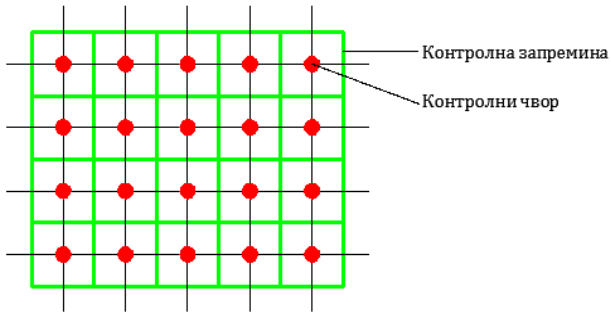

Figure 3. *Method of final volumes*

By using regular equation of preservation (7) it is possible to describe all equations of preservation that are described by streaming and heat transfer [11].

$$\frac{\partial(\rho \cdot \Phi)}{\partial t} + div(\rho \cdot \vec{w} \cdot \Phi) = div(\Gamma \cdot grad\Phi) + S_\Phi \tag{7}$$

By making integral to the equation (7) according the control volume and time it is possible to get integral form of preservation equation (8) which represents basis for application of final volumes method [11].

$$\int_{\Delta t} \frac{\partial}{\partial t}\left(\int_{CV} \rho \cdot \Phi \cdot dV\right) \cdot dt + \int_{\Delta t}\int_{A} \vec{n} \cdot (\rho \cdot \vec{w} \cdot \Phi) \cdot dA \cdot dt = \tag{8}$$

$$= \int_{\Delta t}\int_{A} \vec{n} \cdot (\Gamma \cdot grad\Phi) \cdot dA \cdot dt + \int_{\Delta t}\int_{CV} S_\Phi \cdot dV \cdot dt$$

3 RESULTS AND DISCUSION

On the following figures (Figure 4 and, Figure 5) temperature field is shown in meridian plain of heat exchanger when temperature of primary on the entrance were 40°C, 65°C and 90°C.

Adopted temperature of secondary on the entrance is same in all cases and it is 30°C. It is same for speed of primary and secondary (in all examined cases it amounts to 0,02 m/s).

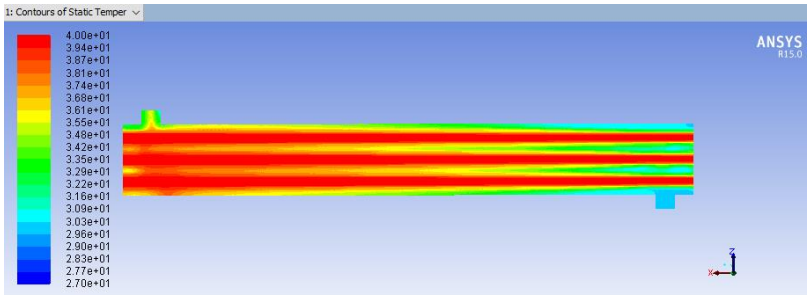

Figure 4. *Temperature field in meridian plain (temperature of primary on the entrance into the heat exchanger is 40°C)*

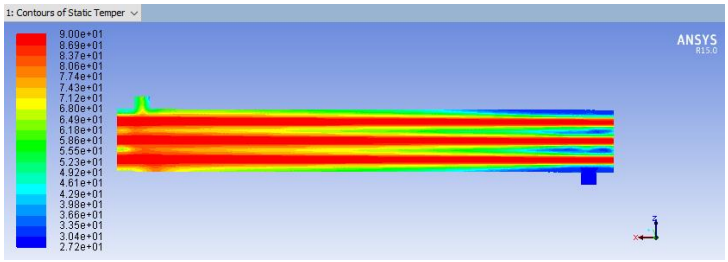

Figure 5. *Temperature field in meridian plain (temperature of primary on the entrance into the heat exchanger is 90°C)*

On the figures below (Figure 6, Figure 7, Figure 8) it is shown that temperature field in plain normal to the direction of pipe (distance of plain from place of the entrance of primary into the heat exchanger is 500 mm.

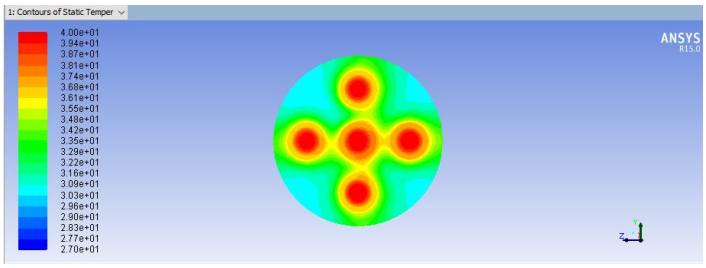

Figure 6.*Temperature field in plain normal to the direction of pipes (temperature of primary on the entrance is 40°C)*

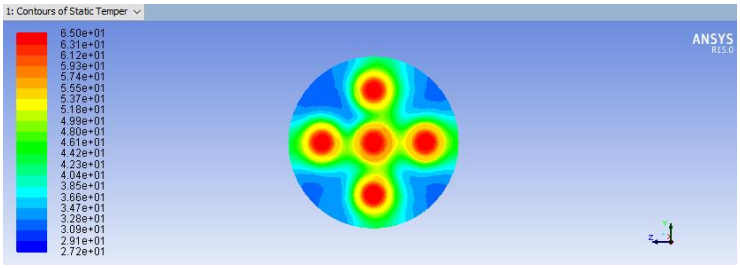

Figure 7.*Temperature field in plain normal to the direction of pipes. (temperature of primary on the entrance into the heat exchanger is 65°C)*

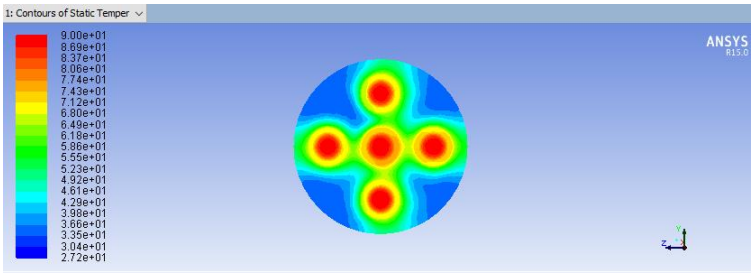

Figure 8.*Temperature field in the plain normal to the direction of pipe (temperature of primary on the entrance into the heat exchanger is 90°C)*

Way by which temperature of primary on the entrance into the heat exchanger impacts the temperature of secondary on the exit and to the total mean logarithmic differences of temperatures is shown on the diagram (Figure 8).

Total mean value of temperature o primary on the exit from heat exchanger is calculated according to the equations (9), (10), (11).

$$T_{1i_{u\,sr}} = \frac{\frac{\sum_{a=1}^{n} T_{1i_a}^{c_1}}{n} + \frac{\sum_{a=1}^{n} T_{1i_a}^{c_2}}{n} + \cdots + \frac{\sum_{a=1}^{n} T_{1i_a}^{c_j}}{n}}{\max(1,2,\ldots,j)} \tag{9}$$

$$T_{1i_{u\,sr}} = \frac{\frac{\sum_{a=1}^{n}\left(T_{1i_a}^{c_1} + T_{1i_a}^{c_2} + \cdots + T_{1i_a}^{c_j}\right)}{n}}{j} \tag{10}$$

$$T_{1i_{u\,sr}} = \frac{\sum_{a=1}^{n} T_{1i_{sr}}}{n \cdot j} \tag{11}$$

Value of total mean temperature of primary on the exit depending from the entry temperature of primary shown on Figure 9.

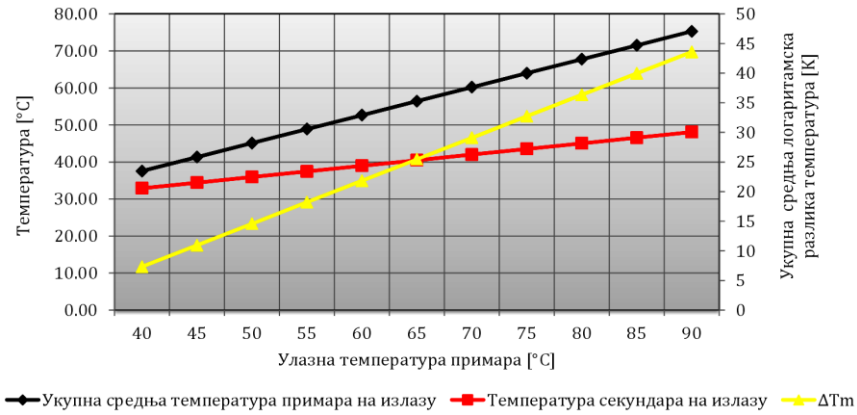

Figure 9. *Dependence between entry temperature of primary and exit temperature of secondary*

Mean temperature of primary on the exit from every pipe contained by flux for every examined case is shown in the following table (Table 3). Table 3 is followed by Figure10.

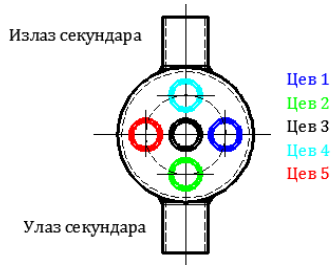

Figure 10. *Position of pipes inside flux*

Table 3. *Mean temperature of primary on the exit from every pipe contained by the flux*

Entry temperature of primary [°C]	Exit temperature of primary [°C]				
	Pipe 1	Pipe 2	Pipe 3	Pipe 4	Pipe 5
40	37,48	37,57	37,8	37,54	37,37
45	41,21	41,36	41,7	41,31	41,05
50	44,95	45,15	45,6	45,08	44,74
55	48,69	48,94	49,5	48,85	48,42
60	52,43	52,72	53,4	52,63	52,11
65	56,16	56,51	57,3	56,4	55,79
70	59,89	60,3	61,19	60,17	59,48
75	63,61	64,09	65,08	63,94	63,17
80	67,33	67,87	68,96	67,71	66,85
85	71,06	71,66	72,85	71,49	70,54
90	74,79	75,45	76,74	75,26	74,22

Change in temperature along every pipe contained by flux is not the same. That is why mean temperatures of primary are different on the entry to each pipe in the flux. If change in temperature is followed it will always be higher than mean temperature in plain and it goes through the point of interest.

Change in temperature of every pipe in flux (for case when temperature of primary on the entrance to heat exchanger is 40°C) is shown on the diagram (Figure 11).

On Figure 12 change of temperature is shown when the entrance temperature of primary is 65°C, while on the Figure 13 for entrance temperature of primary is 90°C.

Diagrams on Figure 11, Figure 12 and Figure 13 are analogue to the Figure 10 and Table 11.

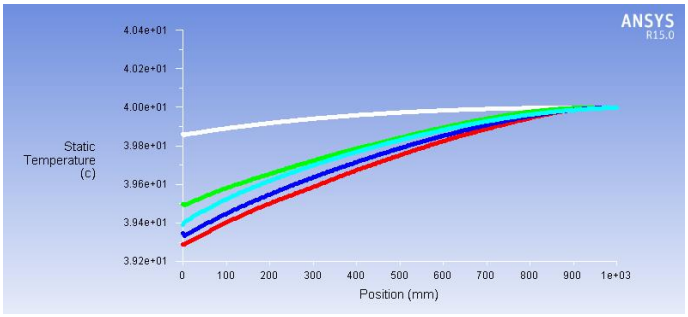

Figure 11. *Change in temperature along the axis of all pipes in the flux (temperature of primary on the entrance into the heat exchanger is 40°C*

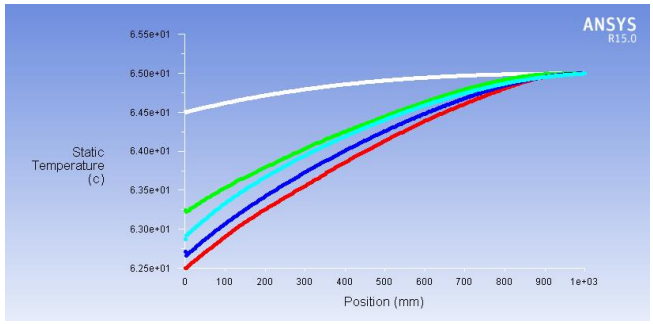

Figure 12. *Change in temperature along axis of all pipes in flux (temperature of primary on the entrance to the heat exchanger is 65°C)*

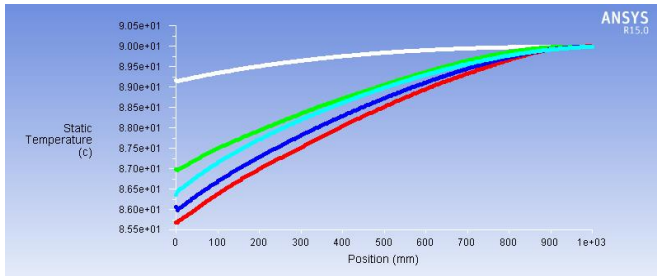

Figure 13. *Change of temperature along axes of all pipes in flux (temperature of primary on the entry into the heat exchanger is 90°C)*

4 CONCLUSION

Heat exchangers are used frequently in heating and air conditioning facilities and in other process systems. Amongst them, heat exchangers “flux of pipes in a shell” take very important place.

Inside this paper, possibility to change working parameter, such as temperature on the side of primary (while other parameters stay unchanged) has been examined. This is done frequently in practice. By changing entry temperature, exit temperature of secondary, mean logarithmic difference in temperatures and finally strength of exchanger are impacted greatly.

Research has shown that, if temperature of primary on the entry to the exchanger is higher, exit temperature of the secondary (and mean logarithmic difference in temperatures) will be higher as well. Also, the difference between entry and exit temperatures will be higher.

ACKNOWLEDGMENT

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BREAKDOWN OF WIND POWER PLANT AS A CONSEQUENCE OF MICRO-PITTING OCCURRENCE ON A POWER TRANSMISSION

Tomislav Mrčela [1], Zvonimir Mrčela[2]

Abstract: Contact surfaces of cylindrical gear pairs, which are found in wind plant power transmitter, are exposed to different physical and chemical phenomena. There are changes occurring in contact lines - surfaces below contact surfaces in addition to wear of hip gear pairs. There are benign changes that need to be controlled at a starting phase, but they do not cause a problem for safe operation. In friction through sliding and rolling, which is an integral part of every movement, there is a thin line between the normal and progressive, i.e. uncontrolled state of wear. The phenomenon of wear of gear hips is a complex process that can be studied only as a systematic model of contact surface wear. This paper presents a theoretical model of wear of gear hips and occurrence of micro-pitting with all relevant factors that affect the described phenomenon. Influence of micro - pitting was analyzed in terms of affecting breakdown of wind plants, i.e. its power transmitters. Power transmitter of a wind plant is located near the sea, thus being exposed to specific working conditions: non-stationary load changes environmentally caused chemical processes and occurrences in electric and magnetic field. In service conditions, power transmitters cannot be controlled only for pressure and roughness, although they are still dominant elements in creation of brittle fractures, plastic deformation, material fatigue and gear pitting.

Key words: gears, micro-pitting, wear.

1 INTRODUCTION

Gears are machine parts that are heavily loaded due to high stress level that occurs as a combination of cut teeth, which slide and roll with another toothed part. Due to high pressures that damage the teeth, the most common form of damage is the tooth root fracture. Another major damage is the appearance of a puncture damage - pitting, which can be either macro-pitting or micro-pitting. Up-to-date technology of gear production influenced significant reduction of surface finishing roughness on the appearance of tooth fractures. Gear teeth are hardened and crushed, however these technologies still have not managed to eliminate other important factors that affect the appearance of micro-pitting. Surface roughness is no longer a dominant factor, because after the drifting phase, the tooth surface roughness is a negligible element in modern power transmissions. In the first place, atmospheric influence happens due to high concentration of salt (sodium chloride) in the air. There is also the influence of

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electromagnetic field, as well as the influence of unpredictable cyclic impact loads, in this case of wind direction change and wind force. This paper presents the influence of other important elements - primarily the influence of atmosphere on the reliability of the power transmission operation. There is the analysis of the wind power plant located near the sea, as well as the analysis of electric and magnetic field influence. Constant overloads are a consequence of extreme changes in the atmosphere at the location of the Ravne 1 wind power plant on the island of Pag, near the city of Pag, above the Pag saltworks. These loads lead to cracking under the thermally processed gear tooth. Such crack, during repeated overload, moves towards the tooth surface, resulting in a sudden fracture of tooth root or its part. This mechanism is well known and it is described in the literature as a formation mechanism caused by cracking initiation, which is described in detail within the material fatigue mechanism. This paper presents a completely different mechanism of damage, referring to the appearance of micro-pitting after the introduction phase, with presence of lubricant – oil, and with the assumption of hydro-dynamic friction. The wind power plant was built by the Croatian company Adria Wind Power in August 2004. It disposes of 5.95 (MW) installed force, consists of 7 Vestas wind turbines of 850 (kW). The average annual wind speed is about 6.4 (ms^{-1}). The blade diameter is 52 (m).

2 THEORETICAL BASIS

The hydrodynamic lubrication of transmitters finds its theoretical basis in 1886, when Reynolds [1] set the differential equation of fluid pressure, as well as the critical thickness of the oil film.

$$\frac{\partial}{\partial x}\left(h^3\frac{\partial p}{\partial x}\right)+\frac{\partial}{\partial y}\left(h^3\frac{\partial p}{\partial y}\right)=6\eta\left[(U_1+U_2)\frac{\partial h}{\partial x}+2\frac{\partial h}{\partial t}\right] \quad (1)$$

In the defined equation (1), η refers to dynamic oil viscosity, and the solution of differential equation gives the pressure *p* in the function of position and time *p(x,z,t),* as well as the thickness of the oil film *h(z)*. U_1 and U_2 are vectors of slide speed.

Defined equality exists only if there are all conditions met that represent the initial state of the so-called "Newton's fluid". The defined parameters provided the theory of real lubrication, which is based on the equation of Navier-Stokes. [2],[3]

The Hetz contact theory defines the state of stress under the tooth surface - although the theory dates back to 1881, it is an absolutely relevant theory that describes the state of stress within the tooth, and it has maximum value for the point contact:

$$p_0=\frac{3}{2}\frac{F_N}{\pi a^2} \quad (2)$$

If there is a line contact on the tooth, then the equation (2) has the following expression:

$$p_0=\frac{4}{2}\frac{F_N}{\pi ab} \quad (3)$$

The equation (2) and (3) gives the maximum pressure below the edge of tooth, depending on the geometrical characteristics of the curve parameters (*a, b*) and the normal force component F_N.[4]

This paper presents the causes of micro-pitting damage on the side of tooth in the gear. The teeth surfaces interact with each other in relative motion, which is often referred to with the generic name of "wear". The wear refers to a variety of physical and chemical phenomena [5]. In order to understand the process of wear and the occurrence of micro-pitting damage, the occurrence itself must be thoroughly studied, because some parts of the gearing process are harmless, therefore the operation requires special attention while engaging a wind power plant.

A complex phenomenon is observed in the tribological mechanism of surface damage and as such, it requires scientifically based treatment. Transversal ruptures, as a result of roughness in the initial stage, are progressively removed from the tooth surface. For the process to be controlled, it is necessary to assure controlled load in the initial stage and to control the content of metal particles in the lubricant, all with the aim to prolong the lifetime of the toothed pair with a minimum slight wear.

The wear process is an inevitable occurrence, which happens because of sliding and rolling of gear teeth. Micro-particles that are ruptured in the process of relative motion travel in the fluid-oil stream and get pressed into the basic crystalline structure of gear sides that are thermally treated. In the contact of two meshing gears, gear slip vectors are opposite, and their roughness is anisotropic.

There is no connection between roughness of gear teeth side in contact. Micro-welding of the contact surface occurs due to high contact pressures to proceed in the next position with the microparticles chipped off the contact surfaces in the sliding and rolling phase, irregardless of the service temperature.

After the chipping process, there is an ideal surface for corrosion action. In this case, the wind power plant is located above the saltworks.

The presence of sodium chloride (NaCl) enhances corrosion. If the gear is additionally overloaded, excessive service temperatures can cause additional heat treatment, which results in a reduction in the gear surface hardness. In some cases of high alternating loads, the lubricant can cause surface erosion, all this because of cavitation.Cavitation occurs because of the high speed lubricant movement in the upper layer of contact surfaces. The described occurrence has long-term effects on the contact surfaces. Since the material is sensitive to this occurrence, there are micro-craters developed to cause progressive brittle fracture.

The gear pair performs power transmission in the electric and magnetic field, therefore the chipped particles are polarized and they freely move in the lubricant, thus contributing to formation of new damages on the tooth sides. Constant cyclic surface deformations at excessive maximum pressure can lead to Hetz's shear stress below the contact surface. The described shear forms a crack below the surface, which is spreading and penetrating towards the surface to reach critical state because the pressurized lubricant penetrates into it, thus reducing the cross-sectional area. It should be stated that this occurrence is a consequence of maximum pressure, and not of roughness.

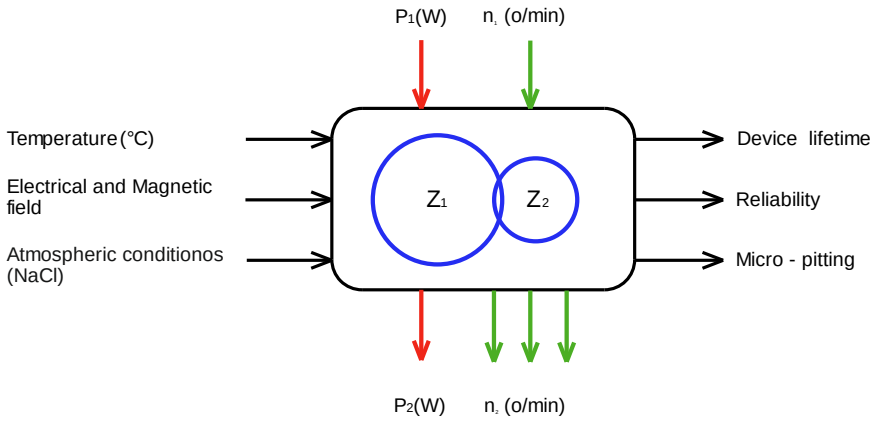

Figure 1. *Model of gear power transmission in real environment*

Puncture damage are formed on the tooth surface and progress toward interior, up to a distance of 100 (μm) from the surface. All puncture damages up to 20 (μm) in depth can be considered as referential value of micro-puncture damage.The mechanism of micro-pitting occurrence can be explained by a complex combination of micro-welding phenomenon, electrostatic and electromagnetic fields, of atmospheric influence - sodium chloride, as well as of strong cyclical load changes. All of the above mentioned parameters were present at the Ravne 1 wind power plant.It can be concluded with high reliability that there was no shear critical stress in the depth of tooth surface because of Hetz's pressure consequence. Therefore, there was no brittle fracture of tooth root and no tooth fracture. The photo of the sliding gear tooth shows a limited surface that matches the line of the current contact. The technology of finishing gear tooth processing, hardening and grinding do not have a dominant effect on the appearance of micro-pitting, but hydro-dynamic friction, corrosion and presence of electric and magnetic fields do have a dominant influence. The authors Bull, Cardis and Webster state that maximum Hetz pressure was the most important factor in the process of micro-pitting damage. The stress condition analysis starts with the general expression for the stress state that is defined by the stress tensor.[6]

$$[\sigma] = \left[\sigma_{initijal}\right] + [\sigma_{elast.}] + [\rho] \quad (4)$$

The total stress tensor is the sum of the initial residual stress in the gear manufacturing process, such as for example, heat treatment, current stress in the shift phase and additional residual stress due to plastic changes on the side of the gear pair.At the example of the Ravne 1 wind power plant, it is concluded that the total stress tensor $[\sigma]$ was affected by other parameters of stress tensor $[\rho]$, as described in this paper

3 PRESENTATION OF THE WIND POWER PLANT CONDITION

The wind power plant was constructed by the Croatian company Adria Wind Power in August 2004. It disposes of 5.950,00 (kW) installed force, consisting of 7 Vestas wind turbines of 850 (kW). The average annual wind speed is about 6.4 (m/s). The blade diameter is 52 (m). Input speed is 25.8 (o/min), and weight is 4.600 (kg). Lubricant oil quantity is 155 (l). The presented wind power plant operates at the transmission ratio *i = 61,92*.

Figure 2. *Deconstruction of power transmitter at the RAVNE 1 wind power plant*

Figure 3. *Technical data of the power transmitter*

After deconstruction and analysis of oil, it was undoubtedly determined that the gear tooth side of the toothed spindle was damaged, as shown in the Figure 6.

Figure 4. *Accumulation of metal particles of oil filter at the power transmitter*

Figure 5. *Multi-stage power transmitter*

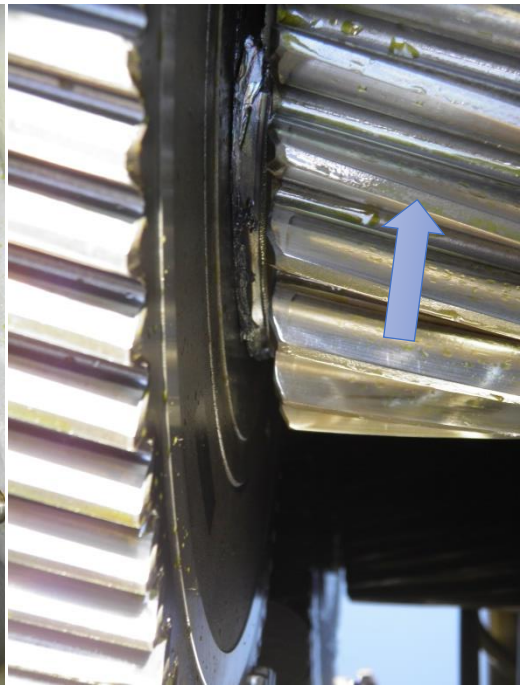

Figure 6. *Occurrence of micro – pitting at the tooth side*

4 CONCLUSION

The mechanism of the micro-pitting damage of gear tooth sides at the Ravne 1 wind power plant can be explained by the complex combination of micro-welding

phenomenon, the influence of electrostatic and electromagnetic fields, the atmospheric influence of sodium chloride (NaCl) and strong cyclical load changes. When designing power transmitters that are constructed at particular locations, such as the Ravne 1 wind power plant, special attention is to be paid to complex exploitation conditions that are present during service of the wind power plants.

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A SUCCESSFUL BUSINESS SYSTEM – Processes and Performance

Zorana Tanasić[1], Goran Janjić[2], Miloš Sorak[3], Miroslav Dragić[4]

Abstract: Managers in modern organizations are required to comprehend the processes of change and the application of adequate knowledge and techniques aiming at continuous increase of efficacy and efficiency of the organization. In order to continue to exist and to improve its business activities, it needs to apply modern quality tools and techniques as well as concept and methodologies relating to the management of business systems. This paper presents the process of business management starting from the vision to the measurable goals and products that customers anticipate.

Key words: Business system, Process performance, Organizational culture

1 INTRODUCTION

An organization's success depends on the environment, culture and operational context. Thus it needs to change and adapt rapidly. New ways of doing business activities impose the need to design organizations which implies the process of creating an organization with engineering dimensions. Organization design is not limited to technical aspects as technical systems are the easiest part of the mosaic for successful implementation of the business system. In design process the strategy represents a challenging aspect. Organizational culture is the most difficult part in the design process because it consists of social elements.

There is one expression in the business environment that is more meaningful than any other and it implies change. Business processes and environments, which inhabit business worlds, change rapidly due to globalization, Internet, e-business, etc. Companies that do not keep pace with these changes in business activities lag behind their competition. This is why the following questions should be asked to maintain or improve both the present and future business success:

- How to control and manage the business in today's conditions?
- Which methods and processes still work, and which ones need to be developed further?

To ensure successful business, managers set the following as their goal:

- Design the process of business management.
- Direct all the work units towards the same end goal - vision!

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- Monitor whether the goal is being achieved.
- Continuous improvement.

To establish the real basis for company's development, throughout the whole process, constant communication between the management and all stakeholders is necessary. Managing performances implies the use of information about performance measurement to achieve positive effects in the business system, processes and organizational culture.

Successful organizations create their own pefromance management system by:

- Transforming visions into clear measurable goals that determine success;
- Ensuring tools for understanding, managing and improving the business system;
- Transforming traditional organizations based on inspection and control into modern organizations based on flexibility and innovation;
- Measuring quality, price, speed, motivation and skills of the employees;
- Changing the model of measuring performance from time to time to a model of continuous performance management.

Business management in a company refers to a process in which the management implements the company's strategy through its employees. The process of business management is designed with the aim to increase flexibility and management in the unstable business environment. It enables the company to take the right course, depending on the type of business and the dynamics of the environment. It is a continued and incessant process of evolution, Figure 1.

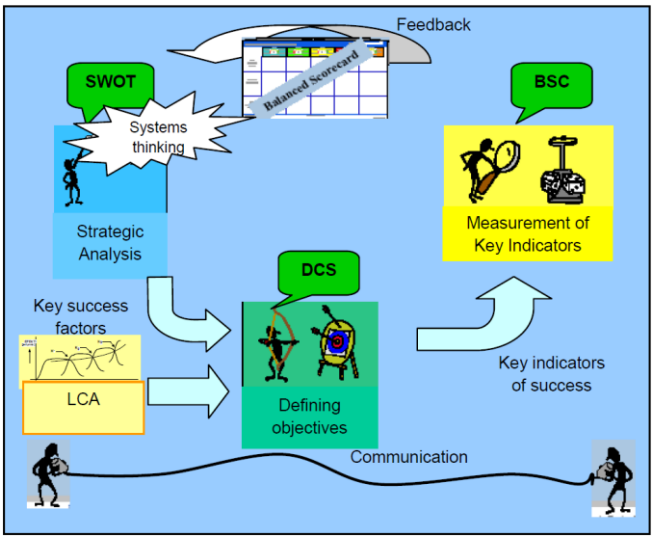

Figure1. *The process of business management, transforming vision into measurable goals*

2 THE BSC METHOD

The BSC method needs to provide a framework for transformation of the vision and strategy of the organization into measurable business goals, especially in reference to the key business processes. The success of the company's business is measured from a few perspectives, namely: customer, internal processes, learning and growth, and financial perspective [1].

To achieve the company's vision, the following four perspectives should give answers to the questions given below:

- **Financial perspective** → Which financial results should be achieved from the owner's and shareholders' perspective?;
- **Customers's perspective** → How should customers perceive us?
- **Internal processes perspective** → What aspect should be our best? and
- **Learning and growth perspective** → What should be innovated and learned and how?

Based on theoretical and practical research, a fifth perspective is introduced in this paper which should answer the following:

- How prepared and aware are we as individuals and organization to accept change? → **Organizational culture perspective** [2].

Figure 2 shows a layout of the BSC strategic map including perspectives, and Figure 3 presents the success factors chart [3].

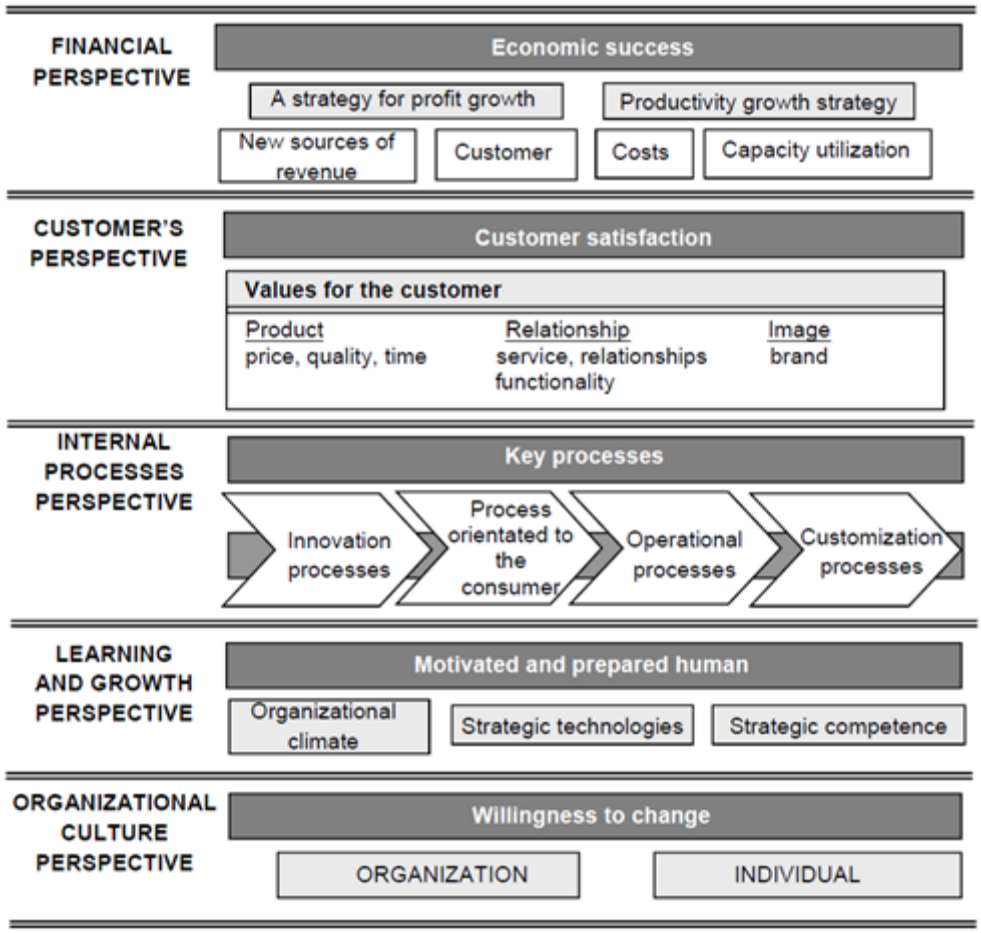

Figure 2. *The perspectives of the BSC method*

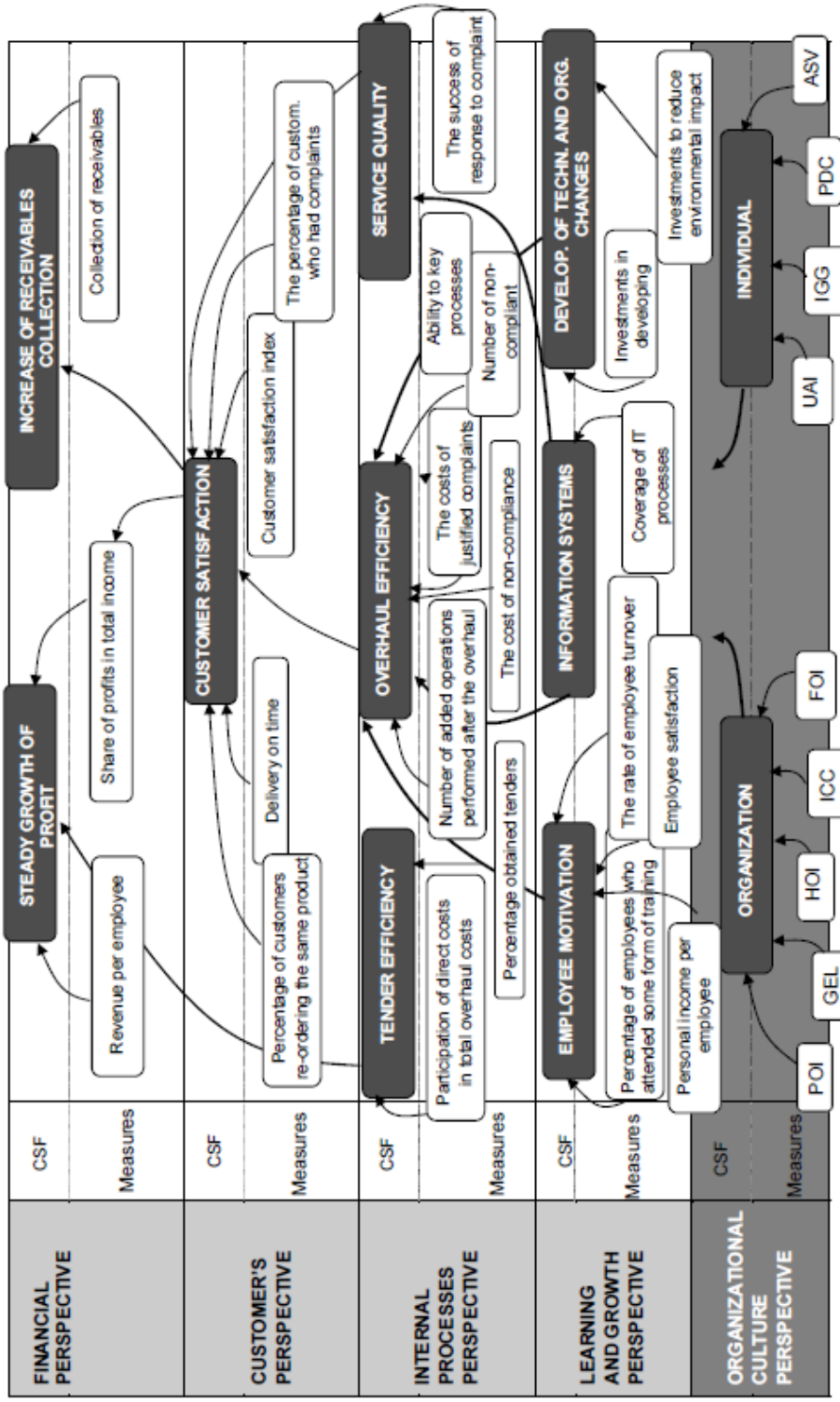

Figure 3. *The success factors chart*

3 PERFORMANCE IN BUSINESS SYSTEMS

After the vision, the mission and key processes are defined, strategic goals and corresponding success factors (performance – criteria) are determined as well [4, 5]. The BSC concept is a model that includes measuring of financial and non-financial indicators in the business system management.

The value of the BSC concept does not only lie in the indicators, but also in discussion that the concept is based on. The communication process initiates the exchange of thought and facts, thereby enhancing innovativeness and creativity in solution finding. Communicating between themselves, the employees exchange opinions thus generating new knowledge and experience.

Softver Dialog Strategy designed for the application of the BSC method was used to process data in the companies. This paper shows only some of the goal criteria and their target values by using graphs grouped in five perspectives. The success criteria for the company under study are shown in Figure 4.

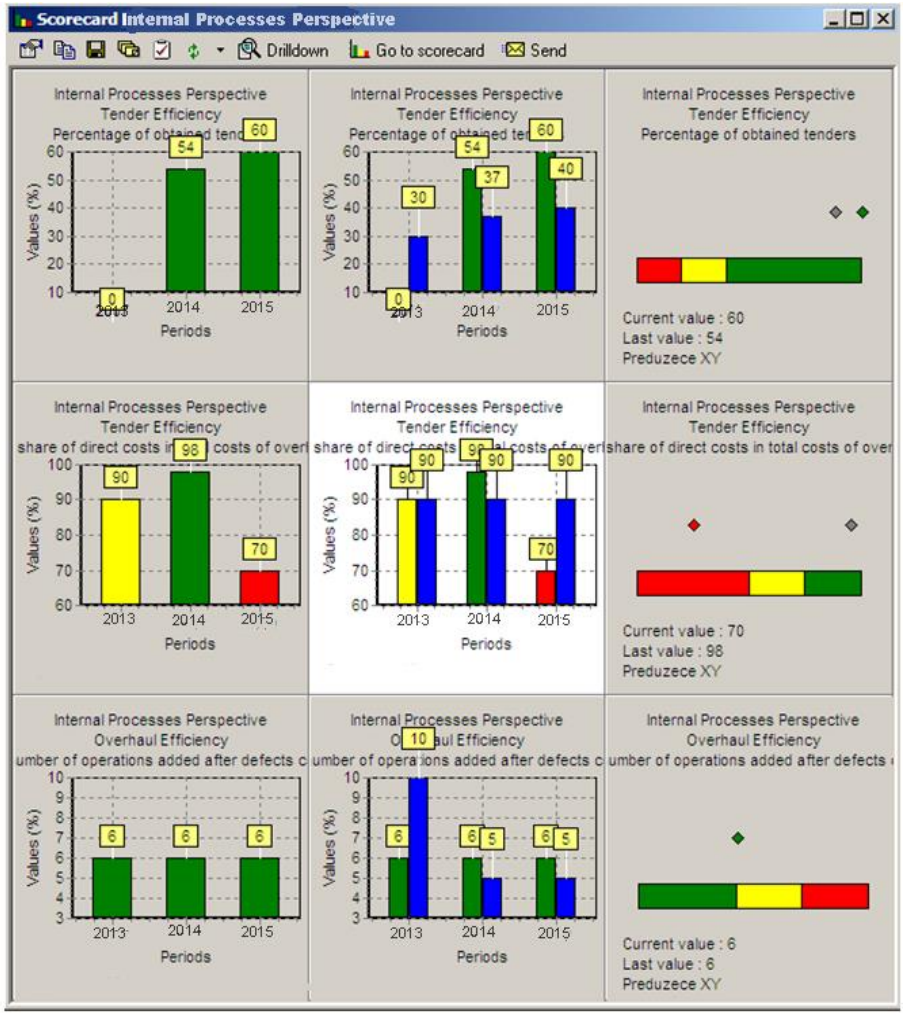

Figure 4. *The company's interna processes perspective: success factors, criteria and target values*

To study organizational culture in companies, the methods and tools of the global research project Worldwide Differences in Business Values and Practices were used in this paper [6, 7].

4 CONCLUSION

Sustainable success of the organization can be achieved only by establishing an innovative and flexible company, easily adapted to the environment changes and ready to learn fast. The company can reach this level by applying the excellence model and its main principles. The key to success lies in the establishment of organizational culture in which every employee feels the need, not the duty, to continuously innovate his/ her own work. This approach provides safe employment for employees, and the company remains on the market.

The application of modern methods and adequate information systems for strategic analysis, the identification of processes and key performance with the aim to measure efficacy and effectiveness of the business systems is supplemented by the design process of a business system. These values affect the creation of the organizational culture and create the possibility for the employees to change their relationship towards the organization's value.

Organizational culture represents one of the key factors in the process of organization design and is subject of research and analysis in many of scientific papers. It determines the way in which the company analyses its internal and external environment and assess its resources and capacities. Also, it is the organizational culture that the coordination, communication and the process of creating an innovative organization depend on. Due to the turbulent environment, it is noticeable that the organizational culture is a factor most closely related to all the dimensions of organization design.

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SOFTWARES PERFORMANCES IN EDUCATION

Rada Kučinar[1], Predrag Pravdić [2], Snežana Gavrilović[3], Ivana Terzić[4]

Abstract: Academic departments and academic support units must fully understand the macro-level goals so that objectives and measures for their individual units are linked to those of the entire institution. Academic planning calls for administrators to focus resources and set priorities. Administrators must link unit goals to macro goals in all scorecard areas, develop strategies to achieve those goals, and allocate resources tothose strategies. Key to the use of a balanced scorecard methodology are the steps that link the larger goals of the university to specific problems to be solved, decisions to be made, and resource allocation choices that present themselves. While the balanced scorecard cannot guarantee a recipe for correct decisions, it provides an integrated perspective on goals, targets, and measures of progress

Key words: BSC, education, measures, goals, perspectives

1 INTRODUCTION

Traditional models for measuring higher education performance also are constrained by departmental boundaries, which encourages unit managers to be concerned only with their portion of a process that may span multiple work groups or units within the institution. Allowing the budget process to drive performance measures does not take into account the critical outside perspectives of customers and stakeholders as well as the dimensions of performance that are meaningful to them, such as time, cost and quality of service. Finally, there is no opportunity to tie individual performance objectives and performance evaluation processes to institutional performance. Complementing financial measures in the balanced scorecard are measures of customer satisfaction, internal operational efficiency/effectiveness and the organization's innovation and continuous improvement activities.

The balanced scorecard focuses an organization’s goals and performance measures on the attainment of its future vision. Goals are roadmaps to achieving the vision and measures are indicators of progress in achieving the goals. Measures pull the entire organization toward the vision, toward the kind of organization that it is trying to become in order to succeed over time. While corporations originally viewed the balanced scorecard as a strategic performance measurement model, it has contributed to a new strategic management system in many organizations that have integrated it

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[4] Msc. Ivana Terzić, School of Mechanical Engineering of Applied study Trstenik, Serbia

into the fabric of their decision-making. Each perspective in the balanced scorecard is a lens through which to view performance. When looked at in total, the balanced scorecard goals and measures should communicate what is really important tothe department in question. They also function as a set of “levers” which can be used to adjust and maintain the balance among those factors critical to the department’s success. All four balanced scorecard perspectives have given our business units new information and insights into their operations.

2 EXAMPLES OF BSC IN TODAY`S EDUCATION

In today’s knowledge-based economy, higher education institutions as centers for human resource development are playing an essential role in economic growth and development of the countries (King,1995). Then the strategic planning in such institutions is of a great and specific importance (Kriemadis,1997) and gives it a holistic and shared understanding of how it adapts to education policy, environment and develops its activities for a better future (Kettunen,2006). Up to now, many have highlighted the vital role of the quality in higher educations (Hammond et al 2004; Kettunen,2006; Umashankar and Dutta,2007).

Also, universities currently face immeasurable complexities and turbulence in their external environments and their internal organizations are consequently under pressure to adapt in an effective way (Brock,1997). Then the intentions to survival oblige them to use strategic planning and management to adapt to their variable environment and to be responsive and supportive of their customers’ needs (Kriemadis,1997; Davies and Ellison,1998)

Till now, many studies have been conducted about applying strategic planning in the area of higher education. A number of them (Dealtry,2000; Ryan and Morriss,2005) investigate the strategic directions in corporate universities. Brock (1997) investigates whether combinations of strategies, planning modes and levels of autonomy are associated with superior college effectiveness.

Also, Petrides (2003) discusses how institutional leaders atcommunity colleges have used the implementation of strategic planning processes to break down information silos, increase collaboration among units, streamline information and work processes, and provide greater access to both academic and operational information.

As the number of enrollees increases and educational inputs become more demanding each year, an educational organization must find ways to make its goals and strategies work. The balanced scorecard for education evaluation is the fitting method to evaluate how far and how effective the school has gone in terms of educational inputs.

This balanced scorecard is actually a strategy management system. Colleges and universities across the world use this tactic to improve an already established institution-wide planning process. Just like most scorecard systems, the education evaluation scorecard system interprets the goals and strategies of the institution into a comprehensible and measurable set of indicators. Most of these indicators, nonetheless, have direct link to the strategies and goals. The balanced scorecard system actually serves as the transportation channel between decision making and effective implementation of performance communication, goals tracking, and strategy measurement.

Making the appropriate linkage between the values and goals of the internal audience, the strategic tasks required, and the data collection and analysis necessary is important for useful internal performance assessment. Key to the use of a balanced scorecard methodology are the steps that link the larger goals of the university to

specific problems to be solved, decisions to be made, and resource allocation choices that present themselves. While the balanced scorecard cannot guarantee a recipe for correct decisions, it provides an integrated perspective on goals, targets, and measures of progress. It ties together information from a variety of perspectives so that trade-offs can be weighed. Academic departments and academic support units must fully understand the macro-level goals so that objectives and measures for their individual units are linked to those of the entire institution. Academic planning calls for administrators to focus resources and set priorities. Administrators must link unit goals to macro goals in all scorecard areas, develop strategies to achieve those goals, and allocate resources tothose strategies. In addition, they must develop credible measures of progress toward those goals. Finally, the feedback and learning step requires universities to evaluate their performance based on updated indicators and to revise strategies as appropriate. Though the timeline for the feedback and learning loop may be months or even years long, the processitself is vitally important. Literature reviewed shows that studies examining effectiveness of BSC for the private commercial sector are numerous, with mixed findings. Empirical studies by Ittner and Larcker (2003), Evans and Jack (2003) as well as Davis and Albright (2004) found that proper usage of BSC led to improved financial performance. Other studies including Dumond (1994), and Forza and Salvador (2000 & 2001) noted that usage of BSC promoted other positive effects such as employee satisfaction and understanding of the business. On the other hand, empirical investigations by Handfield and Ghosh (1995), Neely, Kennerley and Martinez (2004), and Malina, Norreklit and Selto (2005) found no discernible performance improvement.

While some studies like Andersen and Lawrie (2001), Moore (2003) and Szarycz (2004) analysed how BSC can be adapted for effective public sector usage, few focused on its actual effectiveness therein.

Grayson (2004) illustrated the formulation of BSC for a high school using a hypothetical example. Cribb and Hogan (2003) examined BSC usage in a private university library with emphasis predominantly on the implementation process. Hafner (1998) had a similar focus in exploring the University of California's use of BSC across its nine campuses.

Karathanos and Karathanos (2005) provided a general and brief survey of the differences between business and education scorecards which appeared useful as a broad framework to guide the BSC adaptation. Stewart and Carpenter-Hubin (2001/02), and Ruben (1999) both provided detailed analysis of how a research university could adapt BSC for its use and offer broad framework for quality and performance management. In general, there was little discussion of issues concerning the use of BSC in education and training as well as a lack of documented findings regarding its relevance and effectiveness.

Cullen, Joyce, Hassall, and Broadbent (2003) proposed that a balanced scorecard be used in educational institutions for reinforcement of the importance of managing rather than just monitoring performance. Sutherland (2000) reported that the Rossier School of Education at the University of Southern California adopted the balanced scorecard approach to assess its academic program and planning process. Also, Chang and Chow (1999) reported that responses in a survey of 69 accounting department heads were generally supportive of the balanced scorecard's applicability and benefits to accounting programs.

The experience shows that BSC, when applied properly, establishes focused channels and processes to ensure effective communication throughout the organisation. Active communication helps every staff member reach common understanding of the organisational vision, strategies and goals as well as points them

to the programmes and desired outcomes. It brings about consistency and organisational coherence and enables buy-in of everyone in the organisation towards a shared vision resulting in committed actions. In organisations without a proper framework and communication channels as well as processes, it is often assumed that employees understand the organisation's vision and priorities which seem straight forward and easy to understand.

Although the concept of the BSC has been widely adopted and used in the business sector, the education sector apparently has not embraced the BSC concept widely.

With important stakes such as increasing financial resources, encouraging high-quality student applicants, and attracting faculty dependent upon how they measure up, universities are rightly concerned with how best to present themselves. Institutions attempt to improve accountability while dealing with the more difficult and complex issue of how to improve university effectiveness. The assumption of many externally derived accountability programs is that emphasis on one will result in the other. However, until performance indicators are linked to the drivers of institutional effectiveness in a meaningful way, the desired improvements in service, productivity, and impact are unlikely to occur. The real test for institutions is to create meaningful systems for strategic organizational assessment and then use that information in internal policy and resource allocation decisions.

Performance indicators can be powerful tools, at both the university and the college/department levels, for internal evaluation and strategic assessment. Though similarities exist between the indicators used for external reporting and internal assessment—indeed, many of the same data can be used for both—the development of internal indicators requires more attention to the contextual characteristics and operational goals of the university. Under these circumstances, performance indicators can provide substantive information for strategic decision making. To be useful internally, performance indicators must be tied to the values and goals of the particular university and should emanate from the institution's performance objectives. These objectives translate the broad goals of the institution into specific research problems that can be studied and around which strategies for improvement can be developed.

The internal audience represents a very broad spectrum of perspectives and interests with a wide range of opinions regarding what might be acceptable institutional outcomes. Institutes of higher education are also focusing on ways to render high quality education to their educators and have a better performance. Higher education institutes are facing new challenges in order to improve the quality of education. There is a pressure for restructuring and reforming higher education in order to provide quality education and bring up graduates who become fruitful members of their societies. Therefore, these institutes are trying to recognize the dimensions of a quality education and define strategies to reach their pre-defined standards and goals. Educational institutes are just beginning to view themselves as part of a service industry, and many are doing so reluctantly (Gold, 2001) often as a result of an enrollment crisis (Wallace, 1999).

The role of education in building workforce and management capable enough to cope with these challenges has been appreciated and gained much more attention from various governments than ever before (Gill and Lashine, 2003).

As a result, governments and societies are exerting mounting pressures on higher educational institutions to become active, creative and innovative, dynamic, responsive, demand-driven, quality conscious, result-oriented, efficient and effective so that they can play a significant role in transforming their societies.

The Financial Perspective covers the financial objectives of an organization

and allows managers to track financial success and shareholder value. Profit-seeking organizations attempt to increase shareholder value. The financial perspective might include a maximization of funding from outside sources instead of profit, or maintenance of fiscal stability. Financial perspective, defines financial strategic objectives and financial performance measures that provide evidence of whether or not the company's financial strategy is yielding increased profitability and decreased costs.

The Customer Perspective covers the customer objectives such as customer satisfaction, market share goals as well as product and service attributes. Kaplan and Norton indicate that the core of any business strategy is the customer-value proposition which describes the unique mix of product, price, service, relationship, and image that a company offers. Accordingly, an organization must identify the customers it wishes to attract and the market segment in which it will compete. An organization differentiates its customer-value proposition. It selects from among operational excellence, customer intimacy, and product leadership.

The Internal Process Perspective covers internal operational goals and outlines the key processes necessary to deliver the customer objectives. The Learning and Growth Perspective covers the intangible drivers of future success such as human capital, organisational capital and information capital including skills, training, organisational culture, leadership, systems and databases. According to Kaplan and Norton, in utilizing this approach an organization can frequently identify processes at which it must excel to meet its goals. The internal process perspective involves determination of internal processes that will best affect customers as well as process improvements that will affect financial objectives. Internal process metrics are then developed, which communicate the level of product quality through the monitoring of in-process metrics, as well as measuring productivity associated with the number of units produced or services provided.

The learning and growth perspective involves determination of employee capabilities and skills, technology, and corporate climate needed to support a strategy. Strategic objectives and metrics of the Learning and Growth perspective help to identify gaps between current employee skill levels, culture, and supporting information systems and discover the optimum level of operation at which these components become high performing internal processes.

3 STEPS FOR BUILDING BALANCED SCORECARD IN EDUCATION

While there is no single formula for building a successful balanced scorecard, there are several necessary steps and precautions for higher education institutions to take [3,4,7,8,9,10,11,16,19,20,31,34].

1. Define the scope of the business area for which the balanced scorecard will be used: its mission, core products and services and primary customers.
2. Involve the senior management of the institution/department by first presenting the balanced scorecard concept and articulating the benefits of a vision-driven approach to performance measurement. Define a continuingsponsorship role for the senior management team that will span the duration of the creation of the balanced scorecard.
3. Engage the senior management of the institution or department in the process of creating the vision and strategic goals, which provide the necessary context for assessing performance. Balance the institution's typical requirement for broad participation, consultation and consensus with the need to identify future direction and strategy.

4. Seek input from key stakeholders and customers during the process of building the balanced scorecard to ensure that the view that emerges reflects their needs and expectations for performance.
5. Involve department management in both: developing long term goals for their departmental operations and selecting the measures of performance to track progress in attaining these goals over time. Recognize that empowering business unit managers to identify the right performance indicators for their business area is key to gaining their support and buy-in. Provide training in strategic thinking and in developing performance measures to all team members.
6. Identify what kinds of measures are appropriate for different levels of reporting. The operational level requires more information and greater detail. Measures proposed during the building of the balanced scorecard should therefore be sorted, weighted and prioritized. For every performance measure selected, you should know what information will be produced, why it is valuable and to whom. Ultimately, you need to know what actions you can take based on this information. To start with, focus on the few critical measures that will tell you what you most need to know. Then, expand and refine your measures over time.
7. Define clear ownership of the process of maintaining the scorecard as well as collecting and analyzing the data. In the university world of "shadow" computer systems, duplicate databases and inconsistent/incompatible data, the task of linking the measures to databases and information systems is a challenging one. This becomes easier when the data sources for measurements are clearly identified.
8. Clearly communicate the role of the scorecard in managing the unit, department or institution. Above all, it is important to recognize and reward business managers' involvement in the process--as much for the value of the measurement information it provides as for the cultural change that the process effects within the institution. Make the balanced scorecard framework widely available, keep it visible, reference it often and encourage the development of second-level metrics in operational units or decentralized parts of the organization to drive the performance measurement message as deep as possible into the culture of the institution. Ultimately, each employee's performance plan should reflect institutional goals and objectives.
9. Review the balanced scorecard periodically and ask the following kinds of questions:

- Are we measuring the right things?
- Does the cost of gathering the data exceed the value we receive?
- Is performance measurement changing the way we do business?
- Are we making better decisions as a result?
- How can we improve our measures to get the information we most need?

Revisit the department's vision, goals and measures as needed to ensure that they present an accurate view of your focus and future direction.

In order to achieve BSC goals, most profit organisations need to redesign and/or continuously improve key business processes. This includes the structuring, training and deployment of cross functional business process reengineering (BPR) teams for iterative process improvement or more comprehensive process redesign. Considering the limited resources of most companies, a key strategic issue is which processes to focus on first. The focus should be on those processes that are most importantly related to the company's business strategy. Comparisons of future process

performance targets with what the company has previously achieved will reveal the degree of improvement that is required. The company should periodically report and analyse performance results, as well as make adjustments to their strategy based on that analysis. The BSC methodology creates an infrastructure in which top management can easily track and analyse their company's performance. This is easier if the company uses a BSC software solution. Most companies update their BSC's on an annual basis. However, as the business environment changes and BSC learning accumulates, companies tend to change some of their performance objectives, measures and targets. A fundamental aspect of the BSC methodology is making such adjustments in a timely manner to ensure the success of strategy execution.

The company must take the investment and the decisions of financing on a basis of continuation. To take the wise optimum and the decision, a clear arrangement of the objectives is a need. The objectives are employed in the direction of a criterion of goal or decision for the decision implied in financial management. The economists believe that the maximum benefit of income is the single goal of any organization of businesses, because that will also lead to the optimum allocation of resources. Actions which increase the benefit of companies are undertaken and those which decrease the benefit are avoided. Thus, of the prospect for the economic theory, the maximization of benefit is simple a criterion of economic efficiency.

Effective enterprise-wide BSC must allow for the participants to effortlessly move from big-picture analyses to organization-level details to facilitate proactive decision-making. Multi-enterprise BSC gains must optimize performance at every level of the enterprise. The enterprise will accomplish better decision making through consistent and visual business performance management. In order to manage the complexities involved - a high-performance, web-enabled software enabler may need to be considered.

An organization whose members have core abilities in quality awareness can improve its internal processes to increase administrative efficiency. If an organization's services and education are of good quality and has adequate operational facilities, customer requirements will be satisfied. When an organization's internal and external customers are satisfied with its performance, its profit growth will steady within the financial perspective. An adequate financial structure helps an organization achieve its mission and vision. Furthermore, the four perspectives establish orders as well as the employee suggestions and communication feedback from the vertical kind models. An organization's balanced scorecard can be established according to its mission, vision, and strategy. The balanced scorecard includes a series of targets and measurements and instructs members about the causeand-effect relationship in the organization's strategy. The process develops linkages within the balanced scorecard and on the strategic resource distribution platform. The balanced scorecard guided budget has numerous benefits such as scarce resource allocation, budget and organization linkages, identification of primary strategy strengths, renewed budgeting process, transfer of the organization's target from a department to the whole organization, and development of cooperative relationships within the organization. Once sufficient background information has been collected, the findings can be synthesized and confirmed through a one-on-one interview process with each executive team member. This activity will provide feedback on organizational competence advantage, critical success factors (CSF), core competency, and key performance indicators (KPI).

4 BSC PERSPESTIVES IN EDUCATION

Since the 1990s, accountability in higher education has become a challenging issue for higher education. Increasingly, institutions of higher learning have been required to provide performance indicators—empirical evidence of their value—to state, alumni, prospective student, and other external stakeholders. State commissions of higher education and boards of regents have, in numerous states, developed "report cards" that grade colleges and universities according to their level of performance in a variety of categories. Performance indicators can be powerful tools, at both the university and the college/department levels, for internal evaluation and strategic assessment. Though similarities exist between the indicators used for external reporting and internal assessment—indeed, many of the same data can be used for both—the development of internal indicators requires more attention to the contextual characteristics and operational goals of the university. Under these circumstances, performance indicators can provide substantive information for strategic decision making. To be useful internally, performance indicators must be tied to the values and goals of the particular university and should emanate from the institution's performance objectives. These objectives translate the broad goals of the institution into specific research problems that can be studied and around which strategies for improvement can be developed. A different type of institutional stakeholder—university decision makers (i.e., faculty, academic administrators, and nonacademic administrators)—uses performance indicators developed for internal audiences. The internal audience represents a very broad spectrum of perspectives and interests with a wide range of opinions regarding what might be acceptable institutional outcomes. These internal audiences tend to adopt multidimensional views of performance. Often, issues are studied in great depth with information presented in the form of long, complex faculty reports. Just like most scorecard systems, the education evaluation scorecard system interprets the goals and strategies of the institution into a comprehensible and measurable set of indicators. Most of these indicators, nonetheless, have direct link to the strategies and goals. The balanced scorecard system actually serves as the transportation channel between decision making and effective implementation of performance communication, goals tracking, and strategy measurement. An education evaluation scorecard system utilizes a group of core yardsticks or indicators that characterize and gauge institutional effectiveness. In order for the scorecard system to become objective, it needs to cover four important areas of the educational organization: external stakeholder, internal stakeholder, innovation and growth, and operational-financial performance. It is the only way that it can identify what the school should apply or use in order to improve performance. It is the single way also to know which indicators tell the effectiveness of an input. The internal process of an education evaluation balanced scorecard involves the process of inputting, managing, processing, and analyzing data. The right term for a collective amount of raw data is benchmarking. It is the result of the collaboration in research, negotiation, and analysis of each college department or administrative section. Each section in the organization should have its own set of goals, especially those who are involved in the academic side. In order to meet these goals, the benchmarks will serve as keys to adjusting and assessing strategies.

The basic premise of the BSC is that financial results alone cannot capture value-creating activities. In other words, financial measures are lagging indicators and, as such, are not effective in identifying the drivers or activities that affect financial results. Kaplan and Norton suggested that organizations, while using financial measures, should develop a comprehensive set of additional measures to use as

leading indicators, or predictors, of financial performance. Although the financial and market results are the “bottom line” or lagging indicator in the business sector, the bottom line or lagging indicator in the education sector is the student learning results. All other results are considered to be leading indicators or drivers of student learning. The budgetary, financial, and market results in education differ substantially from those in the business sector. In education, the expected measures are primarily internal efficiency measures, whereas in business they are the bottom line or lagging indicators.

In today’s world of global competition, providing quality service is a key for success, and many experts concur that the most powerful competitive trend currently shaping marketing and business strategy is service quality. Institutes of higher education are also focusing on ways to render high quality education to their educators and have a better performance. Higher education institutes are facing new challenges in order to improve the quality of education. There is a pressure for restructuring and reforming higher education in order to provide quality education and bring up graduates who become fruitful members of their societies. Therefore, these institutes are trying to recognize the dimensions of a quality education and define strategies to reach their pre-defined standards and goals.

Table 1. *BSC perspestives in education*

Finanacial perspective	Expand revenue opportunities	Improve cost structure	Fund raising	Strengthen the relationships with donors and foundations	Improve budget utilization and control systems
Students and stakeholders perspective	Faculty satisfaction and quality	Attract and graduate high-quality students	Student satisfaction	Student services effectiveness	Improve student progress in targeted programs
Internal perspective	Enhance teaching and learning innovation and faculty development	Align resources with strategic priorities	Increase knowledge and technology transfer activities	Increase research productivity	Specific systems and networks decision implementation
Learn and growth perspective	Excellence in developing and learning skills	Improve recruitment and retention of highly effective staff	Build a culture of alignment and accountability	Increase employee capacity and leadership	Improve the quality and currency of the faculty

5 CONCLUSION

Effective measurement system in education must be an integral part of the management process. The Balanced scorecard in education provides executives with a comprehensive framework that translates a school's and universities strategic objectives into a coherent set of performance measures.

Clearly, many universities already have implented operational and physical measures for local activities. But these local measures are bottom up and derived from different processes.

The scorecard's measures, on other hand, are grounded in an school's and universities strategic objectives and competitive demands. Furthermore by requiring managers to select limited number of critical indicators within each of the four perspectives, the scorecard helps focus this strategic vision in education.

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ON ACHIEVING PRODUCT QUALITY THROUGH A HOMEOSTATIC SYSTEM

Svetomir Simonović[1]

Abstract: The article proposes a view of product quality as both the mean of fulfillment of customers homeostatic goals and producers homeostatic goals. The way of fulfillment of the goals is presented in the form of a system that takes into consideration the complexity and nonlinearity of the problem involved in the designing of complex products by complex organizations in complex and volatile environment. General theory of a homeostatic system is presented and then applied onto the construction of the system representanion of an organization that designs quality products.

Key words: Complexity,Homeostatic, Nonlinearity, System

1 INTRODUCTION

Norbert Wiener in his 1985 book [1] argued that everything can be described as a system, broken down into “black box” components with inputs and outputs, and then understood using the ideas of information flow, noise, feedback, stability, and so forth. In a structural sense under the term system is supposed a certain object regarded as consisting of interrelated material and conceptual objects which are called subsystems of the given system. For the purpose of the paper following definitions are suitable: "A system is a set of interacting elements that form an integrated whole"[2] . "A system is a network of interdependent components that work together to try to accomplish the aim of the system" [3].

There are many aspects of complexity. Commonly, the term "complex" refers to something involving a lot of different but related parts, or something difficult to understand or find an answer to because of having many different parts (Cambridge Advanced Learner's Dictionary 2nd ed,, 1995). Consequently, a system is more complex if more parts could be distinguished in it, and if there are more connections between them [4]. Taking into consideration that increased number of distinctive components leads in the limit to disorder, chaos or entropy and increased number of relations between them lead to order or negentropy, complex systems can be understood as systems situated somewhere between order and disorder [5]. Also, under the term complex system is referred a system of many parts which are connected in a nonlinear way with respect to the behaviour of the system. That means that behaviour of the whole differs from the sum of behaviours of its parts or, in other words, system level effects cannot be assigned to particular causal components because all components interact

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with each other [6]. In this case complexity can be seen as a paradigm of some sort of holism meaning that reductionist scientific method of analysis is improper for complex systems. So, there is a difference between system modeling which is understood as a creative activity at system level description, and system simulation, which is based on a componental level of system description and is algorithmic, which means that it can be performed by a computer. System that cannot be simulated is termed a complex system [7].

A homeostatic system is a highly complex open system with internal goal of maintaining its basic structure and functions. In classical science, every process is determined solely by its cause, that is, a factor residing in the past. However, the behavior of homeostatic systems is typically teleonomic, that is, oriented towards a future state, which does not exist as yet. Teleonomy (or finality) and causality in homeostatic systems are reconciled by means of non-linear, circular mechanisms, where the cause equals the effect. The simplest example of such a circular mechanism is feedback. The non-linear interaction between the homeostatic or goal-directed system and its environment produces the control of the system over the disturbances coming from the environment. In that sense, nonlinear science proposes a revolution with respect to the linear, mechanistic models of traditional Newtonian science.

2 A MODEL OF A HOMEOSTATIC SYSTEM

A homeostatic system is here conceptualized as a control system, which tries to achieve its goal by initiating the right actions that compensate for the disturbances produced by the environment. For that, it needs to perceive or get information about the effects of its actions and the effects of the events happening in the environment (Figure 1). Downward causation is influence of the whole upon its components and upward causatio is influence of a system components upon the Whole. From the wholistic perspective a system organization has become an object, with its own formal models and its own methods of analysis, independent of its material substrate. So, the wholistic approach is in accord with both the modern nonlinear science and system theory, where mathematically similar dynamics are realized in quite different material substrates, and emergent entities are viewed as real dynamic objects and given suitable ontological identity.

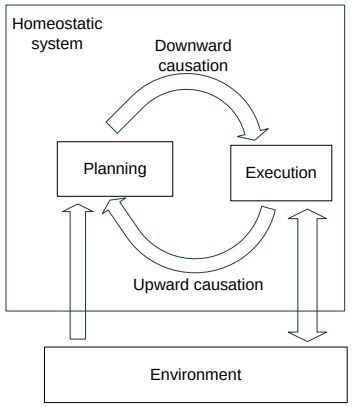

Figure 1. *Causality of a homeostatic system*

Causality in the classical thinking means that similar causes produce similar effects. Therefore, unsimilar causes lead to unsimilar efects. According to nonlinear science some deviation-amplifying interaction between components of a system may also produce the unsimilarity, so the law of causality in nonlinear theory is corrected to state that similar causes may result in unsimilar effects by means of deviation-amplifying mutual causal processes that are not necessarily indeterministic and probabilistic [8]. instead of being logically problematic, as they are for the reductionist, closed causal loops are essential elements of nonlinear science. Nonlinear science offers many examples of positive feedback (PFB) and the subsequent emergence of coherent structures. In the physical sciences, structures that emerge from PFB loops include tornadoes, tsunamis, optical solitons, rogue waves, ball lightning, and Jupiter's Great Red Spot, among many others. Biological examples include the nerve impulse, cellular reproduction, flocks of birds and schools of fishes, and the development of new species, in addition to the emergence of Life itself.

Nonlinearity involves assumptions about the nature of causality. According to Aristotle there are four types of causes[9]: Material Cause, Formal Cause, Efficient Cause and Final Cause. Here are used following interpretations of the causes that respect the nature of a homeostatic system:

- Material Cause is understood in the sense of the material substrate needed to produce some effect
- Formal Cause is understood in the sense of the plan needed to produce some efect.
- Efficient Cause is understood in the sense of energy source needed for producing some efect.
- Final Cause is understood in the sense of intention needed for producing some efect.

Figure 2. depicts general layout of a homeostatic system by using introduced terminology.

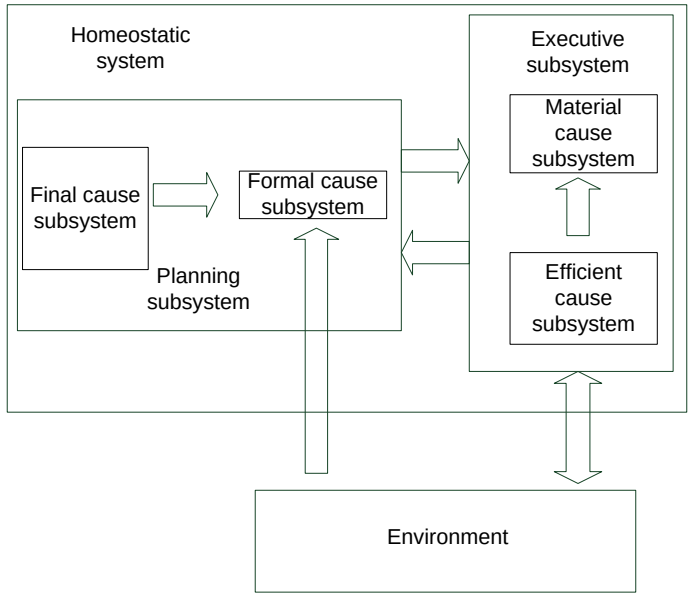

Figure 2. *The general layout of a homeostatic system*

The formal and final cause subsystem acts downward placing constraints on material cause subsystem and efficient cause subsystem, so that an executive subsystem is formed. Executive subsystem interacts with environment and the result of the interaction is feed back from the environment to formal cause subsystem. The formal cause subsystem interprets feedback information and compares the interpretation with final cause subsystem information interpretation. If there is a difference between them a new model of environment is made and appropriate output is produced that either instructs current executive subsystem or form a new executive subsystem. Final cause subsystem and formal cause subsystem are emergent phenomena at the higher level of an organization. A final cause subsystem expresses the ultimate goal of a homeostatic system and a formal cause subsystem forms the plan of achieving it.

3 A PRODUCER ORGANIZATION AS A HOMEOSTATIC SYSTEM

Figure 3. depicts an industrial organization model derived from general homeostatic system`s definitions represented by figures 1. and 2. The material cause subsystem is modeled by a subsystem consisting of machine and material subsystems, that equally can be interpreted as hardware and software subsystems. Initial cause subsystem and planning subsystem are modeled by humans subsystems. The methods subsystem forms executive subsystem by aligning machine, materials and humans subsystems. Design subsystem is a kind of formal cause subsystem which main role is to enforce stakeholders interests which are embodiment of final cause subsystem.

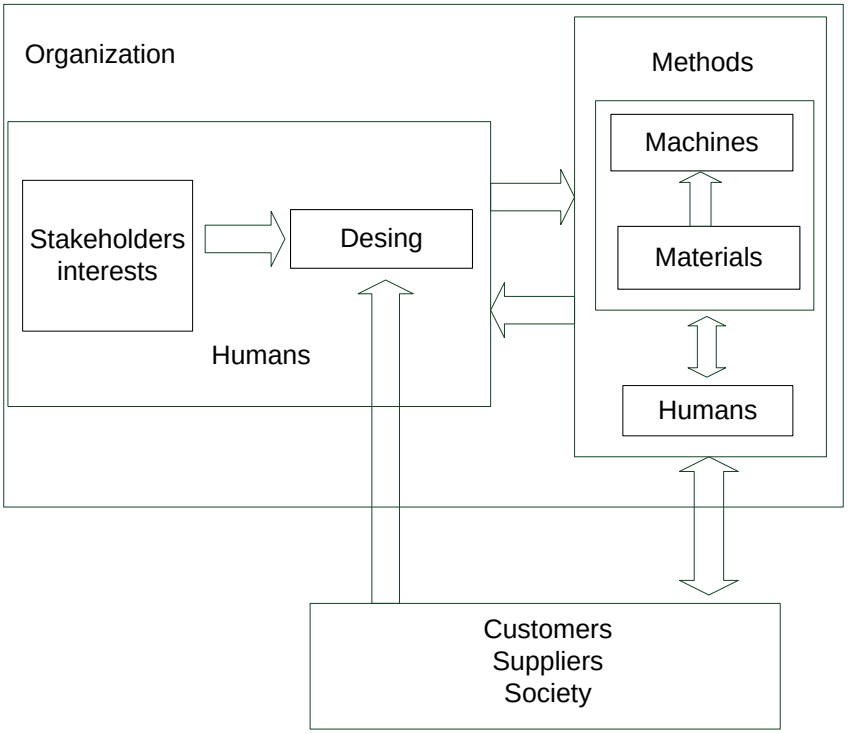

Figure 3. *Homeostatic model of an industrial organization*

What always makes a system complex and homeostatic one is the presence of humans as its component (Figure 4).

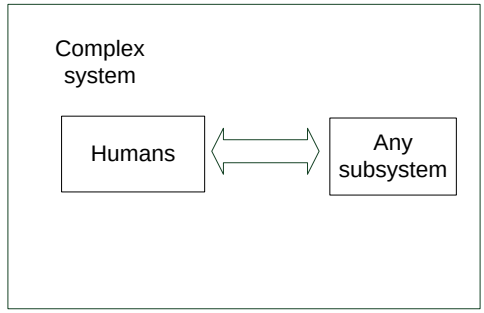

Figure 4. *An always homeostatic and complex system*

4 DESIGN SUBSYSTEM AS A HOMEOSTATIC SYSTEM REGULATOR

A Machine if automatized can respond only to predictable events and the responses are always predictable as they are the outcomes of an algorithm. Complex system can respond to unpredictable events and the response can be both unpredictable and adequate. A machine cannot use information but only instructions. A homeostatic system can use the input from the environment to extract the information about the environment by forming a model of the environment. Also, a homeostatic system can use the input from its primary goal subsystem to extract the information about the primary goal by forming a model of the primary goal subsystem. Then, it uses the model of the primary goal subsystem and the model of the environment to adapt its behaviour to the eventual change of the environment in order to achieve the primary goal of the system. In an industrial organization that is just the role of design subsystem. The design subsystem adapts the behavior of the system (an organization) to a change of the environmen by creating information in the form of conceptual product and process model. The information is then transformed into the product and process model (Figure 5).

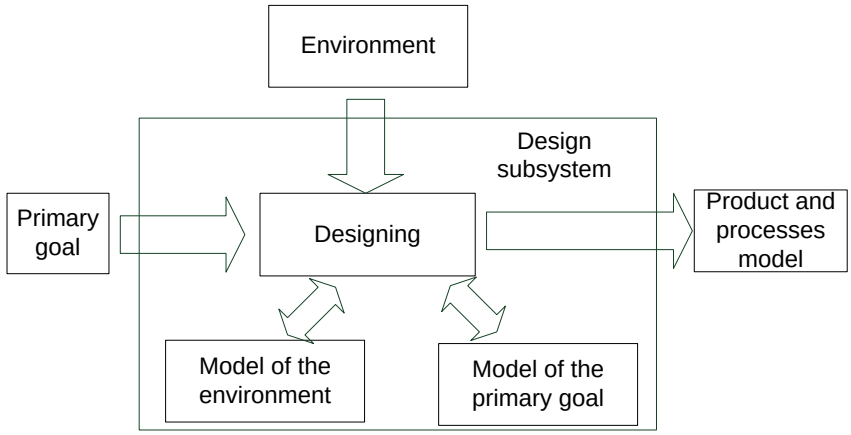

Figure 5. *A model of design subsystem*

Organizations are systems that are created to achieve the goals of their stakeholders (the primary goals) through achieving missions, visions and objectives of the organizations. The stakeholders are persons or organizations that have vital interests in the success of an organization. Primarily, stakeholders are customers, investors, employees, suppliers and society. The society goal is supreme one because organizations are subsystems of a society system and customers, employees, suppliers, investors are institutions of the society that are defined in order to satisfy the primary goal of a society and their existence is only possible within a society. The primary goal of a society imposes the basic relationship between the goals of customers, employees, suppliers, owners and investors.

5 CONCLUSION

Design is an emergent phenomena appearing in homeostatic systems that imposes downward causation on the subsystems of the systems. That downward causation is manifested as an organization of the subsystems into integrated whole, whereas the behaviour of the whole cannot be explained through behaviour of its subsystems. So, the organization per se became an independent entity. The organization of the system is vitally dependent on openness of the system, meaning that there must be exchange of matter, energy and information between the system and the environment. The exchange is regulated by design of quality products. The regulation is aimed to sustaining the quality of life and essential relations between stakeholders of an organization, which is primary goal toward which all subsystems of the organization are aligned. Between the stakeholder`s goals there is a relationship, so that all the goals are aligned toward the society goal, which enables alignment between the organizations themselves, that is the appearance of global industrial system.

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APPROACH TO DEVELOPMENT OF INNOVATION DISTRICTS

Slavko Arsovski[1], Zora Arsovski[2], Ivan Milošević[3], Milan Pavlović[4]

Abstract: Innovation districts are one kind of industrial districts which compromise goals of regional development and business with emphasizing of business goals in a region. In era of globalization regional approach is necessary bat not is enough. A competitiveness becomes key factor which needs interaction between regional and international arena. For it there are four type of innovation districts: (1) consistent with Marshallion industrial districts, (2) consistent with Marshallion industrial districts bat less successful, (3) based an: (a) hub and Snake District or Anchor-Tenant and (b) satellite platform, (4) University Research Centre analyzed, and (5) combination of previous types. In the paper is presented approach of developing innovation districts from aspects of quality and ICT (Information and Communication Technologies).

Key words: innovation districts, quality, ICT.

1 INTRODUCTION

The base for industrial and innovation district is business process orientation (BPO). According to [1] in analysis of impact BPO on innovation performances is necessary to analyse: (1) business process orientation, (2) cross-functional integration, (3) customer integration, (4) employee innovation performances. Using structural modelling approach authors find that: (1) Process Jobs and (2) Process management and Employee Innovativeness and in next step on Organizational Innovation Performances. That has implication on our research, because in Innovation Districts (ID) are emphasized bath factors influenced an Employee Innovativeness. According [2] in ID are included:

- a goal of sparring job creation and innovation through investment in places and institutions,
- formal collaboration between three kinds of partners: higher education/research institution the public sector and private enterprises,
- geographic focus on investing in and improving a particular place that will serve as host to the innovation district,
- efforts to foster communication and collaboration, including compact, walk able design, and new or enhanced programs and institutions,

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- a focus on a specific tupe of industry or industry cluster and or a particular type of knowledge workers.
- A common features of realized ID are:
- most host cities had made significant transportation and infrastructure investments, which modernized the area,
- all districts made and effort to foster collaboration among business leaders and to develop lively retail, cultural, and public spaces for residents, in a concerted attempt to attract and retain young university talents,
- many ID concentrated firms in certain industries and accelerate their business.

In [3,4,5] author analyzed typical networks of actor types in emerging economies for environmental innovations. Generally it consists from:

- social and environmental organizations,
- users,
- universities/public laboratories,
- standard setting organizations,
- regulatory agencies,
- public planners/project developers,
- operators in infrastructure,
- capital providers,
- suppliers of technical equipment and
- local, regional and political support.

In ID, especially in transition countries is question: innovation or imitation? [6]. Using Recursive benchmarking Project (RBP) authors find that: (1) innovation and creativity is higher from 3 to 3.2 on scal 0 – 5, (2) new idea generation for new services from 1 to 3.4, (3) last years from 3 to 3.6, and (4) analysis of customer needs to support the development of new services from 3 to 4.

In [7,8,9] are analyzed three perspectives, i.e.: (1) entrepreneurs perspective, (2) policy maker's perspective, and (3) academic perspective. Using technique of interview they defined basic innovation issues (definition, indicators, and favourable environment), and innovation support policies (public funds, private funds, and clusters). For it active roles in promoting innovation are:

- role of intermediates,
- role of universities, and
- role of entrepreneurs.

Each role in ID has to be supported by government and foreign partners.

Based on ID approaches in [6] authors developed a typology of innovation districts, categorizing regions into four types based on the percent of small firm patents and overall patent rate. It is connected with regional resilience. So, Marchallion regions are characterized by many innovative small firms, with type 4: state - archived regions.

In [10] analyzed two axis: (1) need for coordination and (2) centralization of control identified four dimensions of structure and governance in ID. For the first axis they emphasized aspects of complexity and imperfect separability, and for second axis the architectural control and high minimum efficient scale.

The distinguished archetypes (for each quadrant) have different attributes related to:

- primary mechanism of emergence,
- structure,
- nature of relationship between firms in ID,
- predominant form of governance,
- benefits associated with locating in the ID,

- costs associated with locating in the ID,
- competitive advantage of ID firms vs. isolated firms,
- intra-district differences in competitive advantage, and
- newcomers access to the benefit that the ID after.

In [11] authors analyzed changing nature and sustainability of ID in France. Using process-based analysis they proposed new context, nature of relation and evolution of ID concept, especially:

- changing relations between companies in the district and their clients: a contract-based approach,
- changing relations between companies within the district: strengthening of formal cooperation, and
- changing relations between companies in the district and institutions: an increasing institutionalization.

In conclusion of the research authors emphasized four factors for sustainability of ID: (1) a specific dynamic profile and differential growth, (2) strengthening of embeddedness and institutionalization as a resource to external crises, and (3) implementation of a system and (4) the creation of new institution resulted in the survival of the district.

2 ANALYSIS OF INDUSTRIAL DISTRICTS

For analysis of ID from aspects of fulfilling the stakeholders needs in the paper is used method of Requirements Engineering (RE). In some research papers requirements are viewed as base for development any system in whole Life Cycle [12]. So Joung defined 21 tupes of requirements. For ID′s stakeholders we recognize following types of requirements:

- business requirements,
- user requirements,
- business rules,
- functional requirements,
- performance requirements,
- kvalification knowledge and skills requirements,
- product/service requirements,
- proces requirements,
- logistic support requirements,
- environmental requirements,
- system, subsystem, and component requirements [13].

A chosing the requirements for project of *ID* is necessory to:

1. review related historical information,
2. review related organizational and regional politics,
3. identity stakeholders of ID project,
4. develop a strategy to involve customers, users and regional and state authorities throughout the development effort,
5. write (and iterate) a project vision and scope document,
6. develop a requirements plan,
7. provide for peer reviews and inspection of all requirements-related work products,
8. initiate a project glossary and a project acronyms list,
9. decide on the life-cycle approach to be used on the project (including SWOT analysis),

10. begin tailoring the corporate (or regional) requirements process,
11. establish a mechanism to evolve the real requirements from the stated requirements,
12. provide requirements-related training sessions for project participants, including all stakeholders,
13. rewrite the high-level system requirements as in initial steps,
14. initiate development of the real requirements on the stated requirements,
15. initiatedocumenting the rationale for each requirements,
16. establish a mechanism for incorporating changes in requirements and control of new requirements,
17. perform V & V planing (verification and validation),
18. select the practices, methods, and techniques that will be used to gather requirements,
19. make the requirements repository,
20. select and aquire the automated requirements tool,
21. lead the initial real requirements into selected requirements tool,
22. performs requirements gathering,
23. develop the tracebility strategy to be used,
24. identity the requirements that will be met in the first release (prioritize real requirements),
25. establish an approach for a proof of concept, protype, or other approximation of work product or ID as whole,
26. incorporate requirements best practices and garner management support for effective requirements engineering, and
27. complete requirements gathering for the first release.

A stakeholders requirements are related to:

- economic development,
- human resources,
- sustainability of region (S),
- business excellence,
- environmental and technological development,
- scientic and education development,
- infrastructure development,
- ICT development, and
- quality of life (QoL).

3 A DESIGN OF ID USING INTEGRATED QUALITY APPROACH

One of fundamental principle of a quality approach is orientation to stakeholders or interested parties, including leadership/management, employeers, suppliers.

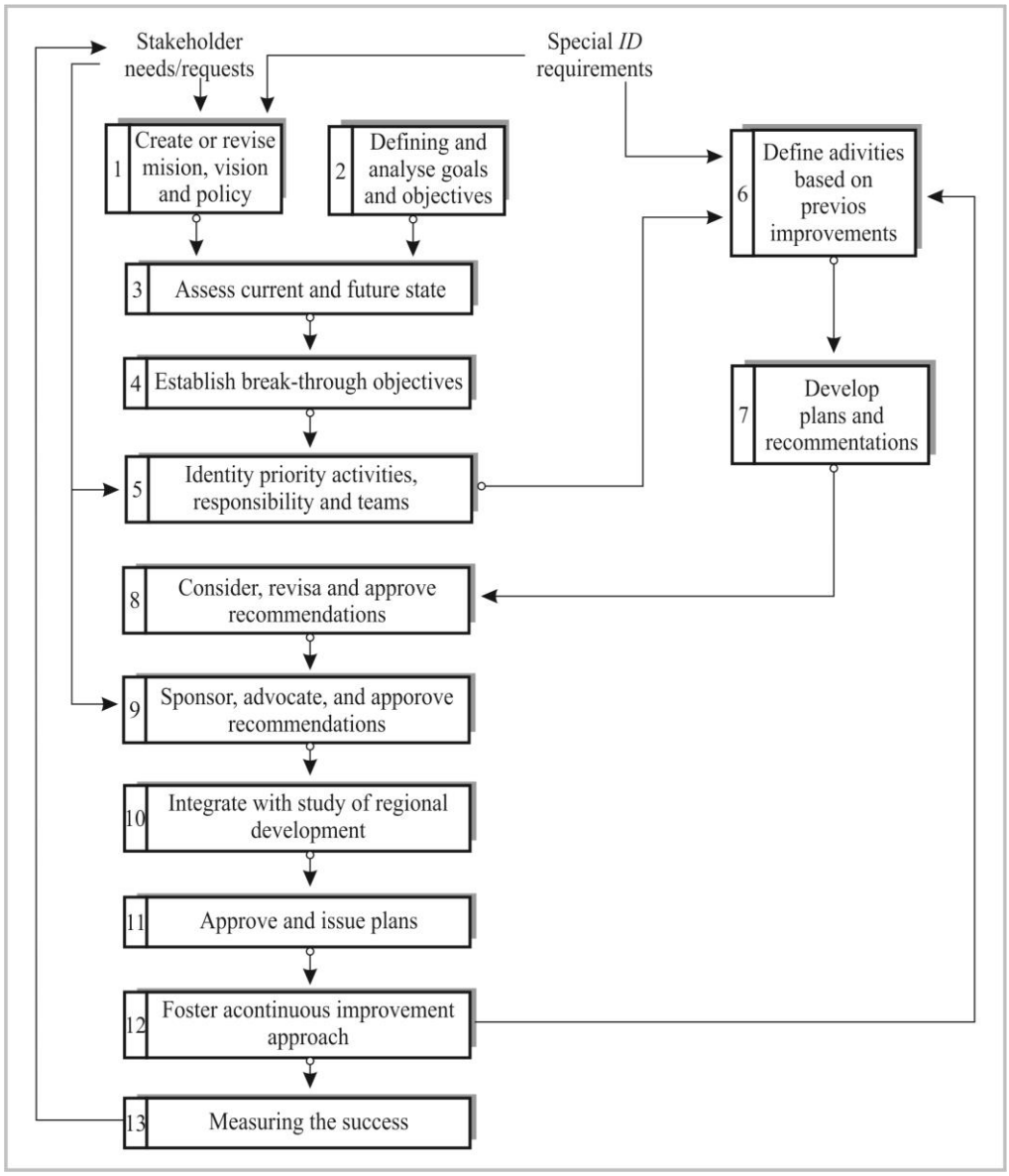

Figure 1. *Deciding flow using integrated quality approach*

In integrated quality approach are also included other requirement related to environmental protection, resilience or business continuity, competitiveness or business excellence [14], sustainability, effective development and change management, safety and security, etc [15,16,17].

In figure 1 presented are steps and components of an integrated quality approach. In this approach is started from stakeholders needs/requests based on present or future needs/ requirements and level of success during works of ID. In proposed 13 phases is defined quality aspects and improvement process of quality in ID. It beginning with creation of mission, vision and policy and ending with measuring of success for closing quality loop.

At the top of the figure are presented a special ID requirements. They are presented in next chapter.

4 QUALITY OF LIFE AS ENABLER AND OUTCOME OF INDUSTRIAL DISTRICTS

A quality of life (QoL) is based an fulfilling human needs and subjective well-being through integrating oportunities [16]. In their research human needs are selected into:

- subsistence,
- reproduction,
- security,
- affection,
- understanding,
- participation,
- leisure,
- spirituality,
- creativity/emotional expression,
- identity, and
- freedom.

In industrial districts (ID) is recognised following opportunities:

- regional/state global development,
- sustainability improvement,
- clear environment,
- competitiveness improvement,
- infrastructure development,
- aglomeration of resources,
- knowledge and innovativene development,
- resilience improvement,
- effective integration in global economy,
- better integration industry with other sectors, etc,

In figure 2 is presented proposed model of integrating ID and QoL (ID/QoL). In first step ID authority analyze and select opportunitics related to ID, based on previos list of opportunities. In second step has been analyzed human needs and generated matrix opportunities/human needs, with explanation relationships among them. It is impact for design and establishment of ID (step 3). After realization business and other processes in ID in 4.step is possible to measure subjective well-being (SWB) and calculate or ass-ess impact of SWB on society (step 5). During functioning the ID in society and ID is expected to happend changes and is necessory to predict and/or assess/simulate its (step 6). It is input for creating new policy of ID with respeding opportunities of QoL [18;19].

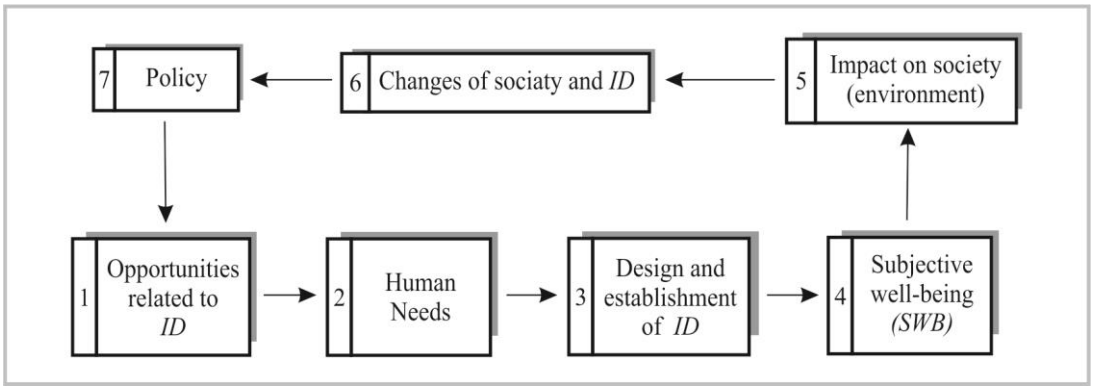

Figure 2. *Integrated model of ID/QoL*

5 CONCLUSIONS

Industrial districts are form of agglomeration of resources on regional basis and have been related to QoL opportunies. In this paper are presented some relations among them i approach for integration ID and QoL into ID/QoL. It is significant for existing ID′s, as well for future ID in phase of development. In future reserch will be created simulation model for development of ID for Central Serbia, based on QoL opportunitics.

ACKNOWLEDGMENT

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THE SYSTEMATIC INNOVATION MANAGEMENT PRACTICES AT UNIVERSITIES AND THEIR ECOSYSTEM

Snežana Nestić[1], Miladin Stefanović[2], Aleksandar Aleksić[3], Marija Zahar Đorđević[4]

Abstract: In the area of the Western Balkan Countries (WBC), the level of the entrepreneurial and innovative culture at WBC Universities as well as networking Universities with SMEs and business in general is not on the high level. It is necessary to promote and improve entrepreneurial and innovation orientation among students, improve and strengthen the role of Knowledge Transfer Centers on the University level, through introduction of framework for systematic innovation management practice, increase competitiveness of SMEs through improvement of their capacity for innovation as well as provide connections and bridge the gap between Universities and business innovation centers. Networking on the level of academic institutions and cooperation and networking on the level of business innovation centers in WBC will provide opportunity for wider integration and educational, institutional, social and economic reform of the region in this road to EU.

Key words: entrepreneurship, innovation, Innovation Management System, WBC Universities

1 INTRODUCTION

The transition from a traditional university to a more engaged and innovative and entrepreneurial one is a complex and demanding task [1]. In addition to educating students and performing research, universities are more and more engaged with their region and business. Higher education, research, innovation are considered as important pillars for regional development and prosperous Europe. Currently higher education's contributions to prosperity, to the jobs creation and to its wider role in regional development are not sufficient.

There is a clear need to bridge existing gap between world of business and education. The main goal is to provide appropriate conditions for successful adoption of entrepreneurial and innovation potential for enhancement of University – business

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cooperation [2-4]. Introducing students with entrepreneurship and innovation is important for their future work orientation and the improvement of their potential for innovation and entrepreneurship. In order to achieve this, it is necessary to promote importance of innovation management practices.

Improvement of the communication system and closer cooperation with local environment should bridge the gaps that can obstruct improvement of the partnership between Universities and their ecosystems. The purpose of this is to increase awareness and to develop a climate for further improvement of the entrepreneurship and innovation management practices at Universities [5].

Universities, research institutions and centers that support innovation and entrepreneurship play a key role in today's society. In addition to educating students and performing research, universities are more and more engaged with their region and business. For all Western Balkan Countries (WBC) partners there are many common problems about involving higher education institutions (HEIs) in process of cooperation with enterprises and insufficient utilization of entrepreneurial and innovative potential among the students, researchers and teachers. WBC need improvement of cooperation in many different fields. This improvement of cooperation should also be accompanied by raising awareness of importance of innovation management system for the increasing competitiveness of SMEs [6].

2 EDUCATION DEVELOPMENT STRATEGIES IN WB COUNTRIES

Social and economic development of modern society is conditioned by the ability to innovate. One of the assumptions of the knowledge society is a higher education system that is characterized by efficiency and innovation. For all Western Balkan Countries (WBC) there are many common problems about involving higher education institutions (HEIs) in process of cooperation with enterprises and insufficient utilization of entrepreneurial and innovative potential among the students, researchers and teachers. HEIs need to be oriented to the student, his expectations, needs, preferences and character building. Strategies of sustainable regional development in WBC stipulate the cooperation between HEIs and research institutions and centers that supports innovation and entrepreneurship in order to achieve the sustainable regional development. Goals of the strategy "Europe 2020" are translated into national goals. Strategy of the Development of Education in Serbia until 2020, is concerned with identifying the purpose, goals, directions, instruments and mechanisms of development of the education system in Serbia [7]. In the Action Plan, for the implementation of the Education Development Strategy in Serbia, are concretized individual activities defined objectives and priorities of the Strategy. The activities, which need to be covered are: strengthening innovative potential and increasing the innovative outcome and strengthening the entrepreneurial component of higher education. According to the Action Plan, some outcomes of these activities need to be: formed innovation centers, business incubators, centers for development and technology transfer; improved innovative skills; organizing manifestations in order to promote science and innovation; introduced entrepreneurial modules of study programs; increased (self) employment; increased interest in studies that lead to faster employment. One of the goals of the Strategy for Development and Financing higher education in Montenegro until 2020 is to link higher education and the labor market and raising entrepreneurial and innovative character of education [8]. This need to be achieved through: harmonization of conditions and study profiles with labor market needs and development directions of Montenegro and encouraging entrepreneurial and innovative character of the studies. Strategic Directions for Development of Higher Education Federation of Bosnia And

Herzegovina until 2022 as one of the objectives states promotion and support of projects with direct application in the economy [9]. So, it necessary to modernise WBC universities and their ecosystem, in such a way, that it can be the engine of economic growth, competitiveness and innovation.

The number of entrepreneurs among the students, researchers and lecturers, has traditionally been low in WBC. It has been identified that lack of entrepreneurial education programs at HEIs in WBC is the main reason why students are not entering into private business. WBC HEIs offer more theoretical education and research. They need to participate more actively into the regional development activities, directed the education and research to serve better the regional needs, co-operate with the industry and incorporate regional development aims into their strategies. Efforts are being made by individual faculties to teach the students about entrepreneurship but the approach has not proven to be efficient. The new role of WBC HEIs as regional development actors need to be establish.

At WBC HEIs the deficiencies in education programs have often been identified in the confusion between the aims of the program, appropriate methods and needs of students. Since introducing students with entrepreneurship, innovation and high-tech research is important for their future work orientation and the utilization of their entrepreneurial potential, training courses and workshops need to be delivered to students and enable them to acquire entrepreneurial skills and gain knowledge on how to implement their research work and entrepreneurial ideas in real business environment.

In order to link the worlds of work and education joint activities of universities, SMEs and centers that support innovation are necessary.

The Universities in Western Balkan Countries (Serbia, Montenegro and Bosnia and Herzegovina) are at the beginning of establishing entrepreneurial and innovative orientation of their academic institutions. They have been making effort to introduce entrepreneurship to the students at different educational level. University of Kragujevac and University of Novi Sad have established Knowledge transfer centers or Centers for technology transfers at their institutions. On other hand, Universities of Kragujevac, Novi Sad and Montenegro have established cooperation and actively participated in the work of business innovation centers in their local environment. Obviously, some pieces of the puzzle exist but some of them are missing and things have not been put together. It is necessary to fulfill gaps that specially exist between Universities and business (business innovation centers, business incubators, SMEs) through development more engaged and innovation-oriented entrepreneurial Universities and their ecosystem as well as to fill other gaps that exists at Universities in WBC and to put everything in the network ensuring synergy effect.

3 EDUCATION DEVELOPMENT STRATEGIES IN WB COUNTRIES

Supportive and encouraging environment for developing a culture of innovation in order to advance international university-business cooperation can be achieved by introducing framework for systematic innovation management practices, the European Technical Specification CEN/TS 16555-1: Innovation Management System (InMS), at WBC Universities and in WBC SMEs. InMS provides recommendations and practical guide for organization to identify and promote innovation, effectively manage their innovation activities, and evaluating and improving the efficiency of their InMS [10]. The introduction InMS can also facilitate capacity building of institutional business services providers and interlinking students with SMEs and business innovative centers.

The main purpose of the framework is applying innovative thinking to creation innovative response to business changes and challenges in WBC region.

The wider objective of the framework is to improve university – business cooperation through development more engaged and innovation-oriented entrepreneurial Universities and their ecosystem. To reach this objective WBC university-business innovation network need to be establish. Better cooperation between Universities and private sector will enable to Universities to strengthen their own knowledge bases and provide a gateway to the new assets for WB regional innovation. Also, private sector in WBC can be able to use knowledge, research from Universities, and create new, innovative products, processes and techniques, and improve competitiveness. On this way, potential available resources for improvement of entrepreneurship and innovation and stimulation of systematic innovation management practices can be widened.

Some specific objectives of the framework can be:

- Strengthening the role of Knowledge Transfer Centers (KTCs) at WBC Universities through enhancement of their capacity to provide support to the nationals' economies in WBC by implementing framework for systematic innovation management practices, an InMS. Enhancement of entrepreneurial and innovative orientation of KTCs by establishment and maintenance of new, effective InMS can enable KTCs to expand theirs activities and become more innovative, to manage and disseminate this knowledge to students and SMEs as well as to drive economic development in the regions where they are located. KTCs need to promote student innovation and entrepreneurship, encourage faculty leadership for innovation and entrepreneurship, actively support knowledge and technology transfer and facilitate university-business collaboration. Also, KTC can offer SMEs consulting services in order to introduce InMS in their enterprises and processes. SMEs can improve their performances, expand their capacity for innovation and generate more value for its stakeholders.
- Increasing Faculties capacity to strengthen their role as engines of entrepreneurship and innovation through applying leadership for innovation framework. This can enable effective leadership of Faculties, which will foster innovation culture and organizational change. The strategy of faculties should be innovation oriented and to define: the faculty's innovation capacity and resources, the type of innovation and level of novelty, the policy enabling innovation (regarding human resources, intellectual property and internal collaboration) with top management commitment, fostering an innovation culture and with clearly defined roles and responsibilities.
- Enhancement of entrepreneurial and innovative orientation through customized training and networking activities at Universities for students. This can enable to

students customized training in areas of innovation and entrepreneurship followed by practical application of gained knowledge. On this way students can advance knowledge in the areas of entrepreneurship, innovation and technology through new ideas, research, suggestions and tools, how to grow and evolve their innovative ideas.

- Improvement of WBC SMEs competitiveness through InMS framework and customized training programs. This can enable SMEs and their top management and developing managers to improve capacity for innovation and increase their professional skills. Also, SMEs can improve their competitiveness and productivity through the better use of knowledge, innovation and technology and skills that reside within universities. Introduction and development of sustainable framework for systematic innovation management practices through applying CEN/TS 16555-1:2013 standard in SMEs is one step in creating an innovative response to change and challenge. The use of this framework to managing innovation is a good way for SMEs to order to improve their culture of innovation by applying innovative thinking to solve problems and develop new products and services.
- Networking universities and their ecosystem through the establishment of WBC university-business innovation network, improvement of communication system and closer cooperation with private sector. An efficient and effective interaction between Universities and private sector is a crucial element in establishment a competitive (regional and national) economy. Working together, Universities and private sector will be able to identify the most promising areas of innovation in the WBC region, but also weaknesses that hamper innovation. Enhancement of networking of Universities and their ecosystems presents strategic orientation for WBC region. Establishment of WBC university-business innovation network represents most appropriate way for widening potential available resources for improvement of entrepreneurship and introduction the innovation management practices at Universities, but also for other ways of University –business cooperation as is increasing capacity to serve the needs of innovative SMEs and the regional economy. Universities and business can exchange ideas about collaboration to ensure that education delivers high-level skills. Also, these networks of innovators will help to stimulate new kinds of innovations.

With realization of these objectives, WBC Universities will enhance local human capital, promote more interactive learning environments and improve the level of entrepreneurial and innovative orientation, while SMEs will be able to expand their capacity for innovation, effectively manage their innovation activities, generate more value for enterprise and its stakeholders and increase professional skills of their employees.

4 IMPACT OF THE FRAMEWORK

The sustainable framework for systematic innovation management practices at universities can help in bringing closer the world of entrepreneurship and innovation management practice to students. Introduction students with entrepreneurship, innovation practice and high-tech research innovation is important for their future work orientation and the utilization of their entrepreneurial and innovative potential. Workshops and training will enable students to gain sufficient knowledge, skills and experience. On this way, new employment opportunities will be created and safeguarded existing employment in the regions.

Through introduction sustainable framework for systematic innovation management practice and applying innovative thinking to solve problems and develop new products and services can increase competitiveness of SMEs in the region. SMEs with a highly aligned innovation strategy and a culture that supports innovation significantly surpass their competition. Nevertheless, in order to remain competitive SMEs it is crucial develop of their top management and developing managers. This allows to managers that evolve new strategies, lead new initiatives and build “the innovative organization.” On this way, SMEs can find innovative solutions to promote growth, increase competitive advantage and access to academic expertise and innovative research. SMEs will accelerate innovation projects and grow their business.

The framework can enable strengthen self-sustainability of business innovation centers and contribution to the increase in resources for future projects. By producing well-designed trainings and workshops for students and consulting services for SMEs and involving business innovation centers staff in the process, as well as transfer of knowledge from KTCs to business innovation centers, long-term cooperation with the Universities and business innovation centers can be develop.

The framework can help to facilitate the improvement of education programs in the fields of entrepreneurship and innovation at Universities as well as introduction of innovation management practice in KTCs at Universities in WBC. Establishment and maintenance of InMS in KTCs will strengthen their role in innovation area. This framework can enable development of an innovation strategy and vision, introduce a best-fit innovation process, use methods, techniques and tools to promote innovation and focus and measure the innovation result.

The cooperation between Universities, business innovation centers and local government is very significant in order to achieve the sustainable national and regional development. Also, one of the measures for encouragement of development of entrepreneurship and innovation culture in the region is strengthening institutional capacities for support and creation of a healthy climate for entrepreneurial and innovation, which can be achieved through establishment of WBC university-business innovation network.

5 CONCLUSION

It is clear that the WBC region needs faster regional development and improvement of entrepreneurship and innovation orientation as a precondition for faster economic development. WB countries need improvement of cooperation in many different fields, according to their National strategies for economic growth and development. This improvement of cooperation should be accompanied by raising awareness of importance of innovation management system for the increasing competitiveness of SMEs. The establishment of such a management system can enable SMEs to become more innovative and achieve more success with their products, services, processes, organizational design and business model innovation. This process can lead to increase in competitiveness of business entities in the region.

The main effect of sustainable framework for systematic innovation management practices at universities could be better cooperation of universities, business innovation centers and SMEs in the field of entrepreneurship and innovation research and practices. Other multiplier effects could be stated as better knowledge of students in the field of entrepreneurship, innovation and technology, competitiveness of regional SMEs, introduction of InMS in SMEs, and upgraded study programs based on high-quality innovative research at WBC universities. On this way, the complete process is formed, education – innovation – research with support to SMEs.

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THE STATE OF ENTREPRENEURSHIP AND INNOVATIVENESS IN MONTENEGRO

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Abstract: European business sector pays significant attention to competences relating to initiative efforts and entrepreneurship. These competences associated to entrepreneurship play a paramount role in EU neighboring countries in their development process towards higher performing market economies and convergence with EU economic and social standards. Unfortunately, that is not situation in Western Balkan counties. Due, the Erasmus REBUS project intends to support development of key competences for employability that will guarantee more flexibility in the labor force and allow adapting more quickly to constant changes in an increasingly interconnected world. University of Montenegro is involved in REBUS project and performed research about current situation of entrepreneurship and innovativeness in Montenegro. Three type of researches were performed: Online questionnaires, Desk research and Interview. This paper is focused mostly on results obtained through online questionnaire in Montenegro but we will also briefly present results from Desk research and Interview. The findings demonstrate that a lot has been done in the field of entrepreneurship development in Montenegro, but there are still many spaces for improvement. Actually, entrepreneurship is the topic which is processed in the elementary and some secondary schools but at the universities it is under-treated. It is also shown that there is absolute lack of involving business sector in education process as well as lack of knowledge of the competency validation methodology which is evaluated as very important.

Key words: entrepreneurship, innovation, questionnaire, competences

1 INTRODUCTION

Although entrepreneurship pulls the roots from the 17th century, a greater emphasis on entrepreneurship in theoretical sense is bound up in the late 19th and early 20th century. The term entrepreneurship is especially emphasized through practical examples and actions in the end of 20th century and at the beginning of 21st century.

Entrepreneurship is a term connected with an entrepreneur or someone who encourages and creates innovations or introduces new things, invests money or

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business experience in order to translate innovations into economic good. The concept of entrepreneurship is mostly related to the process of implementing a new business arrangement. The main functions of entrepreneurship are in relation with foresight, risk acceptance, innovation and learning. In order to establish these functions, the synergistic action of talent, technology, capital and “know-how” approach should be defined. Entrepreneurship represents the observation of new ideas and business opportunities and entering in a new business. Entrepreneurship can also be viewed as an activity aimed at launching, organizing or innovating the organization, with the main goal of creating a new market and generating profit.

Entrepreneurs are persons who launch a new business venture. There is a constant dilemma about whether an entrepreneur is born or becomes. There is also a question of the level of correlation between academic education and success in entrepreneurship. Some studies show that genetics have a great influence on success in entrepreneurial work. Thus, in some surveys, about 48% of entrepreneurship tendency is inherited.

When talking about the underling foundation of entrepreneurship, we can distinguish between three pillars [1] :

- Excellent knowledge of the needs of customers, markets, technology, technics etc.,
- Experience, passion to the work and persistence, as well as the investment in enormous work,
- Ideas and objectives, finding and striving to the unused market conditions.

The following concepts are applied to entrepreneurship: innovation, market analysis, business plan development, marketing strategy, transfer of knowledge and technology, design, testing, validation, etc.

Erasmus + REBUS is a research and development project aiming at developing a learning approach for entrepreneurship in Higher Education institutes. It aims at understanding how stakeholders in Higher Education (e.g. professionals as well as students) are familiar with the concept of entrepreneurship and entrepreneurial competences in connection with web-based learning environments as well as with approaches and instruments for validation of learning outcomes in their practice [2].

University of Montenegro as partner in the REBUS project (REBUS project, 2017) is involved in research about current situation of entrepreneurship and innovativeness in Montenegro. Accordingly, we performed research which consists of three parts:

- Online questionnaires,
- Desk research,
- Interview.

Target groups for the research are: students, HEI, enterprises, administration, Chamber of Commerc, etc. Even that the paper is focused on results of online questionnaires, we demonstrate certain information about results of Desk research and Interview.

2 RESULTS OF DESK RESEARCH

Desk research about entrepreneurship in Montenegro is realized by three professors of the University of Montenegro. Desk research encompasses four topics as following:

- Part 1: Entrepreneurship in practice,
- Part 2: Entrepreneurship in Education,
- Part 3: Learning Technologies and blended learning in Higher Education,
- Part 4: Job related Competences, Informal learning and Validation.

Here is presented some of the most important information about each topic.

Part 1: Entrepreneurship in practice

Montenegro has developed the Strategy of development of vocational education (2015-2020) (Ministry of Education of Montenegro, 2014a) and Strategy for lifelong entrepreneurial learning for the period 2015-2019 (Ministry of Education of Montenegro, 2014b). The Entrepreneurial learning in Montenegro during the last 15 years has undergone several phases of development.

There are many organizations in Montenegro that offer a variety of courses to employers through trainings, seminars, workshops and round tables in order to develop the business in Montenegro.

Part 2: Entrepreneurship Education

Entrepreneurship is represented as an optional teaching course in elementary school. Starting from 2012/2013 in all secondary schools under Entrepreneurship course, children attend the program “Young Entrepreneurs”. There are some courses in Montenegro focused on Entrepreneurship at University of Montenegro. There are also some teaching courses in the field of Entrepreneurship at the private University of Donja Gorica (UDG) and private University Mediteran.

Part 3: Learning Technologies and blended learning in Higher Education

There are used classical learning methods like: oral presentation method, the method of talking, documentation methods, experimental methods, etc. There is no Accredited Program in Montenegro which has the character of e-learning. At the University of Montenegro, software Moodle, as a Learning Platform or course management system, is used sporadically. It is not obligatory.

Part 4: Job related Competences, Informal learning and Validation

There is no validated system in Montenegro in the area of entrepreneurial skills and competences and there is no assessment systems for these skills / competences in Montenegro.

3 RESULTS OF INTERVIEW

The interview is performed with one entrepreneur (business person), two professors (University of Montenegro), one student of University of Montenegro and one member from Chamber of Commerce [5].

Most of the interviewees find that there is a lack of entrepreneurship education in Monenegro. Actually, most of them said that there are the least learning about entrepreneurship on universities that are not strictly focused on economics and business. Most of interviewees consider that the teaching course related to the

entrepreneurship as obligatory course in all study programs should be defined by some strategies, for example, the Strategy of high education or the Strategy of university's development. All interviewees agreed that business sector should be more integrated in education.

All respondents agreed that the best and most interesting learning method is using a mix of different learning modalities using compulsory practice in selected enterprises.

4 RESULTS OF ONLINE QUESTIONNAIRES

The Questionnaire is distributed to all partners' countries at Erasmus + REBUS project. There were 809 respondents. The Questionnaire is consists of 5 parts:

1. Introduction and statistical background data,
2. Entrepreneurship and Entrepreneurship competences,
3. "Learning entrepreneurship" - Acquisition of entrepreneurial competences,
4. Validation of competences,
5. Digital learning.

There were 54 responds from Montenegro. The paper will presented some interesting responds from each part of the questionnaire.

Part 1 of Questionnaire: Introduction and statistical background data

The Structure of the respondents in Montenegro is presented in figure below.

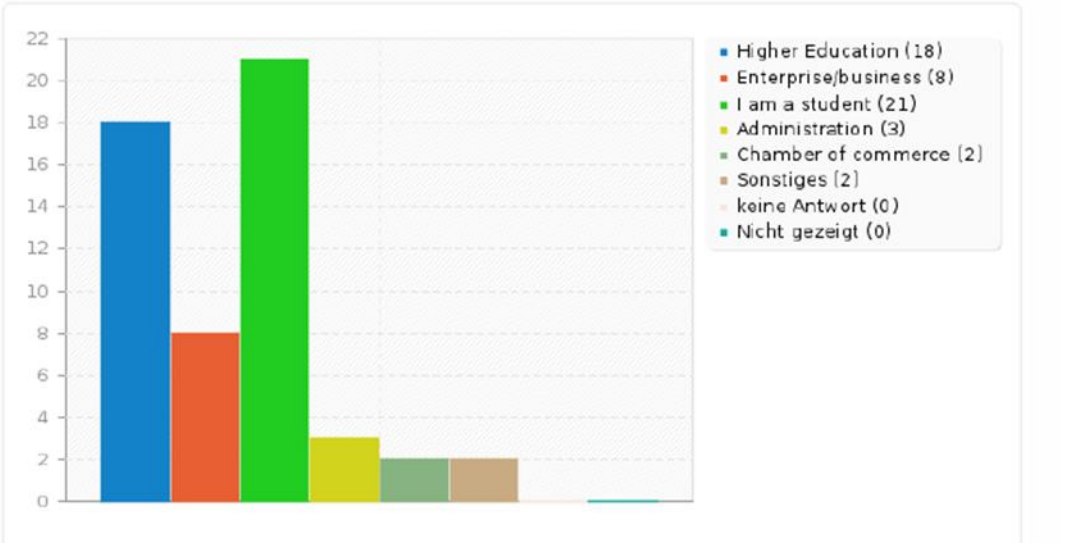

Figure 1. *Structure of the respondents in Montenegro*

More than 70% of respondents are from University (students and professors). Other respondents are from Administration, enterprises and Chamber of commerce.

Part 2 of Questionnaire: Entrepreneurship and Entrepreneurship competences

Results about knowledge of the concept of entrepreneurship are shown in figure

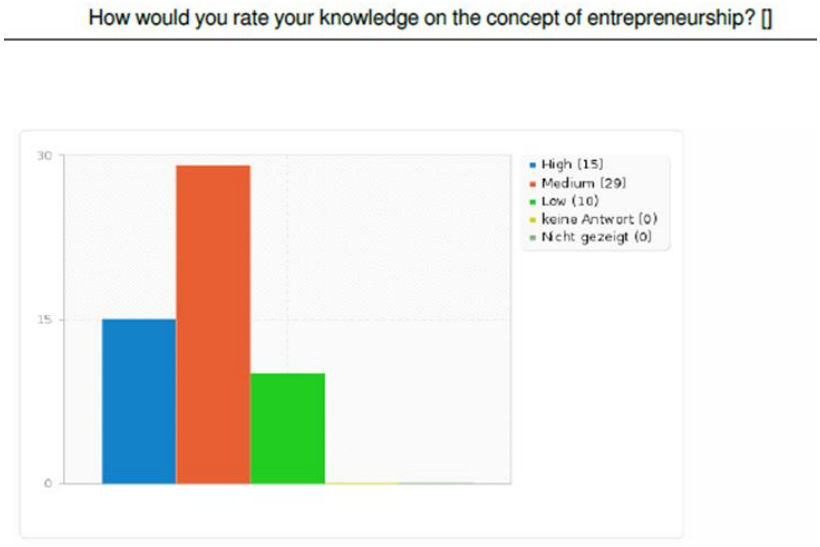

Figure 2. *Knowledge of the concept of entrepreneurship*

The most of respondents said that they have medium level of knowledge of entrepreneurship. It is very interesting that about 20 % of respondents said that they don't have any knowledge about entrepreneurship. Most of respondents also mean that "entrepreneurship and sense of initiative" are very important for finding job (figure 3).

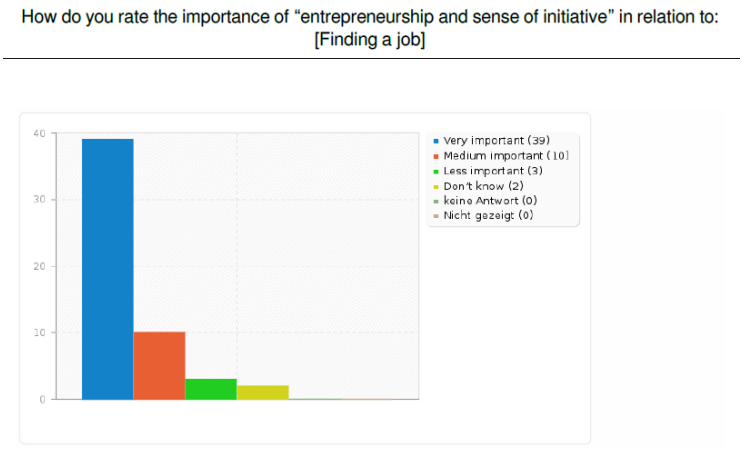

Figure 3. *Impact of entrepreneurship for finding job*

We can see in figure 4 how respondents give answer which aspects and competences are most important for persons, who have entrepreneurial mindset (figure 4).

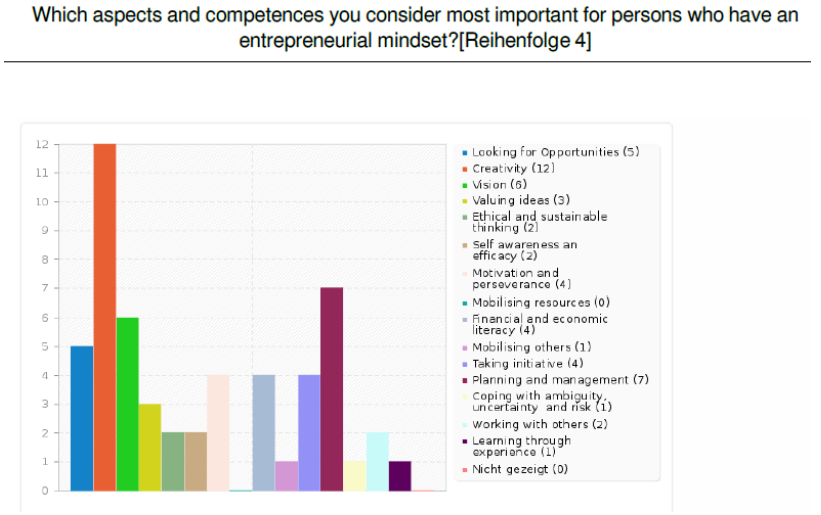

Figure 4. *Aspects for entrepreneurial mindset*

The most important aspects and competences for entrepreneurial mindset are evaluated as following:

- Creativity (12),
- Planning and management (7),
- Vision (6).

***Part 3 of Questionnaire:* Acquisition of entrepreneurial competences**

Figures 5 to 7 present evaluation of knowledge acquisition on different level of education (School education, Adult education and High education).

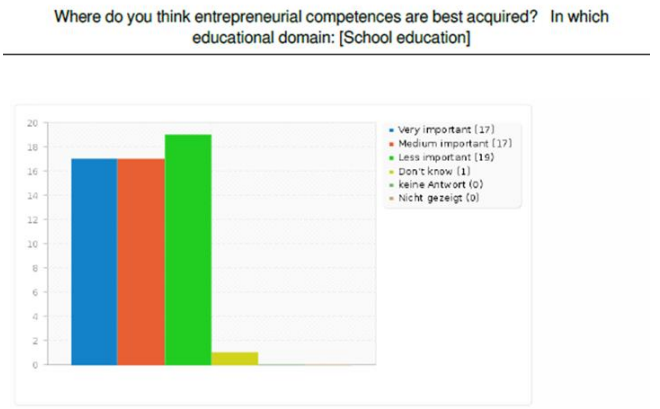

Figure 5. *Acquisition of entrepreneurial competences in school education*

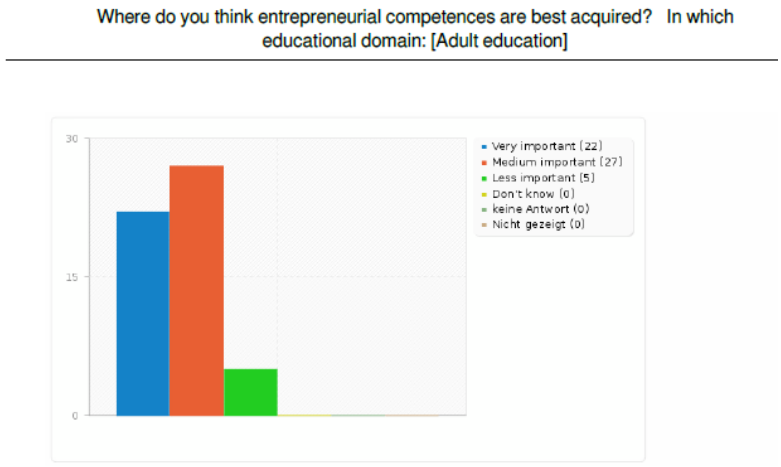

Figure 6. *Acquisition of entrepreneurial competences in Adult education*

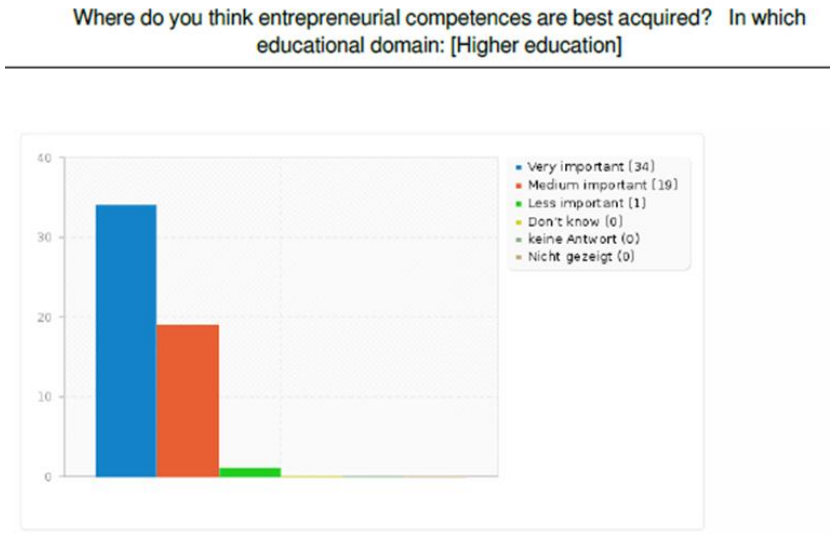

Figure 7. *Acquisition of entrepreneurial competences in Higher education*

Most of respondents think that higher education is the most important for obtaining entrepreneurial competences. There is also high number of respondents who think that school education is not so important for entrepreneurial competences. However, online questionnaire shows that education in general is very important for acquisition of entrepreneurial competences.

Part 4 of Questionnaire: Validation of these competences

Part 4 of online questionnaire is focused on validation of entrepreneurial competences. Validation of entrepreneurial competences is process which is not well known in Montenegro. Figure 8 presents awareness of respondents according any learning program or activity for promotion acquisition of entrepreneurial competences. As we can see most of respondents don't have knowledge about these types of activities. Actually, most of respondents don't have idea about validation of competences or have bit knowledge about it (figure 9).

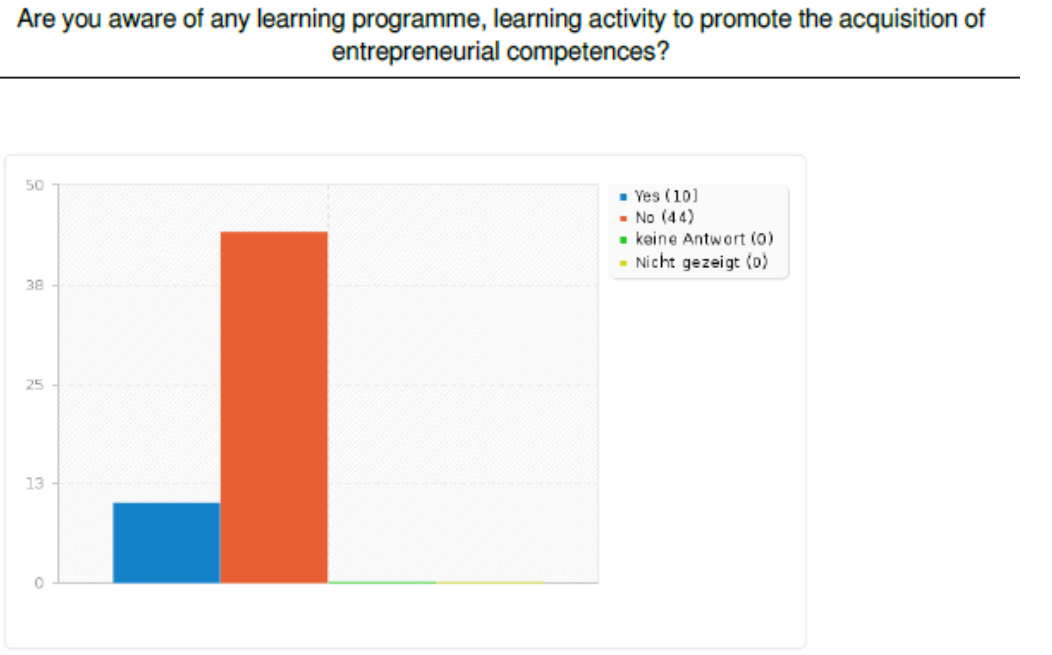

Figure 8. *Promotion of acquisition of entrepreneurial competences*

We can see in figure 9 that just approximately 15 % of respondents have an idea about validation of competences and just 4 respondents said that they know some approaches about process of competences validation.

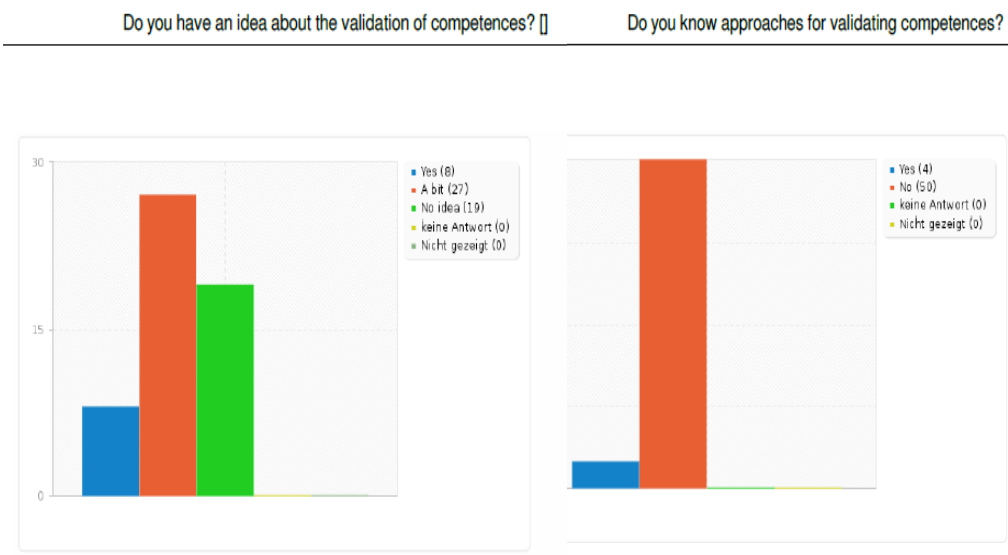

Figure 9. *Validation of competences*

Even validion of competences is not well known process in Montenegro, just one respondent said that it is not important process. Acctually, most of them think that is important process (66%) and 28 % don't have knowledge about it (figure 10).

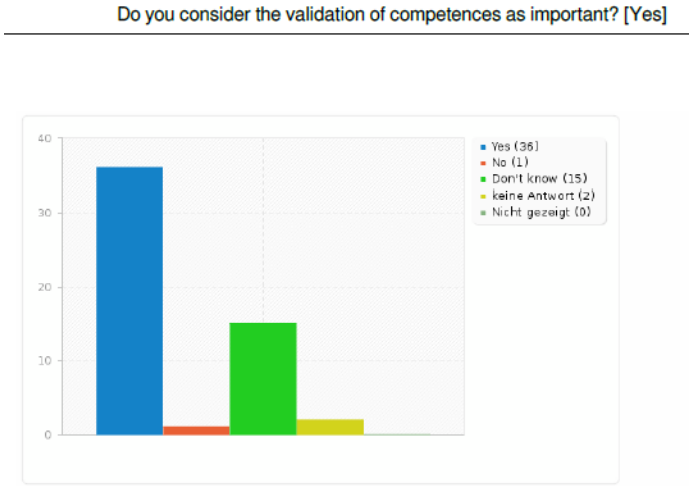

Figure 10. *Importance of the validation of competences*

It is very important to analyze what respondents think why it is important to perform validation of competences. As we can see in figure 11 most of respondents have opinion that validation of competences is very important for Personal development, Job opportunities, Formal education and Career development. Just few respondents think that validation of competences is not so important.

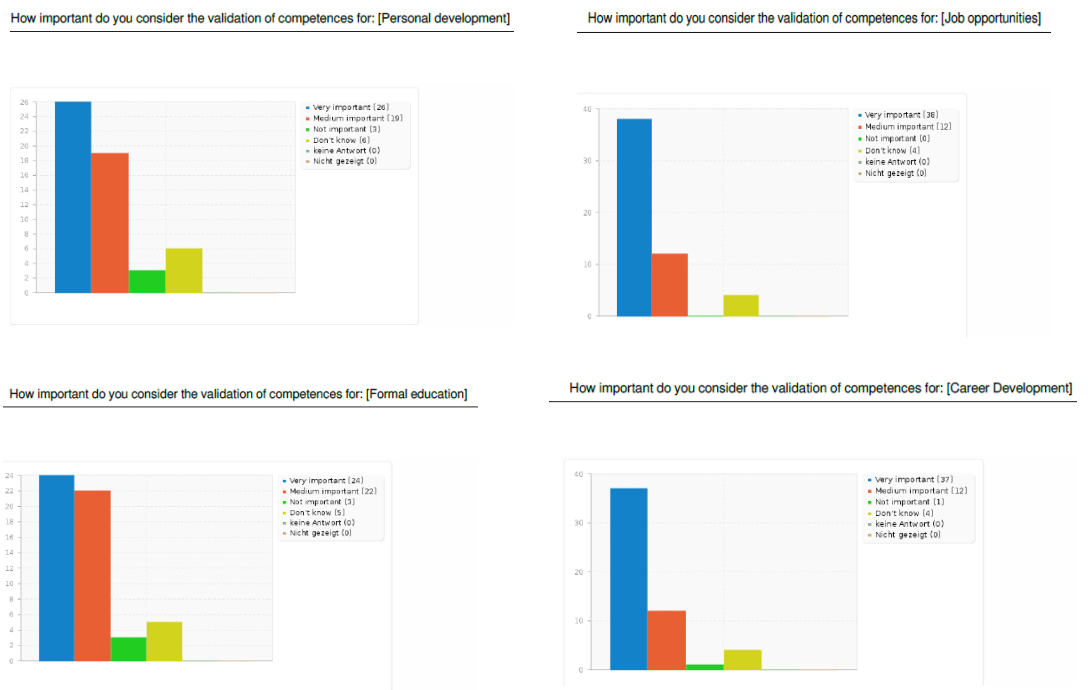

Figure 11. *Degree of importance of competence validation*

Figure 11 shows that:

- 83% of respondents think that validation of competences is important for Personal development,
- 92.6% of respondents think that validation of competences is important for Job opportunities,
- 85% of respondents think that validation of competences is important for Formal education,
- 91% of respondents think that validation of competences is important for Job Career development.

Part 5 of Questionnaire: Digital learning

Part 5 of questionnaire is focused on digital learning (70%). Most of repondents said that they use digital leraning in university. The question is if they really know what does it mean.

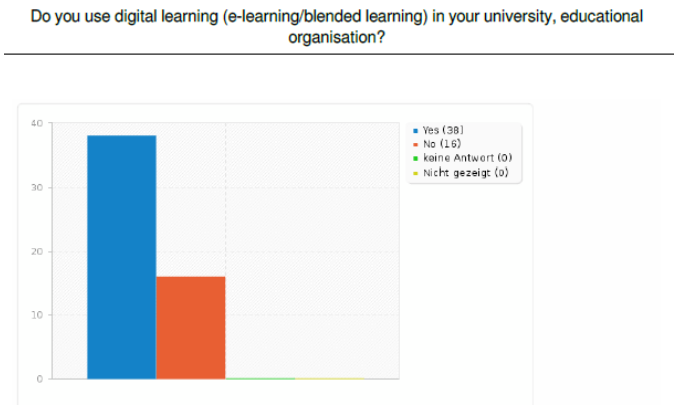

Figure 12. *Using digital learning at Universities*

Many respondents don't have knowledge about any web aided learning system (76%) and more than half of them don't know if it could be useful (figure 13).

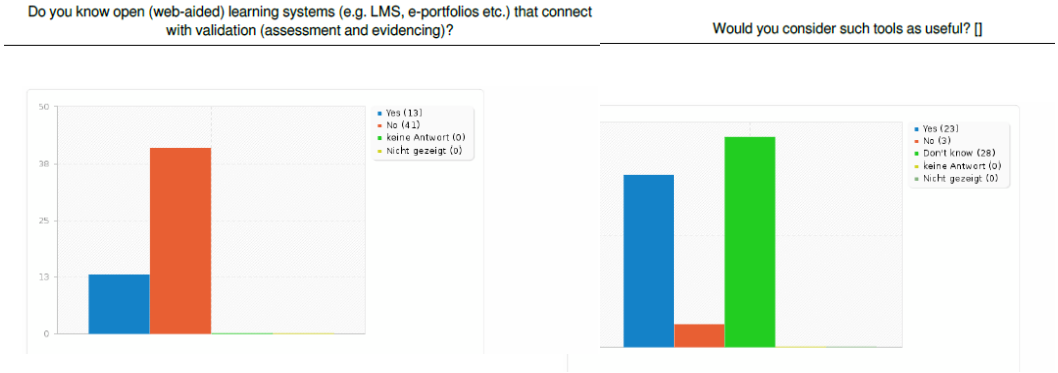

Figure 13. *Knowledge about open learning systems*

We can see on figure 13 that just few respondents (3) think that this type of learning system can't be useful. According that we can conclude that there is not enough knowledge about digital learning in Montenegro but most of respondents don't have resistance to modern technologies.

5 CONCLUSION

Enhancing entrepreneurship competence and entrepreneurial attitudes of graduates of ICT and engineering in the Western Balkans can

support increased employment and improved development of these countries. But, Western Balkan countries, as transition countries from state regulated towards market economy, have a high level of resistance to private initiatives and entrepreneurship. Consequently, the REBUS project will give strong support to develop entrepreneurship competences in Western Balkan countries and Montenegro.

According to the results presented in two parts of the research (Desk research and Interview) we found that there is a certain pre-knowledge about entrepreneurship in Montenegro. Montenegro has developed the Strategy of development of vocational

education and the Strategy for lifelong entrepreneurial learning. There are some teaching courses in Montenegro during elementary school, secondary school and university focused on Entrepreneurship. There is no validated system in Montenegro in the area of entrepreneurial skills and competences and there are no assessment systems for these skills / competences in Montenegro. All interviewees agreed that business sector should be more integrated in the courses.

Online questionnaire shows very interesting results as following:

- The most of respondents said that they have medium level of knowledge about entrepreneurship, while 20 % of respondents said that they don't have any knowledge about entrepreneurship,
- Entrepreneurship and sense of initiative is evaluated as very important for employment,
- Higher education is evaluated as most important type of education for obtaining entrepreneurial competences,
- Only 15 % of respondents have idea about competences validation, so it is not well known process in Montenegro, but most of respondents said that is very important for personal development, Job opportunities, Formal education and Career development),
- Additionally, many respondents don't have knowledge about any web aided learning system (76%) and more then half of them don't know if it could be useful.

However, there is still a lot of spaces for improving entrepreneurship especially in the field of validation entrepreneurial competences which will be established through the REBUS project.

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CHANGES IN THE CONCEPT OF QUALITY IN THE INDUSTRY

Bülent Eker[1], Ayşegül Akdoğan Eker[2]

Abstract :Nowadays, the perspective of quality is changed in every sector. It can be said that each sector has a particular stage of maturity on the issue of quality management .In some sectors quality system dimension is important. In some sectors quality is important in terms of product. In both cases, the human aspect is important. On the other hand ,it is very important to understand the relation between the product manufactured and the end user of that product. Government as well as certain non-government organizations force industries to follow certain rules and regulations to ensure the safety of product manufactured in order to protect the end user. Quality Assurance, Quality Control, regulatory, production, R&D and engineering maintenance all these departments go hand in hand. All these are closely related to each other and play important role while delivering good quality products to targeted customers. Hence everyone involving in the manufacturing of quality product must be familiar with the allied departments and their roles and responsibilities along with the basic concept of quality requirement.In this paper, the basic elements of the quality change in the industry will be discussed and the current implementation patterns will be revealed.

Key words: Quality, concept, industry

1 INTRODUCTION

Change management strategies, as discussed in the literature, commonly share similar approaches and processes. Quality management or business excellence frameworks include many of the elements seen to be essential to effective change management. By adopting a management framework, a holistic approach to organisational change, development and innovation can be achieved. Instead of managing change as a series of events, a system wide approach is adopted.The disparate elements of effective management practice: human resources, industrial relations, customer relationship management, leadership strategies and planning processes are all integrated in a model underpinned by a systems approach and informed by systematic data collection, information and knowledge management [11].

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Quality in manufacturing, a measure of excellence or a state of being free from defects, deficiencies and significant variations.

It is brought about by strict and consistent commitment to certain standards that achieve uniformity of a product in order to satisfy specific customer or user requirements. In a manufacturing or service environment, there are two major categories of quality: quality of design and quality of conformance. Design quality refers to the level of characteristics that the designers specify for a product.

Conformance quality may be defined as the degree of adherence of the product characteristics to the design drawings and specifications. The objective of a industry is to have a system that will measure and control the degree of product and process conformance in the most economical way.A ındustry quality system is a mechanism that coordinates and maintains the activities needed to ensure that the characteristics of products, processes or services are within certain bounds. A quality system involves every part of an organization that directly or indirectly affects these activities in ındustry (Fig.1).Many business leaders define quality as being important, according to Chartered Quality Institute research, but only 50 percent said quality was placed at the heart of their organisation and only 23 percent claimed to be offering a "very consistent" level of quality. Even fewer (16 percent) claimed their quality is market leading, but this is precisely what companies need to set themselves apart as the economy struggles and consumer spending continues to fall [1] [8].

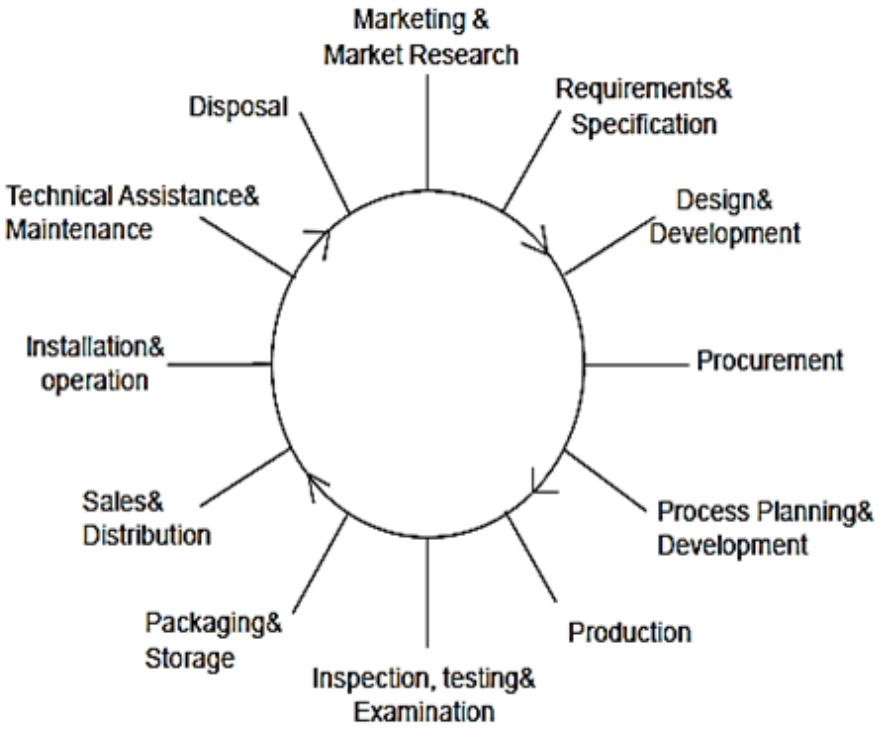

Figure 1. *Quality must be consider at all stages in the life cycle*

There are three basic elements in a quality system: Quality Management, Quality Control, and Quality Assurance. Quality management is the means of implementing and carrying out quality policy. They perform goal planning and manage quality control and quality assurance activities. The term quality control describes a variety of activities. It encompasses all techniques and activities of an organization that continuously monitor and improve the conformance of products, processes or services to specifications [3]. Quality control may also include the review of processes and specifications and make recommendations for their improvement. The term quality assurance describes all the planned and systematic actions necessary to assure that a product or service will satisfy the specified requirements. Usually this takes the form of an independent final inspection.

Quality systems or quality programs in one form or another have existed since the beginning of factories. Companies developed and implemented a quality system that worked for them. Today, new quests have led to the development of qualifications. The industries need to focus on the customer's emotional responses and provide the products with attractive quality in order to pursue customers' delight . In view of the above, quality concepts have changed. New quality concepts pertaining to "customer delight" and "innovative quality" based on the investigation of customers' latent needs in the new century[4] .

2 THE CONCEPTS OF "CUSTOMER DELIGHT" AND "INNOVATIVE QUALITY" IN THE NEW CENTURY

Customer delight" is a new quality concept. A conceptualization of "delight" is the customer's emotional response, which is composed of "joy" and "surprise"—both encountered in the providing process of goods/services . In order to delight customers, the enterprises need to provide the goods/services with attractive and innovative quality incentives. Even though there is no universal formula for success in innovation, you must know that you must provide the minimum requirements on the road to success. We need to understand what innovation is and how to manage it. Innovation is a process that involves different activities in a firm and has a continuity. In order to succeed in innovation, you need to focus on all these processes by focusing on innovation.

Innovation management means managing the company's technology, business processes (customers, suppliers, financial and external resources, etc.) and human relations (culture, communication, organization etc.) to support and encourage innovation. For this reason, your success in innovation depends on two factors: technical resources (people, equipment, information, money, etc.) and your company's ability to manage them[5] [6] .

To successfully bring these two factors together, you must have both strategic and organizational skills, or you must acquire and develop these skills. Your company has a long-term perspective, the ability to identify and predict market trends, and the ability to collect, process, and assimilate technological and economic information if you have strategic competencies. You can understand your ability to identify and manage risks, whether you have organizational skills, the level of co-operation between operational units, cooperation with research institutions, universities, consultants, customers and suppliers, and the level and quality of investment you make in human resources[7]

The strategic actions are to identify customers' latent needs and to create customer value by developing the innovative products and attractive services in order to fulfill these. If a company brings out some innovative products that consumers did not know they needed before, then these innovative products will often spark high demand . Indeed, Moore illustrated eight types of innovations, namely ;

- application innovation,
- product innovation,
- process innovation,
- experience innovation,
- marketing innovation,
- business model innovation,
- structural innovation, and
- disruptive innovation.

These kinds of innovations, especially the first four types, will result in significant effects on the fulfilment of the customers' latent needs and their delight experiences. Sometimes it is needed to reengineer the critical processes, or to redevelop the provision systems based on customer voices. Thus, the aim of reengineering is to create customers' values, which are the critical factors of raising customer loyalty.Besides, reengineering also reaps the benefits including shorter delivery times of products/services (including lead time and production time), reduction of costs, and the effective utilization of resources[8] [9].

Most companies develop and implement enterprise resources planning (ERP), customer relationship management (CRM), and supply chain management (SCM) simultaneously . By integrating these systems, enterprises can exert excellent business' performance and customer's loyalty. The utilization of high-tech functions and the rapid application of the internet resulted in the change of customers' purchasing behavior . Customers now focus not only on the evaluations of price and functions; rather they also integrate quality with the perceived value business systems ought to change and pursue innovation, speed, and quality if they want to satisfy the overall needs of customers and create new value[9]

The features of "innovative products" will satisfy the "customer value" which is accentuated by good quality, delight, good experience, and extra value-added features. In order for thecompanies to fulfill these characteristics, it is hereby suggested to use "mind mining" methods to identify customers' unsatisfied and latent needs. [10] They also ought to use methods and means to eliminate the inconvenient utilization, and to integrate product functions and quality. These findings and results may be hereby included into the quality functions

3 CONCLUSION

Quality requires constant change and learning process. For this reason, it requires a different organization within the company that opposes the status quo, as well as a different culture and understanding. If you are qualified as a corporate culture and you can increase your competitive power in this way, your organization must be quality-based.Only the pursuit of product quality and service quality is not enough to achieve the business objectives. The enterprises should alter their quality concepts from the narrow definition of quality to include customer value and innovation. If we can not manage the quality of the industry in the spirit of innovation, our future will not be brilliant. It is recommended that sustainable quality systems be studied.

Industry 4.0 concept in recent times also plays an important role in quality search in ındustry .The concept of Industry 4.0 promises many positive changes to today's manufacturing,including mass customization, flexible production, increased production speed, higher product quality,decreased error rates, optimized efficiency, data-driven decision-making, better customer proximity, new valuecreation methods and improved work life.At the same time, numerous technical concepts or application are already being marketed under the term Industry 4.0.These innovations address different customer benefits and in some cases, their implementations will have a heavy impact upon today's value chains. Additionally, these concepts sometimes also have a strong influence on the operative and strategic performance management of production related value creation processes ,for example processes in work preparation, production, assembly and production logistics. For this reason, the quality search must be included industry 4.0 concept.

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APPLICATION OF LCA AS QUALITY IMPROVEMENT TOOL IN STEEL MAKING COMPANY AS A BASE FOR TYPE III ENVIRONMENTAL DECLARATION

Matic Iskra [1], Igor Budak[2], Mirko Soković[3], Borut Kosec[4]

Application of Life Cycle Assessment (LCA) as quality improvement tool in steel making company was studied as a base for Type III Environmental Declaration. Type III Environmental Declarations, in practice referred to as Environmental Product Declarations (EPD), are primarily intended for use in business-to-business communication. Initially, cradle to gate LCA study of austenitic stainless steel (EN 1.4301, AISI 304) in form of hot rolled coil was performed. Furthermore, for the purpose of EPD, Product category rules (PCR) for comparability purpose of EPD were selected. Finally, cradle to gate Environmental Product Declaration was created covering raw material supply, transport to manufacturer and manufacturing. Primary energy demand presented renewable and non-renewable resources used for production. Environmental impacts were expressed in a form of acidification potential, eutrophication potential, global warming potential and photochemical ozone creation potential. Recommendations for life cycle environmental impact improvement were given in conclusion.

Key words: Environmental Product Declaration, LCA, Quality, Steel making.

1 INTRODUCTION

Steel making industry is a type of heavy industry, which has, rightly or wrongly, attached a prejudice of carrying heavy burden for the environment. Climate change and the sustainable use of natural resources are among the main challenges for society today [1]. With a mind-set like that, products of steel making industry are easily deemed environmentally unfriendly. That could lead decision makers into selecting alternative materials for projects, instead of steel.

Study has been done on theme, how to transparently present steel product's actual environmental impact. Additionally, recommendations were given on how to improve process in order to improve environmental footprint. Type III Environmental Declaration, based on Life Cycle Assessment, has been used for that purpose. To

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maintain clarity and transparency, declaration has been prepared in a form of Environmental Product Declaration.

EPDs solve the problems associated with manufacturers of products publishing undifferentiated, selective, unverified, misleading, un-comparable and often-incomprehensible environmental data derived through non-standardised methodologies. The important foundation that an EPD is built upon is the Life Cycle Assessment. LCA compiles and evaluates, according to ISO 14040, the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle. Information generated from the process will be relevant, verified and comparable [2].

2 METHODOLOGICAL FRAMEWORK

Global warming, climate change and tendency for sustainable development have all grown into main challenges of modern industry. On the other hand, customers (final consumers or in business-to-business commerce) became more and more aware of their impact on environment, by having a choice in selection of products. Eventually that lead into a situation, where companies have urgency to show their products as transparent as possible, for customers to have clear picture and the most information of the product. By doing so, from business-to-business or final consumer point of view, explained impact on environment has been shown.

LCA with its comprehensive approach to assess the environmental impact from cradle to gate, has been used to support characterisation of a product from environmental point of view [3]. Cradle to gate LCA study of austenitic stainless steel (EN 1.4301, AISI 304) in form of hot rolled coil was performed. Figure 1 shows cradle to gate LCA system used for product's environmental performance during manufacturing.

Based on LCA study, Type III Environmental Declaration under ISO 14025 was used as a tool which is able to comprehensively present product's environmental impact. A form of Type III Environmental Declaration is cradle to gate Environmental Product Declaration, which is a label that discloses the life cycle environmental performance of product using pre-determined parameters. For the purpose of EPD, product category rules for were selected. That improves potential comparability between two or more products. Flow chart showing process steps of obtaining EPD is presented in Figure 2.

Cradle to gate Environmental Product Declaration was created covering raw material supply, transport to manufacturer and manufacturing. Primary energy demand presented renewable and non-renewable resources used for production. Environmental impacts were expressed in a form of acidification potential, eutrophication potential, global warming potential and photochemical ozone creation potential.

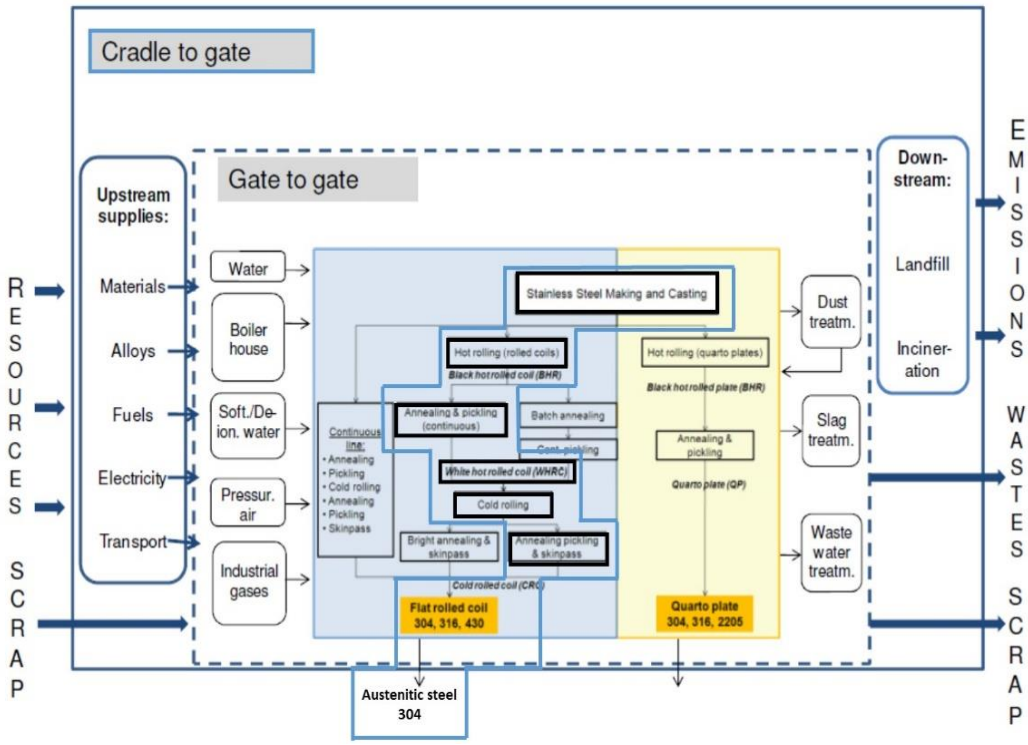

Figure 1. *Cradle to gate LCA system [4].*

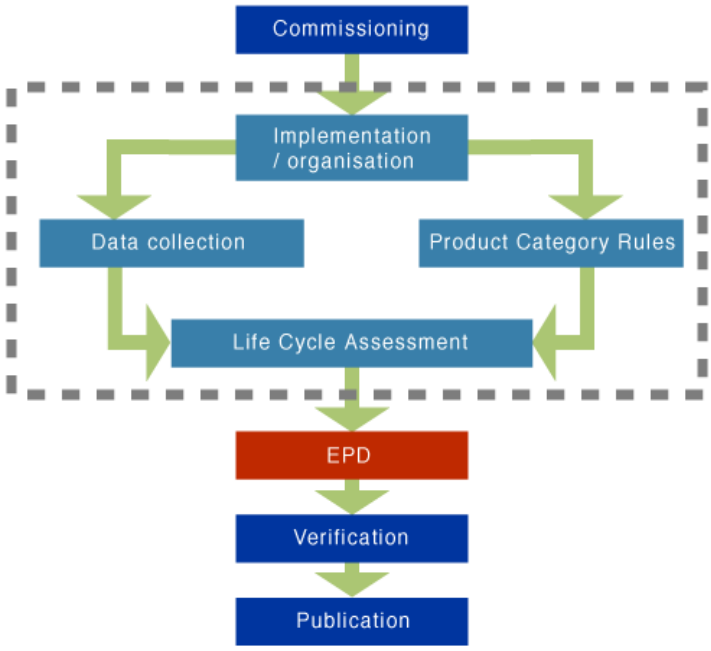

Figure 2. *EPD obtaining process [2].*

3 RESULTS AND DISCUSSION

Environmental Product Declaration contains complete information about the product. It could be understood as product's curriculum vitae in layman's terms. Summary of all data required for customer. Results contained in EPD will be presented in this section.

EPD is initially presented with general information about the owner of declaration, programme holder–publisher, declared product, unit, product category rules and scope. What follows is detailed information about the actual product. Further sections give details about LCA, calculation rules, scenarios and additional technical information, results and interpretation. EPD concludes with requisite evidence and references sections.

Environmental impact categories are broken down by ratio of effect of each life cycle inventory sector in Figure 3. Results are presented in a 100 % stacked column graph, showing relative contribution of input materials, energy, gate to gate, steel scrap and transport on each of the life cycle impact assessment categories.

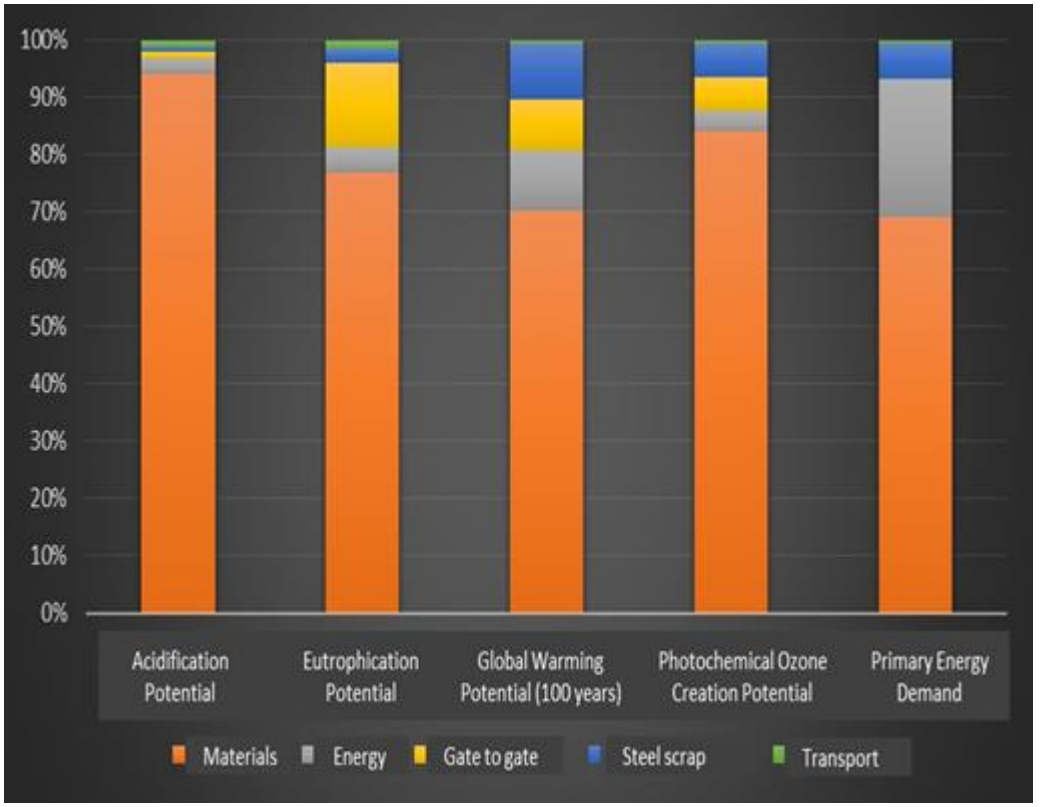

Figure 3. *Life cycle impact category and primary energy demand graph*

Graph in Figure 3 shows relative contribution of main input parameters from cradle to gate. Main contributor through all impact categories and primary energy demand is upstream material production, ranging from 69,0 to 94,2 %. Only the Primary Energy Demand has an additional relevant contribution of 24,4 %, related to the upstream energy production.

Figure 4 is showing further breakdown of environmental impacts of upstream materials production. Same as above, Figure 4 represents relative effects on environmental impact. Only this time, materials are broken down into each alloy. The most exposing factor through all impact categories is nickel and iron based alloy. In average it accounts for 50.6 % of total environmental impact. Second place is taken by iron and chromium based alloy. In average it accounts for 42.5 % of total environmental impact.

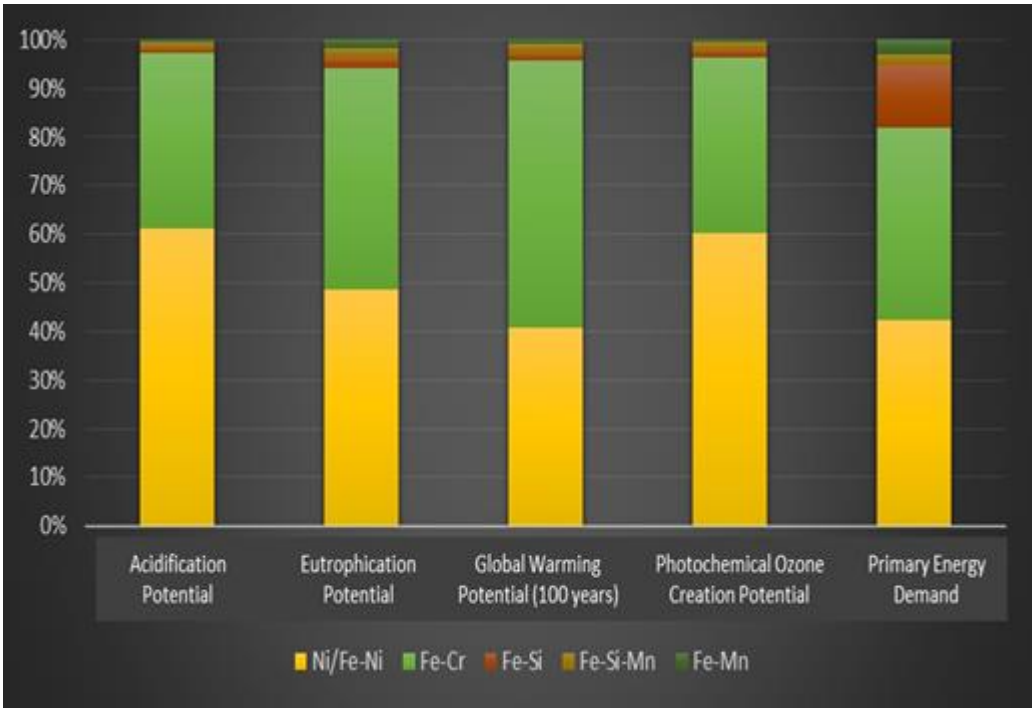

Figure 4*. Upstream materials environmental impact.*

4 CONCLUSIONS

Document Environmental Product Declaration has been done for two reasons. Initial one was to present product to customer. It helps customer having detailed picture of the product. It also provides governing bodies and managers with additional edge at decision making due to improved capability of comparability, if right conditions are met [5].

Secondly, results of Life cycle assessment, included in EPD revealed flows, which potentially have high environmental impact. Such flows are upstream material inputs, with main two being nickel and chromium based iron alloys. If by having clearer image due to LCA and EPD structure, mentioned flows could be challenged, potential environmental impact of product could be substantially decreased to lower level.

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QUALITY OF TRAINING AND EDUCATION – THE ESSENTIAL INGREDIENT OF AN ORGANIZATIONAL CULTURE

Maja Djordjevic[1], Nikola Campar[2], Jelena Pantic[3], Joseph Ricciardelli[4]

Abstract: Training and Education is an ongoing and never-ending process – knowledge of process-improvement techniques and tools must be continually reinforced and replenished within an organization. The need has to be recognized from within and Know-How to implement planned systematically, responsibility owned by Human Resource department. This paper aims at highlighting the difference between the traditional Human Resource approach (administration focused) and strategic one (training and education focused). The paper then follows the latter one, explaining how well-designed training initiatives find the learning and training opportunities that are the most appropriate to support the organizations' improvement goals, skill and knowledge needs, and organizational culture, and how they support the Continuous Improvement implementation. The overall objective of this paper is to depict importance and steps of development of quality within the training and education system to enhance the professional and personal development of every individual and their activities that result in improved and sustained corporate performance.

Key words: Education, Human Resource, Improvement,Training, Quality

1 INTRODUCTION

People are the most important asset of an organization. If one has to grow the business, it has to grow its people. In a modern industrial environment, the need for employee continuous training is widely recognized so that employees keep up and are involved with new technological, process and product developments. Therefore, every company must have a systematic training programme to support people's growth.

The Human Resource Department is linked to the procurement and employment of human resources. Once new employees join an organization, they need to be trained to be fully competent for the tasks they need to perform on a daily basis, in a safe manner. The existing employees, as well, need to be continuously challenged and developed, so that they grow with the business, climbing the career ladder, at the same time making the organization competitive on the market with their advanced skills and improvement ideas.

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However, training is a cost for an organization. Question is: if there is an investment, what is get in return? Benefits of the effective trainings are multiple and visible through elimination of the losses due to human errors, having at their roots lack of training and standards. The results include, but are not limited to, improved quality of products or services, reliability of machines, stability of processes and safety of people.

2 HUMAN RESOURCE DEPARTMENT

Training and Education is an important organizational process whose purpose has to be recognized, responsibility owned and actions driven by Human Resource department. [1] [2] They are the ones to provide framework, know-how through steps and resource for continuous education.

Challenge is that training benefits are not visible immediately. Nevertheless, we need to measure the impact of the training on our organization. Human Resource Management has to plan it very carefully, establishing Key Activity Indicators (KAIs) and Key Performance Indicators (KPIs) [3] very early in the training process, so that they can track the improvements.

In the past, human resource management (HRM) was called the personnel department that engaged people and dealt with paperwork and recruitment processes. Twenty years ago, personnel management focused on administrative aspects – to hire and fire. Today, HRM includes a strategic process that requires working with other departments, managers and executives to be efficient and meet the needs of the organization by developing capabilities of its people, on all levels.

In general, HRM focuses on several main areas, including staff, compensation and benefits, retention issues, training and development, regulatory issues and employee protection [4]:

- **Staff** includes the development of a strategic plan to determine how many people an organization needs to employ. Based on the strategic plan, HRM then performs the recruitment process for selecting the right people for the right positions;
- **Compensation and benefits** as tangible policy making including direct and indirect rewards and benefits;
- **Retention** – building strategy around how to retain employees ;
- **Training and education** of new employees in order to develop skills necessary for their work and to help current employees develop their skills as a tasks of HRM department; training and education of the existing people, enhancing continuous learning and creating environment for self-development;
- **Regulatory issues and employee protection** are under the responsibility of the HRM department, which relates to employment, health care, and other issues.

Focus of this paper is Training and Education as a structured and quality way of improving an organization.

3 TRAINING AND EDUCATION

Training is the process of developing specific skills and knowledge for better job performance (Jucious, 1963) [5]. The concept of human resources development is to improve the performance, productivity and competence of existing and newcoming employees through learning. A well-planned training program helps people to become qualified and experts in performing certain jobs (Dahama, 1979) and is specially designed by the organization to achieve specific goals and objectives [6].

Education is a process of systematic learning that develops a sense of judgment and reasoning with employees. Irrespective of the level in the corporate rankings, it is offered equally to all employees. Education also increases the power of observing, analyzing, integrating, understanding, making decisions, problem solving and adjusting to new situations.

3.1 Difference between training and education

Training and Education are so close that the difference between them is becoming increasingly blurred. However, these two concepts are different in their nature and orientation. There is no education without training.

Table 1. *Comparison chart of the training and education*

Basis for Comparison	Training	Education
Meaning	The process of inculcating specific skills in a person is training.	Theoretical learning in the classroom or any institution is education.
What is it?	It is a method of skill development.	It is a typical form of learning.
Based on	Practical application	Theoretical orientation
Perspective	Narrow	Wide
Involves	Job experience	Classroom learning
Term	Short term	Comparatively long term
Prepares for	Present job	Future job
Objective	To improve performance and productivity.	To develop a sense of reasoning and judgement.
Teaches	Specific task	General concepts

The purpose of Training and Education is to involve Human Resources into leading the process of continuously developing internal capabilities. This includes the learning of such techniques that are necessary for the intelligent performance of specific tasks. It also includes the ability to identify, reflect on the problems, conduct root cause analysis and show problem solving skills of people at all levels. Increase in skills and knowledge is equivalent to increasing ownership of the workplace, raising morale and pride of people performing well their job. It also grows internal training capabilities, so that the organization develops “internal consultants” and trainers that can further train and coach their peers.

3 TRAINING AND EDUCATION IN A CONTIOUSLY IMPROVING ORGANIZATION

In order to improve, an organization needs to recognize its current state. It is done by capturing losses– how much is invested in the resources (man, material, machine and method) to make Value for customers (either products or services) and how much is lost along the way. Those losses get deployed, followed by *why* for each, going deep into the root cause analysis. Discovery is that the identified losses have a substantial part belonging to the lack of training. (Figure 1).

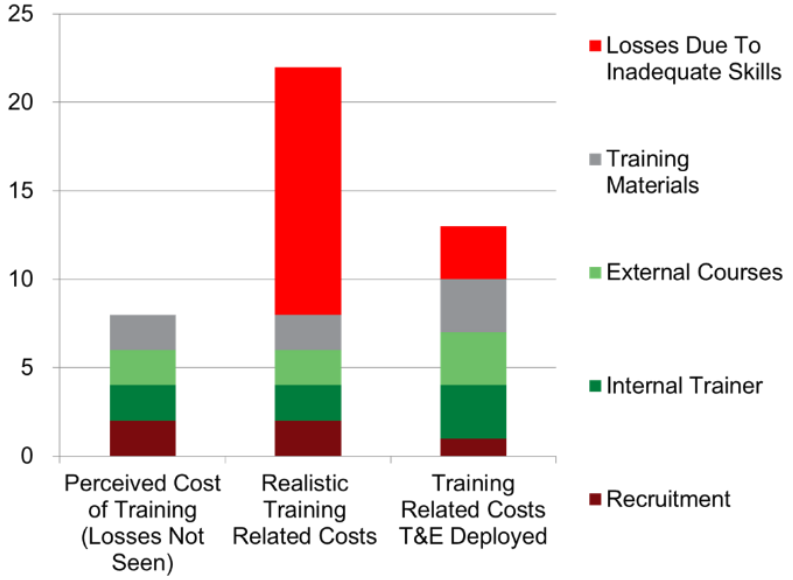

Figure 1. *Cost of losses due to Inadequate Skills*

False belief is that people should be deemed guilty for not performing well. People (might) make mistakes, but the responsibility for them lies on the organization itself for not providing right trainings and moreover, for not checking whether their trainings yielded expected results.

For the purpose of eliminating losses due to human errors, another loss is intentionally introduced – training. It is a loss simply for the reason that people's time is invested, they are taken away from their work stations where they could create value for the customer, and are being paid to be trained. Customer is not paying for trainings, it the investment of the organization.

Therefore, the non-value added cost (loss) is introduced to decrease other losses. That is a little known concept Tecla Consulting is applying to have organizations avoid conducting trainings for the sake of trainings where people would formally and only sign off.

The trainings are introduced for education of people to improve effectiveness of machines, quality of products and process. The cost and benefit of trainings should be measured, by linking trainings to losses so that effectiveness of trainings provided and benefit stemming from it are traceble.

4 CREATING AN EFFECTIVE TRAINING PROGRAM: 7 STEPS TO SUCCESS FOLLOWING IMPROVEMENT CYCLE

The need to train people and measure its effectiveness has been recognized. Now, how to do it? Steps for creating an effective training program follow PDCA Cycle of Continuous Improvement. [7]

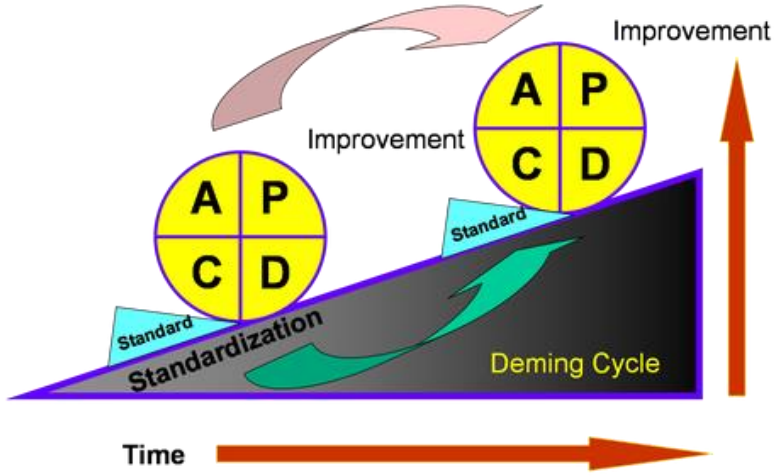

Figure 2. *PDCA Cycle*

PLAN:

1. *Identify training needs*

The need for training is a condition in which there is a gap between "what is" and "what should be" in terms of knowledge, skills, attitudes and behaviours for a particular situation. This gap usually occurs when there is a difference between "desired performance" and "real performance". Training needs analysis is established by skill matrices.

2. *Develop learning objectives*

Learning objectives is necessary to establish so that in the CHECK phase it is assessed whether they have been reached. KAIs and KPIs are indicators that help tracking the progress through a period of time.

3. *Develop training materials*

Training materials are simple and visual tools needed to be created, having in mind objectives and topics of the trainings.

4. *Develop training plan*

is the most important part of the training program after the need for training has been identified. The curriculum states what will be taught, how and when people are planned to be trained. It provides a framework and a basis for training.

DO:

5. *Implement the training*

When the planning phase of the training program is completed, it is time to implement the course. Implementation is the point where the trainer activates the training plan. There are three types that for delivery of the training:

- On-the-job training – the trainee is shown how to accomplish a task by a trainer in the actual workplace.
- Off-the-job training – is often a more theory based approach to learning as opposed to practical, as employee is taken away from the workplace;
- Self-development – is where the employee takes in information, processes it and then retains it without the need for a teacher.

CHECK:

6. *Evaluate the training* - How do we know that the training was effective? It is necessary to determine effictiveness in terms of achieving specific training goals. Individuals also like to know how much they have learned or how well they work.

Training efficiency is the degree to which trainees are capable of learning and applying acquired knowledge and skills during the program. It is influenced by attitudes, interests, values and expectations of trainees and training environment.

KPIs set beforehand might include increase productivity, quality improvement, better planning of human resources, higher morale, better health and safety and improved personal growth. Some of the criteria for measuring the training's training efficiency is the reaction of participants, the level of learning, improving behavior at work and results at work.

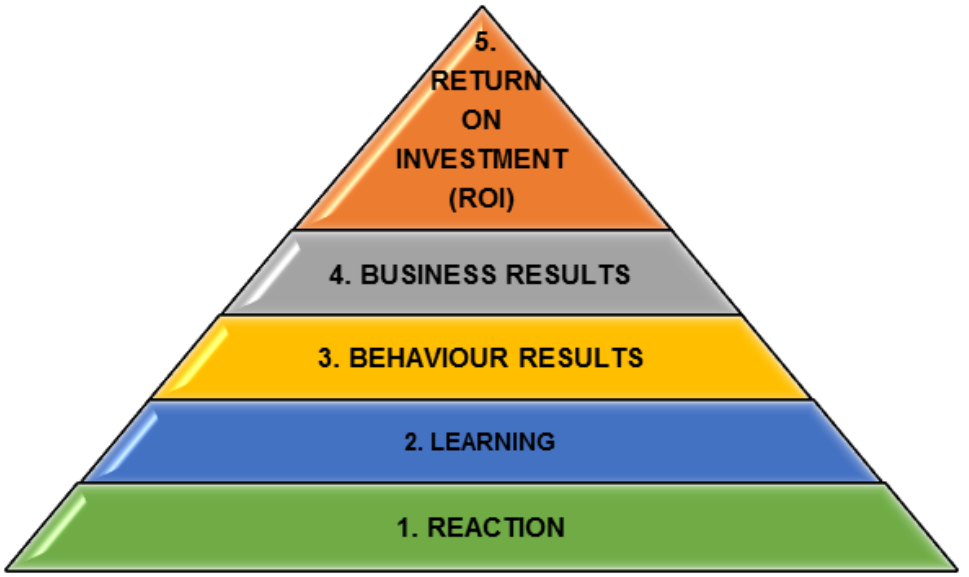

Figure 3. *Kirkpatrick triangle*

Kirkpatrick (1976, Figure 3) proposed four criteria for assessing the training program: (1) reaction, (2) learning, (3) behavior, (4) results, and (5) return on investment. Each criterion is used to measure different aspects of the Training Program. The reaction measures how the participants liked the program in terms of content, methods, duration, trainers, facilities and management.

Learning measures the skills and knowledge of trainees who could absorb during training. Behavior refers to the degree to which participants could apply their knowledge in actual situations on the ground. The results concern the tangible impact of the training program on individuals, their business environment or the organization as a whole [8].

7. **ACT –** *Standardize and improve the training process* - At the early stage of forming the training structure, the HR has established ways to track results - KPIs and KAIs. KAIs can be, for example, number of training hours and number of people trained. With key activities, our KPI (Key Performance Indicators) should be tracked as well. If time is invested into training people, it has to be linked with losses (Figure 1). In other words, increased number of training hours and people (KAIs) need to result in decreasing / elimination of losses due to human errors (KPIs). If KPIs show desired trend, one should standardize the Training process and work on its constant improvement.

5 CONCLUSION

The implementation of a Training and Education system works towards maximizing the potential of every employee, allowing them to play their part in achieving the business goals. It is important that a process is established to give employees the opportunity to systematically develop and become proficient in the usage of their equipment and/or processes, whilst also supporting the business goals. Training and Education is a continuous loop and organization need to create a no-blame, learning environment where mistakes are seen as opportunities for growth.

The paper is written based on practical implementation and results Tecla Consulting approach has had in different industries and sizes of organizations. Culturologically, there is a difference in how the approach is accepted and at which pace it is implemented in different countries. Further study will give us more insight on how background, beliefs, education and social differences can impact Training and Education system within organizations.

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KITTING AS THE WAY OF HUMAN ERROR ELIMINATION

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Abstract: The main logistic tasc is to reduce stock of material to zero. On this way we will reduce working capital to zero. One of the main ways is JIT (Just In Time) type of supply and this paper presents software for Kitting creating. Kiting is type of JIT's way to supply production line with needed parts, and human error elimination during assembly process (parts with more variants).

Key words: Human error elimination, Kitting, Logistic, Pick to light

1 INTRODUCTION

In order to build priority actions and to allocate the necessary level of attention in order to improve logistic flows in accordance with the value of materials, it is necessary to do the classification of materials. Also, the classification of materials allows us to determine the type of flow material that is closest to the ideal WCM standard (World Class Manufacturing Standard), viewed from the production line. Based on material classification, we determine the level of inventory next to the production line, as well as the way the material call off in order to support the selected material flow [1].

The classification of materials into three main classes: A, B i C.

- Class A is additionally divided into:
  - A1: which includes all items that have many variants;
  - A2: which includes materials of large dimensions;
  - A3: which includes expensive materials.
- Class C refers to small parts (screw, nut, ...).
- Class B includes all that is not included in classes A or C, and therefore is called "normal" class.

This paper describes a Pick To Light system developed for the automotive industry for handling and line feeding with materials classes "A". The main request was to remove material from the production line and develop system which will support operators to choose right material and put in kit and eliminate human error during assembling part on the cars.

Paper also describes methodology for creating kitting area, software for assistance in parts selection and future research directions.

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2 LOGISTIC MATERIAL FLOWS

In order to reduce inventories and, consequently, losses, we need to adopt different types of logistics flows for each different type of material class.

The main criteria determining class A1 is that one part has more variants (more then 3). For example, there are several types of batteries for the vehicle. The placement of all types of batteries in separate containers along the production line requires more space along the production line for the storage of such parts and an increase in the NVAA (Not Value Add Activities) workers in production. Therefore, the indirect flow of materials from the warehouse to the production line is not a good solution. In this case, the JIT-type flow is a much more suitable solution, and preferably because production requires and therefore only uses the amount of material required and just in time, which completely excludes stock on the line. In the event that the supplier of a certain part is too far from the factory, required external sequencing of the material is not possible, we can think about internal sequencing of the materials, for which is good solution to be performed directly within the warehouse space [1].

3 CREATING THE KITTING AREA

Based on the classification of the material, it is possible to associate a certain flow of material that is as close as possible to the objectives of the Just In Time system. In order to achieve the ideal conditions, it is necessary to: access uninterrupted optimizations by consolidating the results achieved, knowing the matter and having economic opportunities to achieve improvement.

In accordance with the WCM rules in the first three steps, Logistics selects its model area together with WO - Workplace organization. On the basis of the calculated NVAA, employee ineffectiveness, non-ergonomic movements and security, WO and Logistics selected their Domain1 for their model area. It was first decided that part of the production line should be supplied with parts according to the JIS 4 and JIS 5 (Just In Sequence) principles, which required the creation of the Kitting Area in which to prepare the Kitting trolleys. On the trolleys, only the necessary quantity of parts would be sent on the line. This would greatly reduce the presence of parts along the production line, reduce the NVAA as well as the non-energonomic movements of production workers.

The kitting area should be understood as a supermarket in which we pick parts from the list provided from BOM (Bill of Material) and place on the kiting trolleys. In our case, the list contains a sequence number of vehicles, and an associated version of it. The vehicle variant determines which model the vehicle is working on. So, if it is a diesel version of the vehicle, the parts that are assembled on this variant of vehicle should be placed on the kiting trolleys (for example, from three types of batteries, from the kitting area we will pick the battery that is suitable for installation in this diesel vehicle model). In the whole process of determining variants, the most important point is the so-called "D Point" after which it is impossible to change the order of introducing variants from Paint shop to the Assembly line. From the "D point" to the first work station in Assembly shop we have 40 vehicles and with a takt time of 3.5 minutes, we have about 2 hours to prepare Kitting for a this variant. The function of "D Point" with accompanying software is shown schematically in Figure 1.

The kitting area is organized in the shape of the letter "U" (Figure 2 and Figure 3), so that the worker pushing the kitting trolleys picks parts from both the left and the right side in the kitting area, and put parts on the trolley.

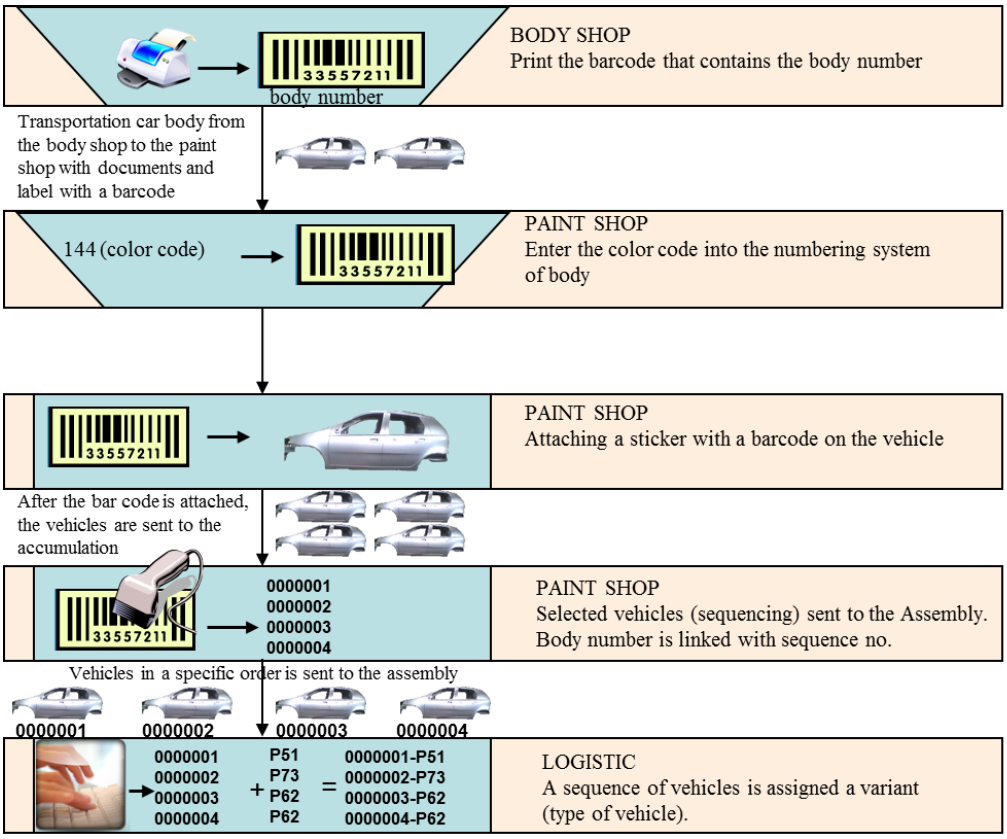

Figure 1. *Generating of vehicle sequence*

4 SOFTWARE FOR ASSISTANCE IN SELECTION OF PARTS

In order for the worker to choose the parts without mistake, not thinking from which box to take, for example, one of three possible battery variants, we designed such a system that beside each box with parts there is a button with light. The system identifies in sequence list what version is the next on the assembly line, thus combining the switches whose lamps will be activated next to the boxes from which the part should be taken. After taking the part out of the box, the worker in kitting area presses the button and thus told the system that he took the part, and the system activates the next light next to the box in which the next part is to be taken. So, if it is necessary to put 22 pieces of different families on the trolley, the system does not activate all the bulbs at once, but one after the other, thus leading the workers in the shortest way in selecting parts, excluding the possibility that he somewhat forgot to take part. Otherwise, worker would have to go back and correct his mistake. When the worker picked up the last part for that vehicle, a red light is activated (Figure 4) confirming that he has successfully completed the "purchase" or the selection of parts for that vehicle. By pressing the red button, the switches are reset, a variant with the parts for the next vehicle is printed, and a new schedule for activating the lights for the variant of the next vehicle variant is set.

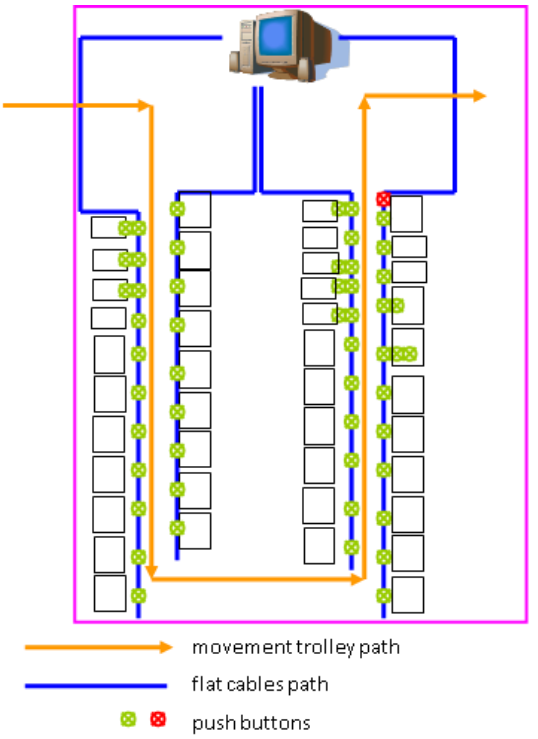

Figure 2. *Layout of Kitting area [2]*

Figure 3. *Kitting area – columns with switches*

Figure 4. *Light switches and buttons*

Each push button contains an 8-bit comparator, i.e. IC (integral circuit) code 74HC688. With jumper, each push button is encoded with a unique 8-bit code (max. 2^8 = 256 combinations).

Through the parallel port of the computer (LPT), an 8-bit code is sent to all the push buttons, i.e. to network or system. Only a light bulb with the same 8-bit code will illuminate (checking by IC). Only this push button can be active at the moment and send a signal of authentication, i.e. that he was pressed. So, the push buttons are inactive until the light bulb above it lights up, i.e. while the PC does not send its 8-bit code. The system has 52 coded keys (1-52) and the authentication push button (code 254). The variant of the vehicle is read from the SQL database and the KITING.TXT file is created. At the same time, a list of parts that will packaged on the kitting trolleys is printed. The first code for the first part is sent through the LPT port, and the first light bulb is on. Only the first button is active and when it is pressed, the first light goes off and the second code is sent for the second part, and another light goes on, etc. When the authentication push button is pressed (code 254), the KITING.TXT file is deleted. Now the system is waiting for a new created file from which it loads the variant and goes on. When there is no file KITING.TXT the software reads from the SQL database the following variant of the vehicle and creates a new KITING.TXT file [2].

5 USER INTERFACE

In Figure 5, we can see the user interface that shows us which lamps will be activated (the check mark „√“ next to the number of switches to be activated in the chek box). Also, we see that after deactivating a certain bulb, the number of this switch from gray switches to green. In this way we can control whether the worker working in the kitting area is doing his job properly [2].

The system is very flexible so that at any time we can adjust which switches will be activated for a certain variant of the vehicle, ie which parts need to be put on the trolley and sent to the assembly line for each variant of the vehicle (Figure 6). This seems to be by selecting from the drop-down menu a variant of the vehicle for which we will define which parts go to the kitting and mark the chek boxes. For example, by marking the Chek Box No. 1, we announce to the system that the switch 1, will be switched on for that variant. After finishing the definition of parts for a particular variant, it is necessary to save the configuration by pressing the "Save configuration" button.

Figure 5. *System for tracking the selection of parts that are packed on the trolley kiting*

Figure 6. *Defining the switches that will be activated for each variant of the vehicle*

The system contains another module for diagnostics of the system Figure 7. Namely, it is often necessary to quickly check the correctness of the hardware part of the system, so it is designed such a procedure that through the software module we can check bulbs and buttons. This part of the software is available to the system maintenance worker. With the "+" and "-" buttons are selected (Figure 7). When the number of the desired switch appears in the edit box, the lights should be lit at that point. By pressing the button of this switch in the white circle under the number of the switch, a black dot will appear (radio button is on).

If the bulb does not light, we can conclude that the bulb isn't work or a cable is damaged. If the light is on, the black dot does not appear in the white circle when the switch is pressed, the button isn't work or the cable is damaged.

Figure 7. *Module for testing bulbs and switches on the switch*

6 KITING TROLLEYS TRANSPORT AND USE

After the trolleys are prepared, and so attached to the electric tractor (Figure 8), logistic worker transport trolley from the kitting area to the Assembly line, where worker connect trolley to the corresponding vehicle (the variant of the vehicle corresponds to the variant of the parts packed on the trolley) (Figure 9) [3].

Figure 8. *Transport of kitting trolleys from the kitting area to the assembly line*

Parts on the kitting trolleys are easily accessible to the worker (Figure 9), there is no excess movements to the boxes with parts along the production line, and any possibility of error in the selection of parts for assembly is avoided [4].

Figure 9. *A trolley is attached to the car body*

7 CONCLUSION

Information systems are taking up positions in logistics flows. Solutions designed to reduce costs, increase ergonomics and safety, can not be imagined without the development of IT solutions. The system shown in this paper clearly demonstrates the importance of choice of logistic flow, but also reducing the possibility of error to a minimum in the parts selection process. With kitting methodology we reduce possibility of parts damages (quality), increase ergonomics, and cost reduction with NVAA elimination (Not Value Add Activities).

Plan for future is to develop wireless system which will be more flexibile when we should change layout of kitting area. Also, plan is to instead of electrical tractor implement AGV (Autonome Guided Vehicle) to reduce cost in internal transportation.

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USER-CENTRIC PERSPECTIVE ON SERVICE QUALITY IN TELECOMMUNICATION NETWORKS

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Abstract: In order to evaluate telecommunication services from users' perspective, quality of experience is the key concept that needs to be considered. Quality of experience is influenced by quality of service, which is mainly network oriented, but it also depends on users' perception and subjective opinions. In this paper, we have addressed main characteristics of service level agreements that include quality defined and measured from network side. We point out the need for a novel type of contracts between providers and end users named experience level agreements, which are based on the user-centric perspective on service quality.

Key words: Experience Level Agreement, Quality of Experience, Quality of Service, Service Level Agreement

1 INTRODUCTION

Recently, researchers and providers of telecommunication services are focused not only on Quality of Service (QoS) that characterizes performances from the telecommunication network point of view, but also on quality from users' perspective, which is specified as Quality of Experience (QoE).

QoS is defined within Service Level Agreement (SLA), that represents a contract between the service provider (SP) and a user which defines all technical, financial and legal aspects related with a particular service. Generally, the focus of SLA is the measurement of the technical performances and the output of the services. Current SLA metrics are measured from a SP's perspective [1]. The question that arises is whether such metrics are appropriate from users' perspective and how relevant they are in driving improved user satisfaction and service experience. Further consideration should be given to the manner of metrics evaluation that is significant to users. It is important for each SP to understand how his users are experiencing the service from their perspective. If SPs are able to manage the experience, they have to be able to measure it too. This requires a new type of agreement, because a relationship based on outputs is no longer enough. The experience of customers, users and stakeholders who use the facilities should be the new focus of attention. This type of agreement is identified as

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Experience Level Agreement (ELA) [2].

Similar to the way QoS has evolved towards QoE, it is expected that besides QoS-based agreements, i.e. SLAs, service providers will deploy QoE-based agreements, i.e. ELAs, in order to provide corresponding solutions customized to the end-users. In this paper we consider user-centric perspective on service quality and corresponding agreements that can be developed for telecommunication services.

This paper is organized as follows. After the introduction, in Section 2, we discuss the extent to which SLA covers both network's and users' perception of service quality. Means of QoE assessments are considered in Section 3 and perspectives as well as challenges of introducing ELA are presented in Section 4. Concluding remarks are given in Section 5.

2 SERVICE LEVEL AGREEMENT

Relation between provider and customer of a certain Internet service can be regulated according to SLA, which represents the minimum level of service provided and measured by one or more quantifiable parameters. In this context, the term "customer" represents all possible users of a certain service with the appropriate contract applied. Customers can be end-users and business customers, i.e. enterprises with its own users, who can have their own experience of the observed service. QoE can be observed by end-users and also by all users enclosed in a certain contract between a customer and a provider.

Besides other effects, SLA provides a previously defined agreement on the performance objective of a service. A wide range of service characteristics can be covered by SLAs, from performance, like network QoS, to maximum response times for service tickets. A set of Service Level Objectives (SLO) is usually associated with an SLA. A set of Key Performance Indicators (KPI) is frequently used to measure achieved level of service. Generaly, SLA can be considered as:

- a set of KPIs for the observed service, usually calculated average values considering certain time period (e.g., average monthly packet loss), or reliability metrics (mean time to failure, mean time to repair, etc.);
- an approach to measure those KPIs (measurement can be obtained by a customer or the provider, or both) and
- penalty for the situations when breach occur (e.g., service refunds, or fines).

SLAs use mostly those KPIs that are associated with the availability of the service (e.g., mean time to failure, mean time to recovery), or with technical parameters of QoS. Nevertheless, those KPIs are associated with the end users perception of the system performance, not to its actual QoE. Consequently, the new term Key Quality Indicators (KQI) has been used to express user-recognized quality aspect of a service by means of certain KPIs that directly control the perceived quality (e.g., packet losses). KQIs are in sometimes very close to KPIs but for some services (notably media), they can also be estimation of perceptual quality [3]. This could provide solid foundation for an ELA.

The verification of an SLA is technically equal to the verification of the implicit guarantees of service made by an Internet service provider. Certain network performance parameters can be used as test of SLAs, such as network bandwidth. However, with the development of the new applications, SLA will be turned to aspects of user perception. Therefore, it is necessary to properly define new metrics that consider QoE. In addition, it is necessary to consider SLAs relation with it. In scenario where each user may have SLAs with different providers offering different services, it is required to consider correlation between different SLAs. This will allow the verification of SLAs

between providers and customers looking from the provider or customer point of view, as well as the customer's verification of advertised throughput for assessment and regulatory purposes [1].

Parameters of QoS should be defined for each Open System Interconnection (OSI) Layer. With the service expansion, the trend is to transfer the SLA confirmation towards application layer. This means that metrics and measurements have to be performed at the application layer; therefore, appropriate SLA parameters must be defined for services such as YouTube. These Application SLAs (ASLAs) will unavoidably depend on lower-layer SLAs (high-quality HD video streaming requires high capacity broadband physical connection guaranteed by a appropriate SLA between ISP and user, although that is not enough to guarantee proper QoS at application layer [1].

There is a plenty of literature related to research and real application of SLAs. An up to date survey of European research related to SLAs offers a tremendous overview of work in progress in that domain (with a special emphasis on cloud services), as well as a model for an SLA life-cycle. With a more general focus, the TM Forum has created a comprehensive handbook that covers basic ideas and conception of SLAs and SLA management.

3 MODELLING USER EXPERIENCE

Nowdays, in highly competitive markets, service providers pay more attention to user experience. QoE concept provides the basis for defining users' requirements in a way meaningful to users. QoE is influenced by QoS and all elements of the system involved in the end to end service, including: network equipment, codecs, techniques, protocols, terminals, etc. Therefore, QoE should consider all degrading effects on a delivered service, which depend on network performances. In this regard, aggravating circumstance is that the relationship with network parameters is usually rather complex [1]. Requirements from the users' perspective are independent of the applied networking technology but they depend on a particular service and users' subjective opinions and expectations. Therefore, QoE is a subjective category, meaning that it depends upon users' actions related to the users' perception and subjective opinions. QoE, also referred to as "perceptual QoS", is defined as "a measure of the overall acceptability of an application or service, as perceived subjectively by the end-user" [4]. Further, there is a need for certain mappings in order to translate QoS to some dimensions of QoE and vice versa.

Total QoE is affected by many other human factors such as psychological and sociological factors. Certainly, QoE takes into account users' expectations, their experience with similar services, reputation of the service provider, the opinion of other users, pricing policy etc. Some of the influencing factors are independent of the service type (for example, user's age, education, occupation, etc.). Moreover, the same service will be assessed differently if it is free or if is charged. Users are more likely to accept the degradation of QoS if it is free of charge. QoE encompasses the issue of the user decision on retaining the service or giving it up [5].

QoE can be evaluated with either subjective or objective tests. Insight into users' requirements and expectations is the starting point in the subjective QoE measurement process. However, users' involvement should be simple and not disturbing for users. The most frequently used subjective measure of QoE is Mean Opinion Score (MOS), which is defined for a telephone service as "the mean of the values on a predefined scale that subjects assign to their opinion of the performance of the telephone transmission system used either for conversation or for listening to spoken material [6]." MOS is

generally evaluated by a pool of reviewers that observe a service and manifest a score either following the quality evolution in time or at the end of the service.

There are absolute and relative indicators of QoE based on subjective test. The value of MOS is usually estimated based on media flow characteristics and a particular telecommunication network [7]. In absolute QoE indicators, the results are displayed in *x*-point scale, where *x* can take values of three, five, eight, ten or even hundred. For example, in a scale of 1 to 5, a score of 5 indicates the highest perceived quality, while a score of 1 indicates the lowest perceived quality. A relative scale must take into account comparative indicators and this scale usually includes positive and negative values. Scales may be based on different categories depending on a purpose. The quantity evaluated from these scores are represented by the symbol MOS [5].

QoE based on objective tests uses software and algorithms tools to quantify the service degradation, for an instance also by using a reference service.

Considering the multi-dimensional conceptuality of QoE, evaluation of QoEin telecommunicaion networks should be incorporated in an interdisciplinary approach, which can include the following steps:

1) Study of users' behaviorthat should be based on a combination of qualitative and quantitative methods in order to identify the most important dimensions of QoE.

2) Examination the extent to which service meets users' requirements which can be interpreted through absolute QoE indicators.

3) Comparison of users' expectations and their satisfaction with a particular service with the aim of identifying differences between expected and actual experiences. Results of such comparation can be interpreted through relative QoE indicators.

4 EXPERIENCE LEVEL AGREEMENT

Following the paradigm change from QoS to QoE, the next step is that SLA moves towards a novel type of contracts between providers and end users, i.e. ELA. The new concept is based on the user-centric perspective on service quality. ELA can be defined as a special type of SLA designed to establish a common understanding of the quality levels that the customer will experience by using the service, in terms that are clearly understandable to the customer and to which the customer can relate [2]. While SLA includes a set of performance metrics (e.g., QoS, availability, etc.), ELA covers the performance of the service only in terms of QoE, possibly as a set of QoE indicators which a user can simply recognize (e.g., some representation of MOS scores).

There is a need of coexistence of both SLA and ELA in an end-to-end system, where the SLA is the interface with the service and content provider whereas the ELA is the interface with the end users, which is illustrated in Figure 1. Relationship between ELA and SLA should be analogous to that between QoE and QoS and a similar mapping such as between QoS and QoE will be needed to derive SLA parameters from ELA, and conversely. Therefore, ELAs cannot in general directly involve QoE but rather an objective representation of it, agreed upon by both providers and users.

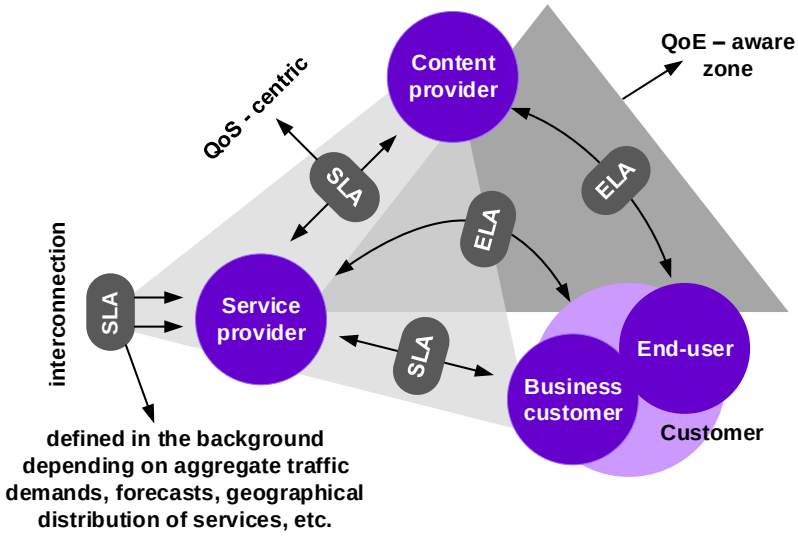

Figure 1. *Relationship between SLA and ELA in end-to-end system*

ELA should be transparent enough in order to convey the complex nature of QoS and QoE to both business customers and end-users. In this fashion, ELA framework shouldbe based on automatic mechanisms as well as agreed-upon, measurable, technically valid and understandable metrics. This framework should be created as a result of cooperation framework among providers independently of regional usage variations.

Operationally, experience levels need to be captured and transferred to a contractual form, which could be achieved by experience simulators that allow measuringa user's quality sensitivity for different service types. Accordingly, users could choose their desired experience level on a quality scale depicting the available quality tiers (e.g. olympic model, absolute category rating 5-level scale, star ratings, etc.), price and typical service usage scenarios [2]. This would contribute an ELA choice reflecting both quality sensitivity and service preferences, which would then be automatically translated to QoS parameters via QoE models [8]. In case service-aware QoS parameters cannot be explicitly defined, QoS indicators may provide descriptors for aggregate QoS bounds (e.g., peak bandwidth up to 100Mbps, latency smaller than 100ms) for the specified set of services at the tested location.

There is a number of open issues that need to be worked out before transition from SLA to ELA can take place. Considering SLAs for telecommunication services are not widely spread foruser-level usage, ELAs cannot yet build upon an existing and adequate infrastructure involving end-users, all involved providers, including service providers and also content providers. It is challenging to describe ELA in a way that can express QoS requirements and concurrently to be easily understandable by all users. Also, ELAs should be consistent across users and platforms, meaning it should be applicable to a range of users' profiles in the service domain [2]. Further, there can be marketing challenges in implementing ELAs, so it is necessary to develop effective marketing strategies to address potential issues.

5 CONCLUSION

Concept of quality in telecommunications has been experienced major transformations in recent years and it has been adjusted to more demanding and unpredictable telecommunication markets. Besides QoS, which is focused on technical parameters of services, QoE, as a subjective category, has been centre of attention for all players in telecommunication markets. Therefore, service providers are encouraged to consider not only technical aspects of quality but also users' expectations and experiences regarding a particular service.

SLA covers service characteristics including QoS but not particularly QoE. Recently there has been an increasing need for novel type of contract that will include users' experiences, perspective and adequate measurements of service quality. In this respect, ELA singled out as a promising concept. In this paper we adressed main issues regarding transition from QoS-based SLA to QoE-based ELA. ELA should be convenient to measure by both service providers and customers. In this manner, ELA should be able to be quantified, guaranteed, validated and maintained.

ACKNOWLEDGMENT

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ANALYSIS AND ASSESSMENT OF BUILDING ENVELOPE WITH INTEGRATED VEGETATION MODULAR ELEMENT FOR A SUSTAINABLE FUTURE

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Abstract: The vegetation walls, which are using in the architecture, have opened new design possibilities and created new challenges for designers, with the aim to increase energy efficiency of the structures.Main goal of the vegetation walls architecture is to enable the building a new type of urban recognition in the environment and to create conditions for more efficient protection of objects from thermal overheating in the summer period.The aim of this research is optimization of the façade by covering existing architectural structure with vegetative modular elements, using factorial design. The application of this technique provide the extensive use of vegetation walls in the architecture of existing and new objects.The analysis shows the impact of the side of the world or the outside temperature and the type of vegetative modular element to the thermal power between the vegetation layer and the wrapper of the building, as well as to the building internal temperature. This paper presents a plot contour and surface plot of considered parameters (external temperature, Leaf Area Index and coefficient of heat transfer) to the thermal power and internal building temperature. Investigation with Taguchi design represents a key element in solving the dependence between comfort conditions in the object, external visage and energy balance of the object. Design and use of vegetation walls is aimed at improving and super-integrating the basic human energy needs, viewing them as a metasystem transition to the completely new possibilities of architecture, society and technology.

Key words: green wall; architecture; energy performances; optimization; Taguchi design;

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1 INTRODUCTION

The research was based on previous analyzes of the urban man's need for new forms of modern urban design and the possibility of active use of vegetation in the design of architectural elements. Vegetation walls contribute to the improvement of energy characteristics of buildings, biodiversity, design values and contribute to reducing air pollution.Since the interaction between the external environment and the interior space takes place through the building envelope, vegetation walls can be a key element in solving the dependence between achieving the comfort conditions in the building, the outer appearance and the energy balance of the building.The design of these elements and the use of vegetation walls aims at improving and superintegrating the basic human energy needs by observing them as a metasystem transition to the completely new possibilities of architecture, society and technology [1-8].

2 PRACTICAL MODEL

The basis for determining the parameters of the analysis and the assembly of the façade is reflected in the collection of the necessary air parameters and technical characteristics of the established model of the vegetative wall according to Sudimac, B. [9], the accurate registration of the following influencing factors: "emissivity of the surface, the air temperature, humidity, intensity and direction, solar radiation intensity and duration of sun, the intensity of the radiation environment, the radiation intensity of the celestial sphere, geometry factors, radiation, local radiation sources, the existence and duration of the rain".

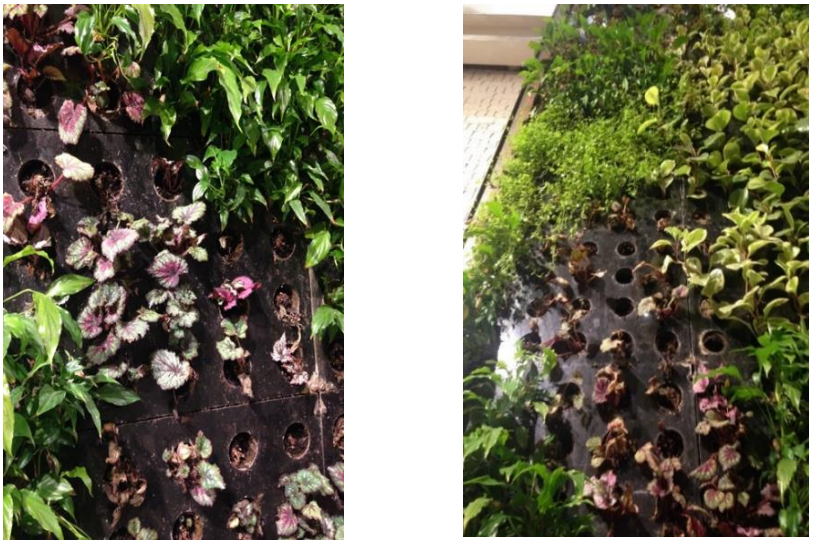

Figure 1. *Example of a vegetation wall using a modular system with a perforated box*

When defining the types of modular elements of the vegetation wall, selected factors were selected which mostly influence the energy performance of the element itself, which in the further analysis can influence the technological characteristics and designing improvements of the model. The very criteria for setting the vegetation wall

being analyzed are defined in relation to the existing facade coating, whose circuit is identical to the reference model and its orientation in the space.

For the purpose of practical measurements and analyzes of the obtained results, a compact object was selected, without facade openings, with the installation of a vegetation wall on the eastern, southern and western sides of the building, in the Belgrade climatic conditions.

3 DESIGN OF EXPERIMENTS

Within the experiment was monitored by thermal power which is obtained between the vegetation layer and the building envelope. Thermal power is calculated for the modular system with perforated boxes. The outside air temperature is measured on all three walls of the building. The heat transfer coefficient h has values of 8, 10 and 12 W / m2K and Leaf Area Index factors are (0.2 = very rarely, 0.8 = medium, and 1.5 = dense). The value of the solar absorption coefficient of the plant α_b is 0.37. Factors that influence the thermal power values as well as their levels are shown in Table 1.

Table 1. *Levels for various control factors*

Control factors	Units	Level I	Level II	Level III
Tev	^{o}C	25.5	28.8	29.4
h	W/m^2K	8	10	12
LAI	m^2/m^2	0.2	0.8	1.5

For the experimental design it has been used orthogonal array L32 (Table 2) obtained by applying Taguchi mixed level design. The Minitab 16 statistical tool was used to form an orthogonal matrix. In the paper, the S / N ratio "the smaller the better" was used for thermal power analysis [10-17].

The equation for calculating S/N ratio for Taguchi characteristic “the less the better” is as follows:

$$S/N = -10\log\frac{1}{n}\left(\sum y^2\right) \quad (1)$$

where S/N is the signal-to-noise ratio, n is the repetition number of each trial and y_i is the result of the *i*-th experiment for each trial. S/N ratio for each level of influencing parameters is calculated on the basis of S/N analysis. Statistical analysis of variable is used to consider parameters statistically worth. Optimal combination of parameters can be predicted.

Experimental results for thermal power are obtained by using orthogonal array L27 for different factors’ combinations and they are given in Table 2. In Table 2 there are also given values of S/N ratio thermal power.

Table 2. *Experimental design using L32 orthogonal array*

	Tev, K	h	LAI	Q, W/m^2	S/N ratio
1	25.5	8	0.2	251.398	-48.0072
2	25.5	8	0.8	256.198	-48.1715
3	25.5	8	1.5	261.798	-48.3593
4	25.5	10	0.2	251.798	-48.0210
5	25.5	10	0.8	257.798	-48.2256
6	25.5	10	1.5	264.798	-48.4583
7	25.5	12	0.2	252.198	-48.0348
8	25.5	12	0.8	259.398	-48.2793
9	25.5	12	1.5	267.798	-48.5561
10	28.8	8	0.2	253.315	-48.0732
11	28.8	8	0.8	263.875	-48.4280
12	28.8	8	1.5	276.195	-48.8243
13	28.8	10	0.2	254.195	-48.1033
14	28.8	10	0.8	267.395	-48.5431
15	28.8	10	1.5	282.795	-49.0294
16	28.8	12	0.2	255.075	-48.1334
17	28.8	12	0.8	270.915	-48.6567
18	28.8	12	1.5	289.395	-49.2298
19	29.4	8	0.2	254.543	-48.1152
20	29.4	8	0.8	269.903	-48.6242
21	29.4	8	1.5	287.823	-49.1825
22	29.4	10	0.2	255.823	-48.1588
23	29.4	10	0.8	275.023	-48.7874
24	29.4	10	1.5	297.423	-49.4675
25	29.4	12	0.2	257.103	-48.2021
26	29.4	12	0.8	280.143	-48.9476
27	29.4	12	1.5	307.023	-49.7434

4 RESULTS AND DISCUSSION

4.1 S/N Ratio Analysis

The influence of control parameters such as external air temperature, transfer coefficient and Leaf Area Index (LAI) was confirmed by the S / N ratio analysis. Process parameter settings with the highest S/N ratio always yield the optimum quality with minimum variance. The control parameter with the strongest influence was determined by the difference between the maximum and minimum value of the mean of S/N ratios. Higher the difference between the mean of S/N ratios, the more influential will be the

control parameter. Impacts of the control parameters on the thermal power Q are shown in Table 3.

Based on the ranking, it can be noticed that the Leaf Area Index is the dominant parameter that influences Q then the external air temperatures (Tev) and finally the coefficient of heat transfer (h).

Table 3. *Response Table for Signal to Noise Ratios for Smaller is better*

Level	Tev	h	LAI
1	-48.23	-48.42	-48.09
2	-48.56	-48.53	-48.52
3	-48.80	-48.64	-48.98
Delta	0.57	0.22	0.89
Rank	2	3	1

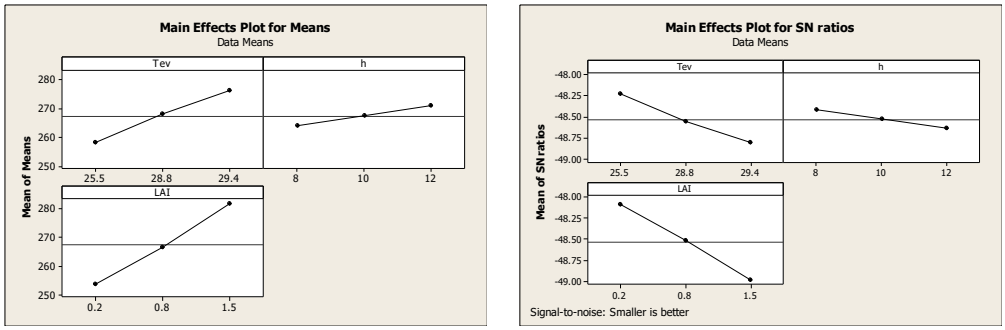

Figure 2. *Main effect plots for a) Means for the Q and b) S/N ratio for the Q*

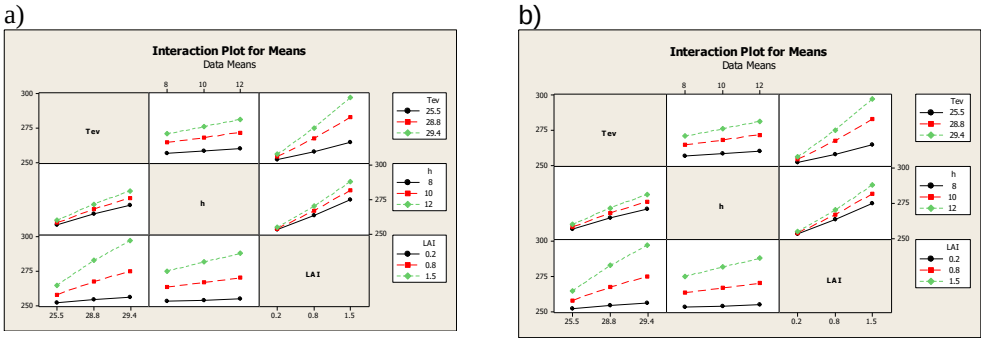

Figure 3. *Main effect Interaction plots for a) Means for the Q and b) S/N ratio for the Q*

Figure 2 shows a graph of the main effects of the influence of the various testing parameters on the thermal power. In the main effect plot, if the line for a particular parameter is near horizontal, then the parameter has no significant effect. In contrast, a parameter for which the line has the highest inclination has the most significant effect. In this case, the Leaf Area Index has the greatest influence on the thermal power, then the external air temperatures (Tev), and the smallest transfer coefficient (h).

Mutual influence interactions in the heating power is shown in Figure 2.

4.2 Analysis of variance results for the Q

The experimental results were analyzed using the (ANOVA) analysis used to examine the influence of the parameters under consideration, the outside air temperature, the heat transfer coefficient, the Leaf Area Index (LAI) on the thermal power of Q. By performing analysis of variance, it can be decided which independent factor dominates over the other and the percentage contribution of that particular independent variable. Table 4 the ANOVA results for specific wear rate for four factors and interactions of those factors. This analysis is carried out for a significance level of α=0.05, i.e. for a confidence level of 95%. Sources with a P-value less than 0.05 were considered to have a statistically significant contribution to the performance measures. In Table 4 the last column shows the percentage contribution (Pr) of each parameter on the total variation indicating their degree of influence on the result.

Table 4. *Analysis of Variance for S/N ratios for **Q***

Source	DF	Seq SS	Adj SS	Adj MS	F	P	Pr
Tev	2	1.46282	1.46282	0.73141	499.68	0.000	26.17
h	2	0.22175	0.22175	0.11088	75.75	0.000	3.97
LAI	2	3.55953	3.55953	1.77977	1215.89	0.000	63.68
Tev*h	4	0.03424	0.03424	0.00856	5.85	0.017	0.31
Tev*LAI	4	0.56918	0.56918	0.14229	97.21	0.000	5.09
h*LAI	4	0.08146	0.08146	0.02036	13.91	0.001	0.73
Residual Error	8	0.01171	0.01171	0.00146			0.05
Total	26	5.94068					100

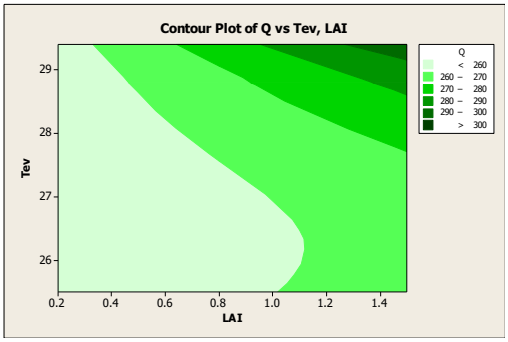

Figure 4. *Surface plot for dependence between thermal power Q rate of the Leaf Area Indexa (LAI) and external temperature (Tev)*

Table 4 shows that Leaf Area Index has the greatest impact on thermal power (63.68%). The lower thermal influence of Q has an outside temperature (26.17%). The smallest influence has a heat transfer coefficient (3.97%). The interaction concerns the greatest impact of Tev * LAI interaction (5.09%). The influence of other interactions is less than 1% and can be ignored. Since the inteaction has the greatest influence on thermal power, Tev * LAI interaction has shown in Figure 4 is the Surface plot for the dependence between the thermal power Q rate of the Leaf Area Index (LAI) and the external temperature (Tev).

4.3 Multiple regression model

Multiple linear regression model has been developed using statistical software "MINITAB 16". This model gives the ratio between parameters and respons by setting linear equation for the observed data. Regression equation generated this way establishes the connection between significant parameters obtained by ANOVA analysis, i.e. external air temperature, heat transfer coefficient and Leaf Area Index (LAI). Regression equation developed for S/N ratio of toplotna snaga Q is as follows:

$$Q = 118 + 4.07\ Tev + 1.78\ h + 21.3\ LAI$$

$$S = 6.27467 \quad R\text{-}Sq = 84.7\% \quad R\text{-}Sq(adj) = 82.7\% \qquad (2)$$

The equation (2) shows that the thermal power increases with an increase in the external air temperature, the coefficient of heat transfer and the Leaf Area Index.

Figure 5 gives comparison between the actual test results and the predicted values, which were obtained by the linear regression model.

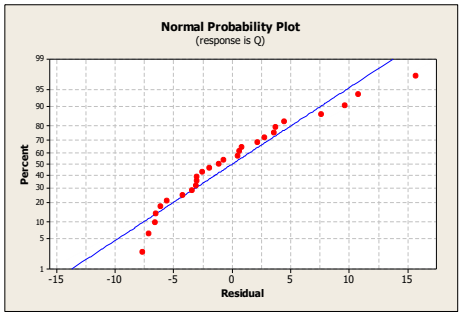

Figure 5. *Comparison of the linear regression model with experimental results for the thermal power Q*

5 CONCLUSION

This investigation has shown that Taguchi experimental design can be used to analyze the effect of parameters on increasing thermal power by applying the appropriate model as explained in this paper. This analysis can be concluded:

- The application of a modular system with a perforated box and vegetation positively influences the increase in the thermal power of the building,
- Leaf Area Index has the greatest influence on thermal power (63.68%). The outside temperature is lower (26.17%), while the smallest influence has a heat transfer coefficient (3.97%). When interactions into question the greatest effect is the Tev * LAI interaction (5.09%). The influence of other interactions is much smaller and can be ignored.
- Minitab 16 software was successfully used to form a linear regression model of heat dependence model from the input parameters with a high degree of regression.

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