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Engineering Management Department (EMD)

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Environmental awareness as a universal European Value

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Contents

INTRODUCTION TO THE VISEGRAD FUND PROJECT: "ENVIRONMENTAL AWARENESS AS A UNIVERSAL EUROPEAN VALUE"

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The main target in the Engineering Management Department (EMD) Strategy for development is intention to increase international cooperation and internatiolization of our research work and educational process. Based on this goal, the employees of this Department, of Technical faculty in Bor, University in Belgrade, are organized in research teams, dedicated to form consortiums and to prepare and apply international project applications. One of the target International cooperation is cooperation in the frame of the Visegrad fund projects.

During the year 2015/2016, research group from EMD have organized and applied one V4 international project, which was connected to International Students Symposium with the main topic: "**Environmental awareness as a universal European Value**" . The project was financially supported by the Visegrad Fund - http://visegradfund.org/news/2016/02-15/ . This symposium was organized in frame of the International May Conference on Strategic Management - IMKSM2016 (28-30 May 2016). The project is listed with the following classification number 11540386.

Our partners at this project, that participated in the research and also participated in the events on 28-30 of May 2016, were:

1. Óbuda University, Keleti Faculty of Business and Management - Hungary: http://kgk.uni-obuda.hu/
2. Institute of Production Engineering, Faculty of Management, The Czestochowa University of Technology - Poland: http://kgk.uni-obuda.hu/
3. University of South Bohemia, Faculty of Economics - Czech Republic; webpage of the partner institution : www.ef.jcu.cz
4. University of ss. Cyril and Methodius in Trnava, Faculty of Mass Media of UCM - Slovakia: http://www.ucm.sk

5. The Managers of Quality and Production Association - Poland; webpage of the partner institution: http://qpij.pl
6. University American College, Skopje, Macedonia: http://www.uacs.edu.mk/

Details and the project description are available in the manuscript: "Environmental awareness as universal European value, published in Serbian Journal of Management, issue 11 (2) (2016) 149 - 153. DOI: 10.5937/sjm11-11245. The final manuscript is available at: http://www.sjm06.com/SJM%20ISSN1452-4864/11_2_2016_May_149_319/11_2_2016_149_153.pdf

The authors of the published text are the members of the research team, responsinle for this V4 project application: Ivan Mihajlovic, Danijela Voza, Isidora Milosevic and Danijela Durkalic.

ENVIRONMENTAL AWARENESS OF EUROPEAN YOUTH: A COMPARATIVE STUDY

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Abstract

Research, presented in this manuscript is result of the project: "**Environmental awareness as a universal European Value**", financially supported by International Visegrad fund (http://visegradfund.org/). The aim of this study is comparative analysis of ecological awareness level between youth from EU member states, on one side, and candidate states, from the other side. The main issue of this article is to examine if the existing legal framework in EU has inevitable influence on young people to adopt environmental protection concept and behave ecologically responsible.

Keywords: environmental awareness, youth, European Union, environmental protection, ecological education

1. INTRODUCTION

Nowadays, solving ecological problems requires advancement of peoples' awareness, attitudes and knowledge about these issues. Awareness is defined as concern for what is happening in the environment [1]. Environmental awareness of processes and systems play an important role in environmental education [2]. Students' environmental awareness is one of the most important indicators for displaying national civilization. *Wray-Lake et al.* indicated two key reasons call for paying close attention to trends in these age groups views. First, the theory of generational replacement argues that changes in adolescents' attitudes are important markers of long term social change. Second, young peoples' environmental concerns also deserve attention due to the many examples showcasing youth as active agents in protecting the environment. [4]

Environmental protection is one of the basic and fundamental European values. Preservation and improvement of this concept implies a collective partnership action, both within the EU and beyond. In order to prevent and solve the existing ecological problems,

concept of environmental protection is institutionalized and legally prescribed. Over the past decades the European Union has put in place a broad range of environmental legislation. In the actual Environment Action Programme of EU (7th Environmental Action Programme) the only non-institutonal recommendation is education of citizens about the importance of environmental protection [5]. The aim of the environmental education is to encourage people to sense environmental values and to take environmentally responsible actions.

Considering that most of the environmental problems are regional or global, it is required to join actions of all interested countries in order to preserve the concept of sustainability. The theme that was specially elaborated in documents about environmental protection of the European Union is the enlargement of the EU. In the process of joining the EU, candidate countries, among which is Serbia, will have to synchronize their environmental standards with European, but also achieve sustainability by increasing environmental awareness, which is foreseen the current Action Plan for the Protection of the Environment – 7th Environmental Action Programme 2010 -2014 [5]. That would be very helpful for Serbia in order to adopt experience and knowledge of V4 countries which are EU member states.

Study, presented in this manuscript, is result of the project: "Environmental awareness as a universal European Value", financially supported by International Visegrad fund. The aim of this study is comparative analysis of environmental awareness level between youth from EU member states, on one side, and candidate states, from the other side. The main issue of this article is to examine if the existing legal framework in EU has inevitable influence on young people to adopt concept of environmental protection and behave ecologically responsible.

2. EXPERIMENTAL

The research carried out using questionnaire as data collection instrument. Questionnaire used in this study is developed in 2004. by author Lasso De la Vega (Appendix A) [1]. It was included 72 closed-ended questions covering various aspects of the current environmental issues at global and local levels and eight questions about demographic characteristics (e.g., socioeconomic status, gender, ethnicity, education, leisure activities, etc.). This questionnaire is consisted of using a five point Likert – type response scale, an agree/disagree response section. Participants of this study were 429 students from the Hungary, Poland, Czech Republic, Slovakia, Macedonia and Serbia. Moderators of the research were the profesors and PhD students from the universities included in the project. The Statistical Package for the Social Sciences (SPSS v17) was the computer software used to analyses the collected data.

3.RESULTS

3.1. DEMOGRAPHIC STRUCTURE OF RESPONDENTS

There are some predictors of environmental awareness and attitudes, like gender, residence, income and political tendency [6], [7], [8]. In order to identificate the demographic structure of respondents descriptive analysis was conducted. In the following figures the obtained results could be seen. In survey participated mostly females with a

share of about 61%, while interviewied men were almost 40%. (Figure 1) According to the results of the descriptive analysis of demographic questions relating to the age of respondents, the survey included the most young people between 19 and 22 years. Also, the more numerous are the respondents between 23 and 25 years. (Figure 2)

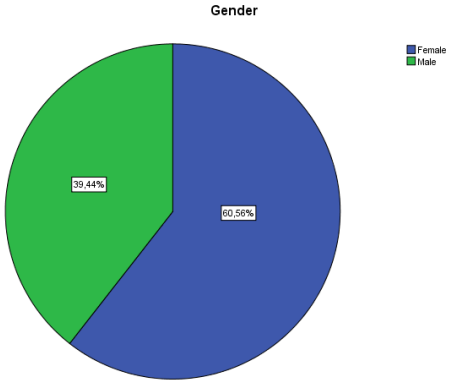

Figure 1. The structure of respondents by gender

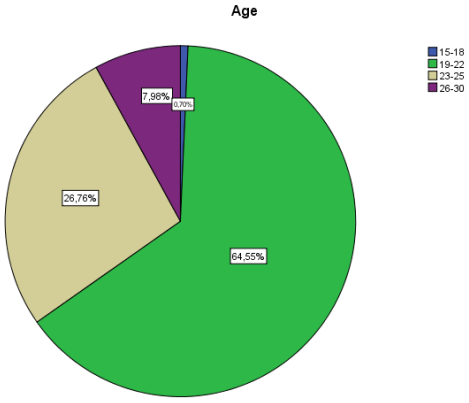

Figure 2. The structure of respondents by age

In the Figure 3 are presented data about education level of the respondents. It could be noticed that in the survey participated mostly young people who are attending bachelor study level. The national structure of participants in the survey is shown in Figure 4. According to the results, in the survey participated the most Serbs and Poles, followed by Hungarians, Czechs, Slovaks and Macedonians.

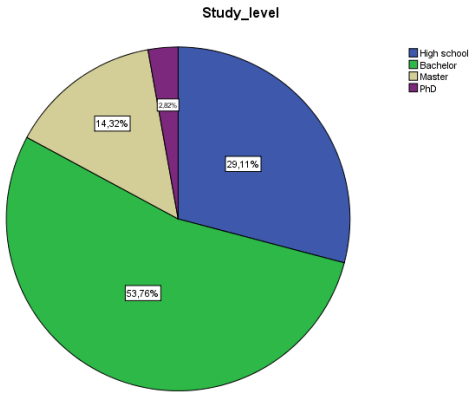

Figure 3. The structure of respondents by their education

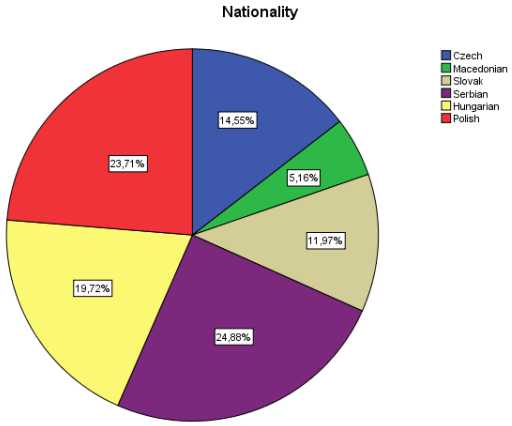

Figure 4. The national structure of respondents

In rural surroundings, direct daily contact with the basic natural resources was prevalent, especially within men's immediate environment. As men became progressively urbanized, his intimate association and interaction with natural resources diminished and, with it his awareness of his dependency of them [9]. Regarding the area where respondents grew up, the results indicate the approximate percentage of young people who spent their childhood in urban (55,87%) and young people who grew up in rural areas (44,13%) (Figure 5). Young people who took part in this research are residing in urban areas, mostly (Figure 6).

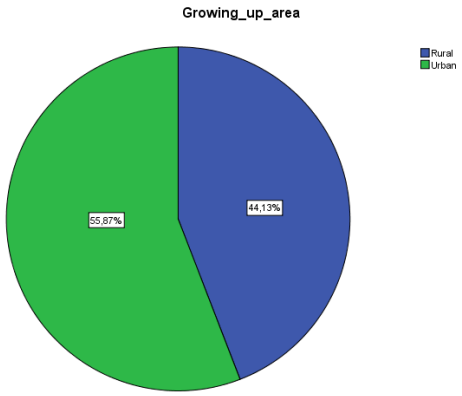

Figure 5. Growing up area of respondents

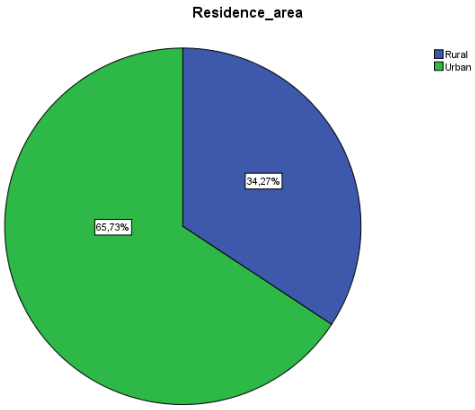

Figure 6. Residence of the respondents

3.2. COMPARATIVE ANALYSIS OF THE LEVEL OF ENVIRONMENTAL AWARENESS AMONG YOUNG PEOPLE IN THE EU MEMBER AND CANDIDATE STATES

The aim of this section was to compare the level of environmental awareness among young people from EU member states and candidate states. Into consideration have been taken 20 statements from the questionnaire related the issues of environmental awareness. These statements are devided as follows:

- Statements from 1 to 5 (AW1 – AW5) are related to the influence of authoritative figures on respondents' environmental awareness and their interest for the ecological issues;

- Statements from 6 to 14 (AW6 – AW14) measured awareness as perception of local environmental conditions or issues;

- Statements from 15 to 20 (AW15 – AW20) define the level of respondents concern about environmental issues in their country.

For this purpose are calculated the mean values of the answers of respondents from Serbia and Macedonia, on one side, and Czech Republic, Poland, Slovakia and Hungary, on the other side. The results of analysis of questions from (AW1-AW5) show that the mean of

the responses is higher among young people who come from EU countries. The exception is the first statement: *"Participating in outdoor activities such as camping and fishing".* Based on these results, we can conclude that parents and teachers in the EU put more effort to draw attention of young people to importance of environmental protection. At the same time, in these countries is greater interest for environmental issues. This indicates that authoritative figures from EU significantly encourage young people to be informed about the environmental conditions.

The results of the descriptives are presented in Table 1 and Table 2:

Table 1. Descriptives of Serbian and Macedonian responses

	N	**Min**	**Max**	**Mean**	**Std. Dev.**
AW1	128	1	5	2,03	1,019
AW2	128	1	5	2,81	1,222
AW3	128	1	5	2,67	1,158
AW4	128	1	5	2,83	1,058
AW5	128	1	5	2,34	1,132
AW6	128	1	5	2,41	0,968
AW7	128	1	5	2,2	1,043
AW8	128	1	5	2,21	0,969
AW9	128	1	5	2,89	0,949
AW10	128	1	4	2,27	0,92
AW11	128	1	4	2,36	0,801
AW12	128	1	5	2,39	0,941
AW13	128	1	5	2,52	0,842
AW14	128	1	5	2,26	0,881
AW15	128	1	5	3,56	1,162
AW16	128	1	5	3,09	1,177
AW17	128	1	5	3,68	1,203
AW18	128	1	5	3,48	1,21
AW19	128	1	5	3,4	1,096
AW20	128	1	5	3,65	1,201
Valid N (listwise)	128				

Table 2. Descriptives of responses from EU states (Czech, Poland, Hungary and Slovakia)

	N	Min	Max	Mean	Std.Dev.
AW1	298	1	5	2,62	1,048
AW2	298	1	5	2,66	0,996
AW3	298	1	5	2,49	0,873
AW4	298	1	5	2,46	0,873
AW5	298	1	5	2,19	0,909
AW6	298	1	5	2,8	0,859
AW7	297	1	5	2,75	0,812
AW8	298	1	5	2,58	0,861
AW9	298	1	5	3,01	0,928
AW10	298	1	5	2,3	0,882
AW11	298	1	5	2,5	0,809
AW12	297	1	5	2,75	0,87
AW13	298	1	5	2,93	0,911
AW14	298	1	5	2,8	0,829
AW15	297	1	5	2,75	0,915
AW16	298	1	5	2,54	0,954
AW17	298	1	5	2,9	1,095
AW18	298	1	5	2,73	0,981
AW19	298	1	5	2,97	1,028
AW20	297	1	5	2,97	1,052
Valid N (listwise)	295				

The results of analysis of questions from (AW1-AW5) show that the means of the responses are higher among young people who come from EU countries. The exception is the first statement: *"Participating in outdoor activities such as camping and fishing".* Based on these results, we can conclude that parents and teachers in the EU put more effort to draw attention of young people to the importance of environmental protection. At the same time, in these countries is greater interest for environmental issues. This indicates that authoritative figures from EU significantly encourage young people to be informed about the environmental conditions.

Regarding the environmental changes in the region where respondents live, mean values of answers from this group are higher in the candidate states, then in the EU states. So, it could be concluded that Serbia and Macedonia are not enough dedicated to solving

ecological problems. Analasys of statements from the third group (young people concern for the environmental conditions) has shown that mean values of answers are higher in the candidate states, then in the EU states. So, it could be concluded that the state of environment in Serbia and Macedonia is worse than environmental state in EU countries.

However, it is important to emphasize the extenuating fact that young people are aware of environmental problems and their concern gives hope that they would try to solve these problems in the future. Although these results indicate a higher level of environmental awareness among young people in the EU than in candidate countries, it should be noticed that this difference is not significant in most of the statements. The largest deviations occur in responses to statements from the third group, which indicate a concern for the environmental situation.

3.3. THE INFLUENCE OF NATIONALITY ON THE LEVEL OF YOUTH ENVIRONMENTAL AWARENESS

In order to determine the influence of respondents' nationality on their environmental awareness, „*One-way analysis of variance"* (ANOVA) test has been conducted. The results show that nationality has a statistically significant impact ($p < .001$) on the answers to most of the statements (Table 3). The exceptions are statements from the first group:

AW3: *„I have a teacher who encourage me to care for the environment",*

AW5: *„I read books or magazines with an environmental message".*

Also, there have been extracted two statements about local environmental changes (AW11: „*The conditions of wetlands and nature preserves*", AW19: „*Solid waste management*") and statement about respondents' perception of environmental conditions in their country: AW20: "*Endangered species*".

Table 3. The results of ANOVA test

		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
AW1	Between Groups	44,798	6	7,466	6,982	0,000
	Within Groups	451,272	422	1,069		
	Total	496,07	428			
AW2	Between Groups	25,696	6	4,283	3,841	0,001
	Within Groups	470,463	422	1,115		
	Total	496,159	428			
AW3	Between Groups	12,601	6	2,1	2,285	0,035
	Within Groups	387,935	422	0,919		
	Total	400,536	428			
AW4	Between Groups	29,816	6	4,969	5,905	0,000
	Within Groups	355,121	422	0,842		

	Total	384,937	428			
AW5	Between Groups	16,747	6	2,791	2,911	0,009
	Within Groups	404,554	422	0,959		
	Total	421,301	428			
AW6	Between Groups	50,941	6	8,49	11,394	0,000
	Within Groups	314,443	422	0,745		
	Total	365,385	428			
AW7	Between Groups	51,85	6	8,642	11,462	0,000
	Within Groups	317,412	421	0,754		
	Total	369,262	427			
AW8	Between Groups	21,298	6	3,55	4,465	0,000
	Within Groups	335,462	422	0,795		
	Total	356,76	428			

AW9	Between Groups	28,838	6	4,806	5,832	0,000
	Within Groups	347,768	422	0,824		
	Total	376,606	428			
AW10	Between Groups	9,679	6	1,613	2,023	0,061
	Within Groups	336,531	422	0,797		
	Total	346,21	428			
AW11	Between Groups	7,834	6	1,306	1,976	0,068
	Within Groups	278,781	422	0,661		
	Total	286,615	428			
AW12	Between Groups	34,605	6	5,768	7,602	0,000
	Within Groups	319,413	421	0,759		
	Total	354,019	427			
AW13	Between Groups	47,111	6	7,852	10,721	0,000
	Within Groups	309,048	422	0,732		
	Total	356,159	428			
AW14	Between Groups	52,613	6	8,769	13,376	0,000
	Within Groups	276,659	422	0,656		
	Total	329,273	428			

AW15	Between Groups	71,154	6	11,859	12,006	0,000
	Within Groups	415,844	421	0,988		
	Total	486,998	427			
AW16	Between Groups	40,758	6	6,793	6,541	0,000
	Within Groups	438,235	422	1,038		
	Total	478,993	428			
AW17	Between Groups	83,082	6	13,847	11,254	0,000
	Within Groups	519,245	422	1,23		
	Total	602,326	428			
AW18	Between Groups	53,651	6	8,942	7,901	0,000
	Within Groups	477,594	422	1,132		
	Total	531,245	428			
AW19	Between Groups	17,868	6	2,978	2,649	0,016
	Within Groups	474,403	422	1,124		
	Total	492,27	428			
AW20	Between Groups	48,894	6	8,149	6,706	0,000
	Within Groups	511,61	421	1,215		
	Total	560,505	427			

3. CONCLUSION

Environmental protection is an issue of international importance, which requires intensive cooperation between countries from the same region and from all over the world. Concept of environmental protection is an imperative of membership of every European Union (EU) member and candidate state. Besides adopting an adequate legal framework, it is possible to improve environmental protection through the ecological education of people of all ages. At the same time, special attention should be directed towards raising ecological awareness of youth as the main carriers and decision makers of future sustainable development. In order to facilitate the adoption of environmental (ecological) values and environmentally (ecologically) responsible action, it is necessary to educate citizens, especially young people, about the importance of environmental protection. Institutional mechanisms will not give sufficient results if environmental awareness is not enoguh developed. Therefore, the main conclusion of this paper is that without the adoption of environmental values and changes in behavior of individuals, the environment as a global concept remains meaningless.

4. RECOMMANDATIONS FOR FUTURE RESEARCH

One of the ideas for future researches is to examine the relations between three components of environmental education: awareness, attitudes and knowledge. Also, aim is to define similarities and differences of environmental awareness among youth from participating countries. On that base, it would be possible to recognize strenght and disadvantages of each of them. This would allow creation of new methods and instruments used for advancing environmental education of students from participating universities. The results would indicate the best way of raising environmental awareness among youth, thus ensuring the most perspective environmental future of Europe

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Appendix A: **ENVIRONMENTAL SURVEY FOR YOUTH**

Below are the series of personal questions regarding demographic data. Please circle your answer:

1. **Gender:**
   a. female
   b. male

2. **How old are you:**
   a. 15 – 18 b. 19 - 22 c. 23 - 25

3. **Which of the following alternatives characterize the region where you grew up?**
   a. Rural b. Urban

4. **Which of the following alternatives characterize your living area?**
   a. Rural b. Urban

5. **What is your most preferred activity for entertainment?**
   a. Sports
   b. Outdoor activities such as camping, fishing, boating, etc.
   c. Indoor activities such as reading, watching TV, computers, etc.
   d. Social activities
   e. Gardening
   f. Other: _____

Please indicate how often you have had following experiences by circling the option that best represents you.

1 = Never 2 = Seldom 3 = Often 4 = Very often

1	Participating in outdoor experiences such as camping and fishing.	1	2	3	4	5
2	Having your parents or grandparents encourage you to care for the environment.	1	2	3	4	5
3	Having a teacher encourage you to care for the environment.	1	2	3	4	5

4	Watching television programs with an environmental message.	1	2	3	4	5
5	Reading books or magazines with an environmental message.	1	2	3	4	5

Please indicate how you feel local environmental issues, of your region, have become since you have lived here.

1 = Much worse 2 = Worse 3 = Better 4 = Much better

6	The water quality in your local streams, rivers, and lakes.	1	2	3	4	5
7	The level of pollution or waste produced by nearby businesses, farms, and industries.	1	2	3	4	5
8	The misuse of chemicals such as fertilizers and pesticides.	1	2	3	4	5
9	Water shortage.	1	2	3	4	5
10	The number of exotic animals and plants.	1	2	3	4	5
11	Wetland protection.	1	2	3	4	5
12	Endangered species protection.	1	2	3	4	5
13	The population of native animals such as fish, birds, and mammals.	1	2	3	4	5
14	The overall environmental state of *insert the name of your country*	1	2	3	4	5

Please indicate how concerned you are about the following environmental issues in insert the name of your country.

1 = Not concerned at all 2 = Somewhat concerned 3 = Concerned 4 = Very concerne

15	Water pollution from industries, farmland, and urban development.	1	2	3	4	5
16	The conditions of wetlands and nature preserves.	1	2	3	4	5
17	Water shortage.	1	2	3	4	5
18	Unlimited development of cities.	1	2	3	4	5
19	Solid waste management.	1	2	3	4	5
20	Endangered species.	1	2	3	4	5

CULTURE AND ENVIRONMENTAL AWARENESS, A STUDY ON HUNGARIAN HIGHER EDUCATION STUDENTS

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Abstract

During the past 20-30 years, concern for the environment has greater than before and, at the same time, people's values and attitudes towards nature have changed in substance. The main purpose of this paper is to describe to show how the national culture effect on their Environmental Awareness and Environment Related Behaviour and their willingness to take action to arrest environmental degradation in Hungary. This study focus on the impact of human conflict and international relations on the environment, or on how environmental problems cross state borders in the aspect of culture. Our research question is focused on two main themes: Do the Hungarian Youth perceive that what is the most important issue that Hungary is facing nowadays? Which actions they have taken on behalf of environmental issues?

Keywords: Environment Security, Security Awareness, Culture, National Culture, Hungarian Youths's Environment Awareness

1. INTRODUCTION

Nowadays globalisation and the increasing economic activities especially in developing countries enkindle more energy and consumption demand, which generally lead to environmental degradation. However, there is some theory which thinks the pollution problem will be solved as soon as the developing countries achieve the adequate level of economy and it could enable them to afford environmental friendly technology as well as pro-environmental regulations and policies.[1]

In the last few decades, there has been a number of studies showing many countries that have conducted an awakening interest in environmentally friendly attitudes and there are needs for public participation due to the recent change in sources of environmental problems.

In this paper we are looking for the answer for the following question:

Do Hungarian youths have the environmental behaviour drive?

2. LITERATURE REVIEW

2.1. ENVIROMENT SECURITY

Numerous sources define environment security as a security concern of the last decades as the relationship of the viability of the environment's life support.

According to Whyte (2001)[2] environment security is the linkage of environment and human security. It includes more than just physical security, but economic, food, health and the environmental causes (i.e. water shortages).

Zurlini and Müller (2008)[3] provides a social-ecological landscape perspective, where environmental security is defined as the notion of ecosystem functions and services, ecosystem integrity, resilience, and sustainability as fundamental values for the survival and well-being of mankind, and of the threats to those values either anthropogenic or from natural hazards and disasters from local to global scale.

Environment security has three main sub elements according to the Millennium project[4]:

- preventing or repairing military damage to the environment,
- preventing or responding to environmentally caused conflicts, and
- protecting the environment due to its inherent moral value.

Since this research did not contain details about military damages and environmental conflicts. Thus we concentrate on the third point, which focused on the cultural value and its impact on individuals' environmental behaviour.

2.2. CULTURE

Numerous studies have discussed and theorized the link between national culture and environmental conditions. Cohen and Nelson (1994) are of the opinion that the mechanism of a link between culture and the environment must be the influence by culture on normative ethical beliefs regarding on that society what is morally correct behaviour. [5]

These beliefs are show up in our common business, weekday practices/ activity and government regulation of business activity. Which means the perception of environmentally responsible behaviour can be significantly different across countries.

Gorham (1997) really thinks that cultural factors effect on various levels of policy: through the policies of sovereign states, public and private agencies that serve the policies, and the public officials who are directly responsible for how the policies are carried out. Taking a slightly different view, many studies have focused on the relationship between culture and environment in the context of the bonds of social/human capital and natural capital. Etzioni's (1995) study shows that, those societies which have a high level of social/human capital, members are able to balance their own rights with collective responsibilities and managing their natural resources. [6][7]

At the present there are at least six models of national cultures to help us understand the effect of culture on the environment. Some models have been made to examine the overall relationship between dimensions of culture and environmental sustainability. Each theory

examines different aspects of societal beliefs, norms, and/or values and as such convergence across the models have been seen as being limited.

Below we summarize Kluckhohn and Strodtbeck, Hofstede's national culture models very briefly as a prelude to a comparative analysis.

KLUCKHOHN AND STRODTBECK

Florence Kluckhohn and Fred Strodtbeck's (1961) model is one of the earliest models of culture that has served as a principal foundation for several later models. [8]

Their model of culture based on value orientations, and hold a brief that there are a limited number of problems that are common to all social groups and for which there are a limited number of solutions. Furthermore, they suggested that values in any given society are distributed in a way that creates a dominant value system. [9]

They proposed that cultures could react to the issues in at least three ways and that all cultures could express each of the three responses. Therefore, this concept could characterize difference cultures. They separated these responses to five concerns which are called "value orientations." or "core values."

Their model is set to answer the following specific questions:

1. What is the nature of human beings: are they good, evil or neutral?
2. What is our relationship to nature: are we subjugated to nature, in harmony with nature, or do we have mastery over it?
3. What is our relationship to other human beings: is it lineal (ordered position within groups), collateral (Groups' goals and welfare take precedence over individuals), or individualistic (primacy given to the individual)?
4. What is our primary mode of activity: is our basic orientation one of becoming, doing or reflecting?
5. How do we view time: do we focus on the past, present, or future?
6. How do we think about space: is it public, private, or mixed?

In this system, culture is defined as the template of variations within a society, or, more specifically, as the template of deep-level values and assumptions associated with societal effectiveness, shared by an interacting group of people. [10]

Table 1. Kluckhohn and Strodtbeck's definition of national culture

Concern/ orientation	Modern- low context	Mixed	Traditional- high context
Relationship with nature; Beliefs about the need or responsibility to control nature.	Mastery: Belief that people have need or responsibility to control nature	Harmony: Belief that people should work with nature to maintain harmony or balance.	Subjugation: Belief that individuals must submit to nature.
Relationship with people: Beliefs about social structure.	Individualistic: Belief that social structure should be arranged based on individuals.	Collateral: Belief that social structure should be based on groups of individuals with relatively equal status.	Lineal: Belief that social structure should be based on groups with clear and rigid hierarchical relationships.
Human Activities: Beliefs about appropriate goals.	Being: Belief that People should concentrate on living for the moment.	Becoming: belief that individuals should strive to develop themselves into an integrated whole.	Doing: belief on striving for goals and accomplishments'.
Relationship with time: Extent to which past, present, and future influence decisions.	Past: In making decisions, people are principally influenced by Past events or traditions	Present: ln making decisions. People are principally influenced by present circumstances.	Future: In making decisions. people are Principally influenced by future prospects.
Human nature: Beliefs about good, neutral or evil human nature.	Good: Belief that People are inherently good.	Neutral: Belief that People are inherently neural.	Evil: Belief that People are inherently evil

This model might help us understand individual motivations, and clarify many elements of individual behaviour alone and in social settings, within and across cultures. [11][12][13][14][15]

TROMPENAARS CULTURE THEORY

Taking a slightly different view, Trompenaars' theory built on his study of Shell and the work of Hofstede', introduced a somewhat different model of culture which separated the explicit and implicit forms of manifestations of culture it is similar to the onion model of Hofstede.[16]

Trompenaars' 3 layers of culture from the outside towards the inside:

1. symbols of the objective, deeper layers, (explicit level)
2. norms, values (that may be both explicit and implicit)
3. axioms, assumptions, efficient cohabitation with the environment, automatic, unconscious, only implicit

Trompenaars Theory focuses on variations in both values and personal relationships across cultures, generally used to understand people from different cultural backgrounds better by helping prevent misunderstandings. It consists of seven concepts of culture.

The first five dimensions of trompenaars model focus on relationships among people, while the last two focus on time management and society's relationship with nature.

The seven dimensions of culture:

1. Universalism versus particularism.
2. Individualism versus communitarianism.
3. Specific versus diffuse.
4. Neutral versus emotional.
5. Achievement versus ascription.
6. Sequential time versus synchronous time.
7. Internal direction versus outer direction.

Trompenaars' dimension of nature shows the general world view of a culture, how people from different countries relate to their natural environment and changes. There are cultures where individuals place the emphasis on peaceful coexistence with the nature, where they consider themselves to be a part of the nature, those cultures are called internal oriented.

The nature of environmentally conscious behaviour is unlikely to deliver instant personal benefits or pleasure, but rather a future oriented outcomes (e.g., a cleaner environment) that often benefits society as a whole.[17] In this context, individual's value orientations (e.g., person's cultural values, ethical, and political values) have found significant relationship to human behaviour. Homer & Kahle (1988) have pointed out the relationships between personal values, attitudes, and environmentally conscious behaviour.[18]

So it can be said cultural values and dimensions are important for shaping individuals' view about the world. It is shared by all members of a social group and shape one's attitudes and behaviour. Kluckhohn and Strodtbeck (1961) Which means cultural differences may vary and these basic cultural differences can apply a profound influence on the way in which the members of the culture think and act. These differences reflect whether the extent to which a culture values the individualism over the collectivism, whether the culture is past or future oriented, and whether the culture is masculine or feminine in its orientation.[8]

As cultural diversity exists among nations numerous models were made to describe cultural orientations such as people's relationship to nature and the world; their relationship to other people, their primary type of activities; and their orientation in time and space.[19][20]

Studies indicates that different cultural backgrounds may have different environmental attitudes and behaviour (environmental attitudes and behaviour mean predisposition behaviour that consciously seeks to minimize the negative impact of individual's actions on the natural world).

Among the different cultural values, the following part of the study focus on collectivism concern based values as the most common variables for any society.

Individualistic cultures, individual goals are considered as more important than group goals and in collectivism cultures group goals are more important than individual's goals.

Triandis (1989) denote that in collective cultures, entities are expected to participate in group activities and cooperate with the group, and individualistic cultures, individuals tend to have an identity of the group. [20]

On the other hand, Hofstede (1980) has implied that collectivistic cultures can be seen as affiliation, admiration, and status which tend to be one of the main drive of individual behaviour. He really thinks that collectivism emphasizes interdependence, in group harmony, family security, group oriented goals, social hierarchies, cooperation, and law of competition.

Kim and Choi (2005), argued that people in collectivistic culture are more likely to develop environmentally friendly attitudes as they tend to determine cooperative behaviour, help to others and give priority to the goals of group rather than their personal goals.[21]

Based on the above arguments this proposed that people who are more collectivistic are likely to be more concerned about the environmental issues than people who are individualistic. Therefore, environmental concerned significantly differ between the collectivist and Individualistic culture.

3. METHODOLOGY

For this study, online questionnaire was used to investigate Hungarian youths' opinions and evaluation of environmental awareness in their own daily routine. The online survey has been initiated and circulated (via google drive) essentially among students in Hungary. The online quantitative survey consists of 17 questions on required fields. The collected data have been analysed using SPSS 20 program. In addition, descriptive statistics, an independent t-test was run in order to explore the relationship/ correlation between the variables.

Since there were only 87 persons who filled out the online questionnaire (39 males and 48 females), expressing their opinions of environmental awareness. Compare to the Hungarian population this sample is a small one. Hence, we cannot consider this sample as representative, so all of the relationships described below are seen as indicative, rather than evidential statements.

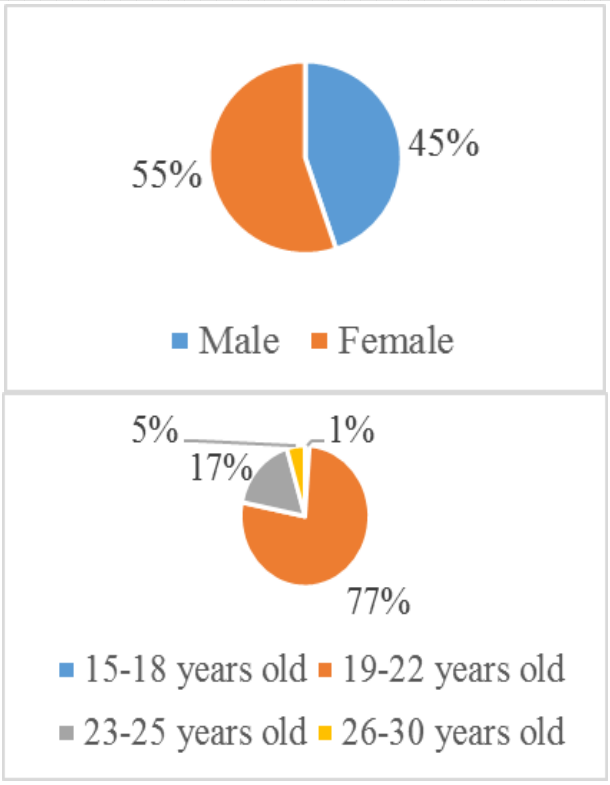

Figure 1. The respondent's distribution by gender and age

The sample included 1 answers from 15-18 years-old students, 67 responses from students in the age group of 19-22, 15 from the 23-25 years-old students and 4 from students' who are 26-30 years-old.

For the question about whether "*Humans have the right to modify the natural environment to suit their needs?*" 47 respondent agree with that statement. Based on the Trompenaars' model, it is referred more than a half of our respondents' relationship with the environment is internal.

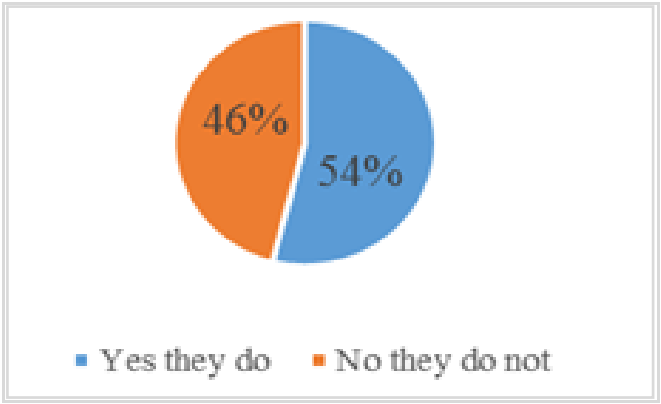

Figure 2. Respondents' opinion about whether humans have the right to modify the natural environment to suit their needs.

However, at the same time we receive controversial answer for the following question "*Please indicate how much you agree or disagree with following statements when humans interfere with nature it often produces disastrous consequences.*" 76 respondents agreed and only 11 of them disagreed with the mentioned statement above.

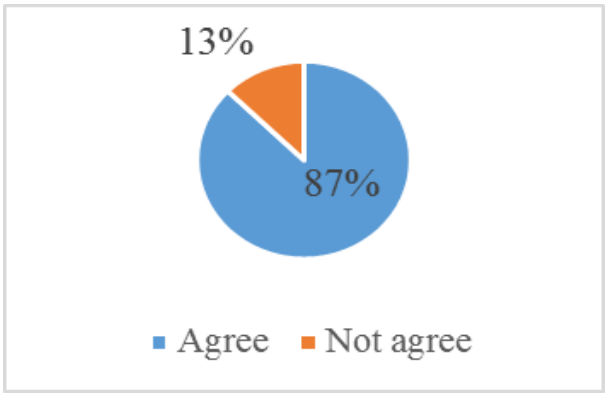

Figure 3. Respondents' opinion about human should not interfere natural environment

Furthermore, most of them are rarely enquire about environmental information. Parallel to this trend, teachers/instructors at institutes are seldom motivate or encourage their students to care about natural environment

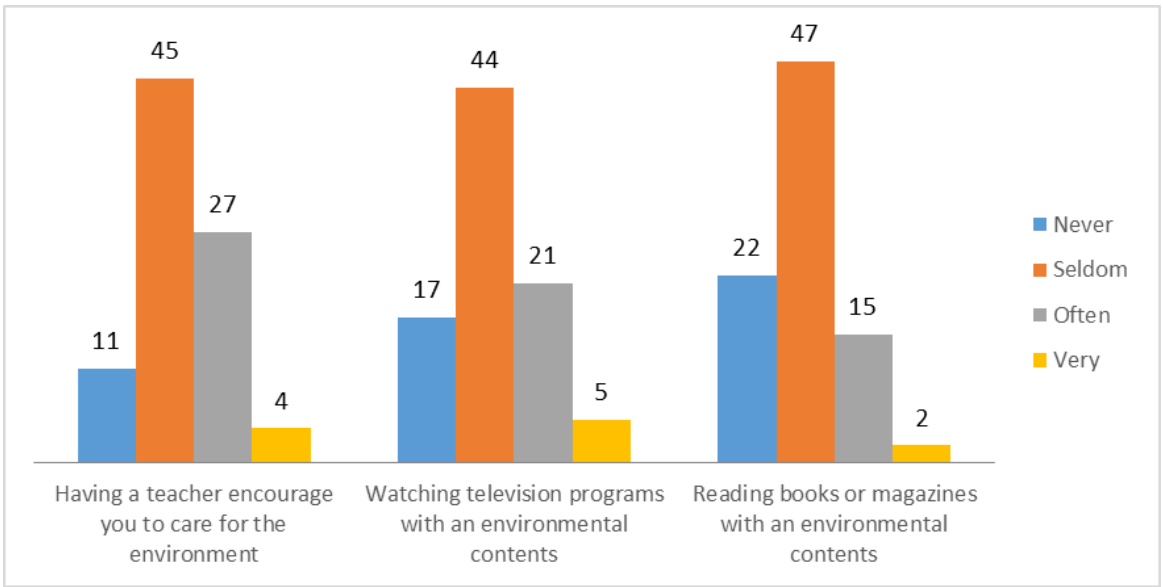

Figure 4. Respondents' habits of gathering information about protecting the environment

These answers suggest that our respondents pay attention to environmental issues and they know exactly what is the consequences, but they do not consider themselves responsible for the evolving hazard.

Nevertheless, most of them take actions to keep their environment safe. Such as sign a petition (71% of respondents already signed a petition before), 62% of them joined an action group or attend a meeting and last but least 57% of respondents took part in a protest.

We used the independent t-test to determines whether there is a statistically significant difference between the means in two unrelated groups. Since Levene's test Sig. values is 0.008 and 0,042 which means both of the values is less than our alpha of .05 ($p < .05$) hence, we reject the null hypothesis (no difference) for the assumption of homogeneity of variance and conclude that there is a significant difference between the two group's variances. That is, the assumption of homogeneity of variance is not met.

As it is displayed in the Table 2, participants who think *humans interfere with nature produces disastrous consequences* had statistically significantly lower willingness to take action in order to protect the environment (0,58[1] and 0,61 ± 0,152 and 0,152) at the end of the experiment compared to participants who are arguing that statement (0,73 and 0,73 ± 0,152 and 0,152), t(13,5) = 0.97, p = 0.346 and t(13,42)= 0.804, p= 0.435

Table 2. T-test for Equality of means

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Complained to the company/person causing the damage	Equal variances assumed	7,385	0,008	0,932	85	0,354	0,148	0,159	-,168	0,465
	Equal variances not assumed			0,976	13,498	0,346	0,148	0,152	-,179	0,475
Joined an action group	Equal variances assumed	4,283	0,042	0,773	85	0,442	0,122	0,158	-,192	0,436
	Equal variances not assumed			0,804	13,424	0,435	0,122	0,152	-,205	0,449

When humans interfere with nature it often produces disastrous consequences		N	Mean	Std. Deviation	Std. Error Mean
Complained to the company/person causing the damage	Disagree	11	0,73	0,467	0,141
	Agree	76	0,58	0,497	0,057
Joined an action group	Disagree	11	0,73	0,467	0,141
	Agree	76	0,61	0,492	0,056

Source: own data

[1] 0= they have not taken any actions in order to keep the enviroment safe, 1 = they have taken actions in order to keep the enviroment safe

4. CONCLUSION

In this paper we presented Kluckhohn and Strodtbeck's, Trompenaars's national culture models. Based on our examination, in the context of Kluckhohn and strodtbeck's model we found that our respondents' relationship with the nature is a mastery one. Which is connected to Trompenaars' findings about Hungarian internal oriented behaviour.

Although our respondents are aware of the negative effect of natural intervention. Through their culture drive they take the environmental problems that they can modulate and/or control it.
The solution of this issue might be the motivation and incentive environmentally activities from the instructors or teachers at their institution (elementary schools, high schools and universities).

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EFFECTS OF ECOLOGICAL AWARENESS THROUGH THE EVALUATION OF SCIENTIFIC CONTRIBUTION

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Abstract

Raising ecological awareness can be achieved by education concerning environment among all segments of society, leading to changes in environmental awareness with permanent, positive behavior. Individuals who are aware of environmental issues have a need for education and in the search for solutions to these issues - they include teachers who have sufficient knowledge and experience and who know that ecological education is extremely important. This paper is a contribution to the literature in the field of environment and it is comprehensible to a wide circle of those who are engaged in various scientific and professional fields. The starting point in finding a solution to the problem lies in raising environmental awareness of individuals on environmental issues. Therefore, education as well as aspects of science should have a key role in raising awareness of the population, and should be consulted in the development and positive attitude. In this study in overview of the possibility of raising environmental awareness a comprehensive review of scientific research, production on this issue was being made. The significance of science in solving this problem is highlighted through number of published publications.

Keywords: Environmental Awareness, Science, Environmental Protection

1. INTRODUCTION

In the last decade of the last century, there was a large scientific and technological development which faced humanity with a number of crises, particularly the environmental crisis, which because of its importance, takes a special place. Endangering the living and working environment causes a high degree of risk, which not only puts the ecological balance of the ecosystem in question, but at the same time it also endangers even the survival of the human race. For this reason there is a need to increase the environmental awareness of the population, while science provides a significant framework of action as well as the theoretical basis for the development of eco-efficient method with the dominant using features.

The science of the environment is interdisciplinary natural science, although many consider it as the interdisciplinary science (which is by no means strictly a natural science, but it also has elements of technical, biotechnical and social sciences).

Environmental Science deals with issues such as climate change, the protection and conservation of nature, biodiversity, water quality, water pollution, land pollution, use of natural resources, waste management, sustainable development, air pollution, noise pollution, natural disasters, risk management, remediation methods and others.

The simplest definition of the environment can be represented as the external environment in which all living things live and maintain their lifelong relationship [1]. The environmental management as a science, essentially represents a new concept for solving ecological problems of our age, or age of many local ecological disasters that threaten global destruction of healthy environment and whole biosphere. The importance of environmental protection is an issue that has emerged as an imperative and takes an important place in modern society. Protection of the environment and its improvement are one of the most important challenges which modern society is facing. The rapid scientific and technological development, application of new and powerful sources of energy, construction of a large number of industrial facilities, the creation of large urban areas, have led, particularly in recent decades, to a conspicuous degree of pollution of basic living natural resources as well as to a distortion of harmony between man and the environment, and a serious threat to the natural conditions necessary for the preservation of the environment, which ultimately puts the survival of the humans into question. One could even say that a threat to the environment at the same time is a disease of modern society, which initiates a completely different role, i.e. action of man in the world that surrounds it.

The problem of the environment, from the beginning of the industrial revolution, in many areas of society is one of the most popular topic [2]. Environmental problems that started threatening humanity and the planet, are especially conspicuous in the second half of the 20th century. However, new prospects both in the mutual relationship between man and nature and in their interpretation emerged.

The starting point for finding a solution to environmental threats is to raise the awareness of individuals on the environmental issues. In order to raise awareness of individuals it is necessary to develop the knowledge, values and positive attitudes towards the environment. Therefore, education and aspects of science have a key role in raising awareness on this field, and should be consulted in developing of a positive attitude [1]. Environmental awareness of the individual consists of environmental knowledge, environmental values and ecological behavior. All three components are necessary for true knowledge, appreciation and management of the ecological lifestyle of each individual. Activities in raising environmental awareness should be focused on young people, who can represent the force for positive environmental change in the future, as well as educating them in this field to alter their behavior towards the adoption of environmental values in environmentally responsible action.

The fields of study in the science of the environment are: Chemistry, Physics, Earth sciences, Biology, Economics (the Natural sciences), Law, Sociology, Psychology, Ethics, Politics, Philosophy (Social sciences, humanities-philosophical sciences), Engineering, Agriculture (Technical sciences) Informatics (I.T.) [3], as can be seen in Figure 1.

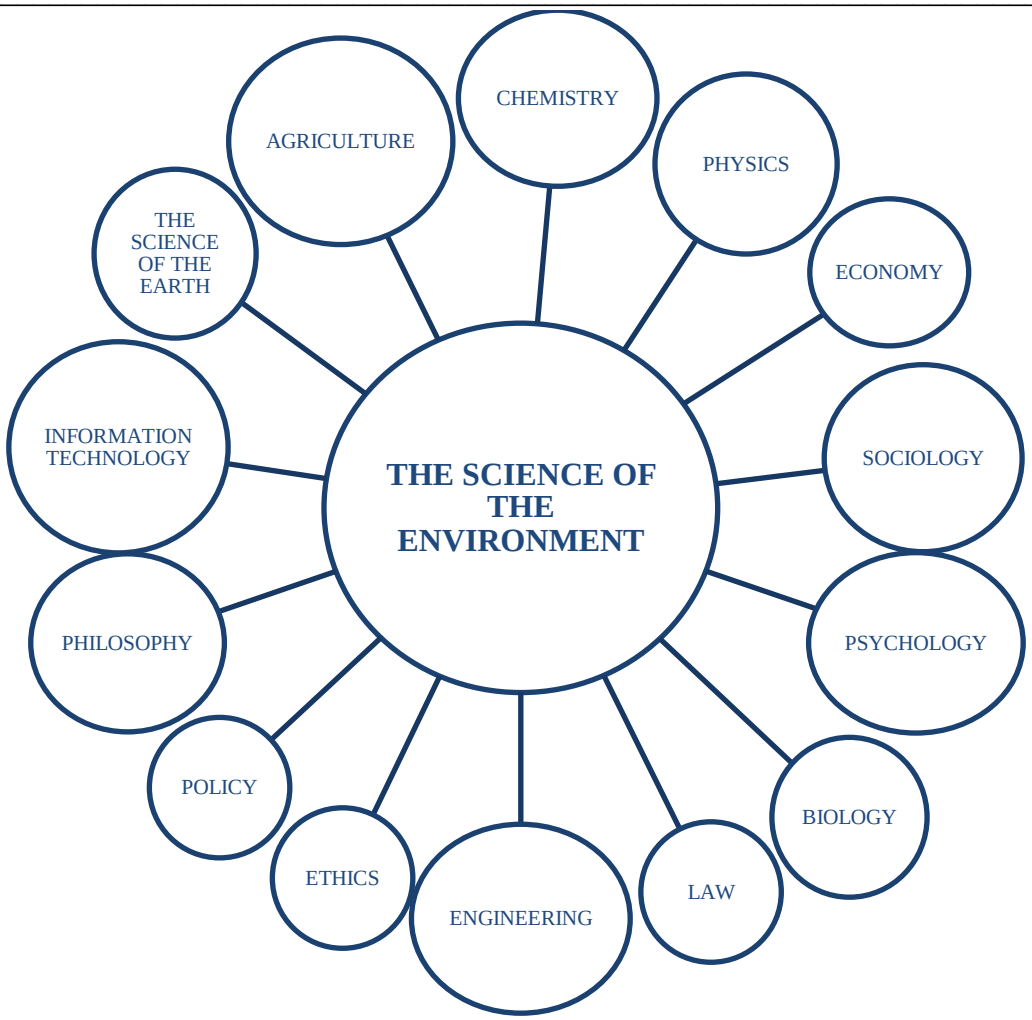

Figure 1. *Field support science on the environment*

As a very important and complex discipline which synergistically operates in the field of various sciences and related scientific fields, which can be classified in: the science of management with Ecology, the Science of the Environment (Biogeochemistry, Geochemistry, Biology in general) with science on the legal protection of the environment; science of technological development and Eco-Technology with biological sciences and legal sciences, the sciences of the state of the environment with the social sciences.

Management in function of ecological development is becoming an increasingly important priority for virtually every society, and its principles are accepted globally. In conditions of limited natural resources through the concept of environmental management, linking of economy and ecology is inevitable, as both the economy and ecology are oriented towards development goals of the human kind. [4].

In further text scientific and technological aspects of management science with the ecology will be discussed, where the integration of environmental knowledge with conventional scientific knowledge can manage a specific system most effectively [5], with a reduction of technical and technological influence on the biosphere and the survival of living beings to the minimum.

2. LITERATURE REVIEW

Today humanity faces the problem of their own survival due to increasing pollution. A complex ecological situation occurred also due to the fact that it has been considered for a long time that the basic natural components, which man uses in its production activities, are practically inexhaustible. Nature was equated with the universe: since its resources are infinite man thought he could take what he wanted from nature, exploiting these resources the way he wanted to -and that still air and water would remain in infinite amounts. But this is not the case in reality and the environment has changed significantly over the years under the influence of new technologies.

The science of management with ecology, as an important scientific discipline, has recently studied the influence of economic and technological development on ecosystems, in order to change the current situation of pollution and environmental degradation, using the methods of environmental engineering and legal and economic instruments in accordance with existing laws, regulations and international standards with the educating all social strata in line with the concept of sustainable development. It includes knowledge of all the consequences of technological development and the measures which mitigate this influence on the ecosystem.

Protection of ecosystems requires a multidisciplinary approach to solving problems from observing and understanding of adaptive management. Activities are planned in relation to the resources- water and air, biodiversity of urban systems and forests. Significant problems people are facing daily air pollution of arable land and the lack of a system for the treatment of industrial and urban waste water which is being discharged into the river flows. Currently, the significance of the environmental area assessment is primarily focused on one characteristic, whereby the safety of water, conservation of biodiversity and protection of land from erosion are fundamentally important [6].

Some studies have developed method of evaluation to identify new priority areas that meet the desired goals combined with all existing protected areas in the best possible way. [7] .There is a possibility that this method is likely to produce a portfolio with a large number of small and isolated protected areas, but such portfolio is less ecologically and economically feasible. [8, 9] Other studies have addressed the assessment of the degree to which the macro ecological functioning can overcome deficiencies in our knowledge of biodiversity in tropical forests and assist in identifying priority areas for their conservation and management [10].

Through the identification of water security, some scientists [6, 11] analyzed the environmental, social and economic influences of their protection and restoration. Some studies [12] have identified the key areas of erosion, using GIS and Universal Soil Loss Equation (USLE). While some studies on eco-area care more about how to configure eco-space to maintain the security of the regional ecological environment, and for these studies mostly at small watershed scale. To assess the importance of regional environmental space, Chinese scientists have mainly focused on the ecological sensitivity and ecological suitability [13, 14], wherein models for the evaluation of environmental sensitivity were developed.

For assessment of the ecological importance, numerous studies have focused on aspects of the natural ecology, but the results do not reflect the spatial characteristics of regional

ecosystems and maintenance of ecological safety. Based on the analysis of the environmental characteristics, evaluation of environmental importance represents the exploration of spatial distribution of regional environmental importance in order to provide certain measures for the restoration of ecologically security issues of regional development and construction [6].

3. ENVIRONMENTAL MANAGEMENT AND THE INFLUENCE OF NEW TECHNOLOGIES ON ENVIRONMENTAL PROTECTION

Environmental management refers to environmental planning and its focus is on implementation, monitoring, checking and control, as well as the practical issues facing the real world goals in terms of environmental protection (such as, for example, modifying habits that harm human nature) much more than the theoretical planning.

In the age of new technologies, which is represented by scientific and technological development, mankind is mostly faced with an ecological crisis that has taken many dimensions of endangered human living and working environment, but at the same time the basis of the survival of the human race as well. For this reason, this scientific discipline is suitable for research so that problems that arise in practice could be solved from the scientific point of view as well. Although close integration with environmental planning is desirable, field of research of environmental management primarily represents the understanding of the interactive relationship between man and the environment, as well as the application of science and common sense thinking in solving environmental problems.

The negative influence of technology on ecology manifests through constant exposure to hazardous agents and chemicals in the environment. True, there is a certain probability that every individual will suffer negative effects as a result of such exposure. This process was designed by researchers for the protection of the environment and it is shown as a paradigm describing the continuity between exposure and disease [15]. For environmental protection exposure can come from several external sources, including environmental media (air, water and land), food consumption or compounds which are specific for the job or the profession of an individual. Therefore, there is a need to approach this exposed problem from the scientific point of view and thus provide reasonable scientific explanations.

Like in other priority fields for the development of science it is of great importance to establish and strengthen cooperation between scientific research organizations and users of research results. Environmental protection covers almost all segments of the society and therefore for this reason it is necessary to engage all: researchers (multidisciplinary approach to research), relevant ministries, enterprises, local government and others [16].

The aim of this paper is to analyze the environmental awareness from a scientific point of view, whereby significance which care about environmental management in recent years of the 21st century has got, is reflected in the number of publications. In the study statistical review of published works in this field are being presented, where it can be seen the enormous effort which science puts in understanding and solving this problem.

4. PUBLISHED RESULTS IN RECOGNIZED INTERNATIONAL JOURNALS

Consideration of environmental awareness from a scientific point of view is reflected in the number of publications. One of the relevant indicators is the number of published papers within Scopus base [17]. Scopus is the largest base of reviewing literature that has a comprehensive overview of scientific research production in the fields of science, technology, medicine, as well as in the social sciences and humanities, where environmental management belongs . Searching this database by keywords *Ecological Management* resulted in a total of 53,391 publications found, as illustrated in Table 1 and Table 2.

Caring about the environment from a scientific point of view started back in 1940 when the first works in this field were published. After that, due to the outbreak of World War II, which was reflected in all spheres of social activities worldwide, led to stagnation in research activities in this field. However, in this period, scientists have not dealt with this issue. Because of the consequences of war this topic did not occupy the attention of the researchers for some time until 1966 when four works globally significant were being published (Table 1). After that, this trend is slowly starting to grow from year to year and the number of papers had been gradually increasing until 1981 when a total of 66 works were being published. Just two years later in 1983 the number of papers doubled and amounted to 118, which had previously accounted for the highest growth rate. This linear trend continued in the coming years in research activities.

In the following period, environmental management had slowly but surely becoming a profession of individuals and very important factor in business. Operating systems through environmental management saw their better position on the market. As globalization increased, the number of publications increased as well. So in 1995 the number of published papers was 484, and in 2000 it was considerably more - 1026 (number of publications per year are presented in Table 1) - which presented by far the biggest move in science on this then-hot issue of the period.

Table 1. *Number of papers in the period from 1985. to 2000. (Accessed March 15, 2016)*

Year	Documents
1985	129
1986	124
1987	163
1988	179
1989	212
1990	238
1991	369
1992	343
1993	339
1994	405
1995	484
1996	609
1997	704
1998	794
1999	914
2000	1026

Through the environmental management, sustainable development is achieved, which is not only a material precondition for survival of business systems and today's generation, but also the ethical question of civilization honor defense for future generations. In fact, sustainable development means balance between resource consumption and the ability of natural systems to meet the needs of future generations. In other words, sustainable development represents one development that does not lead to degradation and depletion of resources which makes development possible and permissible. Such growth is conditioned by and followed by raising the awareness of the need to preserve and improve the environment which contributes to sustainable economic development. Due to the importance of preserving the environment for the survival of both present and future generations, growing number of researchers paid attention in their research work on this very subject, which is why the number of publications in 2010 increased significantly to 3680 (Table 2). In comparison to 2000 the number tripled.

Table 2. *Number of papers in the period from 2001. to 2016. (Accessed March 15, 2016)*

Year	Documents
2001	1015
2002	1294
2003	1401
2004	1525
2005	1954
2006	2077
2007	2397
2008	2712
2009	3316
2010	3680
2011	4351
2012	4374
2013	4845
2014	4943
2015	4698
2016	**905**

The contribution of researchers in the current period culminated in 2014 with a total of 4943 published papers as graph in Figure 2 shows.

Environmental management is very broad and covers different research approaches, where researchers published results of their research; in the following areas: Environmental Science (31 627 papers), Agricultural and Biological Sciences (23,064 papers), Earth and Planetary Sciences (7 044 papers), Social Science (6 419 papers) and Engineering (4 117 papers).

According to document type of field of Ecological Management on Scopus is available following documents: Article (38 565) and Conference Paper (5 of 7324), Review (4 424) Book Chapter (1 348), Article in Press (598).

The largest number of papers was published in English language (49 165), those published in other languages are in negligible number, considering that most of the leading magazines are English. The largest number of papers published is in the United States with a total of 15 463 works, followed by China with 5 877 works, followed by Australia, England and Canada.

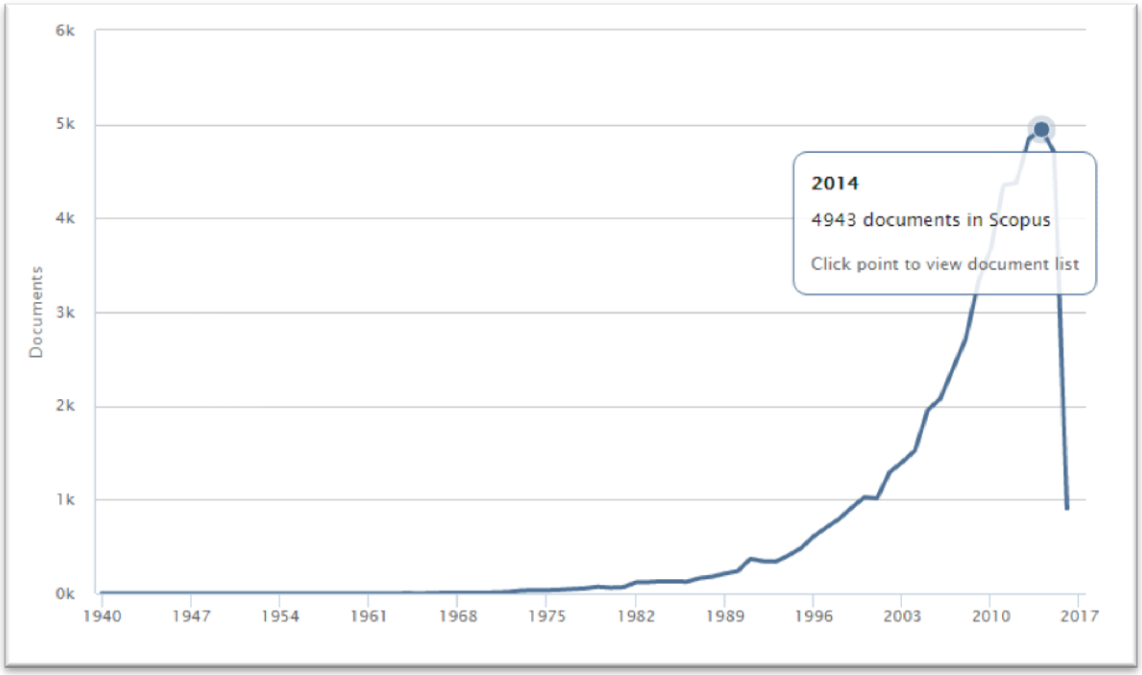

***Figure 2**. Graph of published works' distribution from 1940 to the present*

5. DISCUSSION AND CONCLUSION

Although it can be said that today various issues in the field of environmental protection or in connection with the environment occupy a significant part of the activities of researchers, only until the early eighties (Table 2), science had begun to take a more intensive exploration in this area. This coincides dedication of scientific production to problems of the environment as well as taking appropriate actions by researchers with a tendency towards population awareness.

In order to explain the complexity of the natural components, introducing environmental management as a separate discipline was necessary, which would manage the environmental resources in an appropriate manner to ensure its sustainability. In world, today, a large number of scientists and researchers deal with this theme linking cause and effect relations in this field and demonstrating new ways of solving them, from a scientific perspective [18].

The results of the analysis carried out on the number of publication in the field of environmental management has a progressive trend observed respectively since 1944 - the year of the first publication in this field. With the increasing trend of exploiting natural resources occurred the need for a large number of authors to discuss the results of their research work. Significant year in this research field in the world was 1993, because the number of papers in that year for the first time exceeded one hundred, or more precisely 118 papers were being published. After that year, the number of publications in international scientific journals began to grow in much faster pace. 339 papers were published, which means that the number of published paper tripled. In 2000, the number of

publications topped one thousand (1026). Due to the increasing pollution of the environment which is exposed to human negligence there was a need for a larger number of different solutions in the field of environmental management, which in the first period of the 21st century testifies the rapid increase in the number of works- in 2010 it amounted to (3 680) , in 2014 there was a record of 4 943 papers. Researchers from different countries deal with this topic, but the most numerous researchers are from the United States.

Assessment of the influence on the environment enables environmental factors to become fundamentally important and to be equally considered with economic and social factors for further sustainability plans [19]. This helps promotion of the sustainable way of the environment's physical development.

Development without violation of the environment is the motto which is embedded in the environmental standard and widely used around the world. Many international and regional conventions seek commitment to it, therefore, environmental management is a prerequisite for environment and man to be in touch. The men with their scientific contribution tend to improve environmental protection and ecological awareness of individuals.

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ENVIRONMENTAL ASPECTS OF CORPORATE SOCIAL RESPONSIBILITY

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Abstract

In the submitted scientific contribution the authors deal with the issue of the need of finding a balance between the economic, social, and environmental interests when operating a business activity in the territory of Slovak Republic. It is exactly the awareness of entity's own existence as a part of a complex system of diverse relations, which are not only connected to the line of business, but extend also to the unknown third parties, that leads to the elimination of issues such as global air pollution, separate waste collection or decline of biodiversity. The growing demands for responsible business practices are thus becoming an integral part of strategic management of trading companies. A part of this scientific contribution is also an approximation of actual trends forming public opinion concerning ecological innovations and the perception of environment-friendly products labelling in the purchase decision-making process.

Keywords: Corporate social responsibility, competitiveness, sustainable development, environment, environment-friendly product

1. INTRODUCTION

The business environment is nowadays typical for being highly unpredictable and volatile, mainly due to persisting negative impacts of the world economic crisis on society. Business entities as well as national legislators are striving to create favorable conditions for maintaining the balanced and sustainable development of industry. The necessity of a change of mindset in business, in the single European market, often requires redefining the existing rules or adoption of completely new instruments, which are used to achieve higher efficiency of human resource management system. From the long term perspective, companies without the necessary reflection are not able to permanently perform in a high level of profitability in the social environment, which is characterized by the occurrence of serious adverse phenomena with significant social impact. This is true especially in a situation where companies as such are regularly their main cause. As a result, foregrounded are mostly the relationships between stakeholders in specific sectors and existing forms of their in-house policy in planning, realization and control of the performed activity. As being beneficial for the public can be considered especially those business strategies, which not only promote economic growth of the company, but also contribute to the improvement of working conditions for employees or to the current state of the surrounding marketing environment. Implemented measures may also lead to an increase of public awareness about the benefits and possible risks associated with the production of goods or provision of services. Compliance with the principles of corporate social responsibility (hereinafter referred to as "CSR") provides organizations with the opportunity to achieve outlined considerations.

2. PRIMARY FOCUS AREAS FOR SOCIALLY RESPONSIBLE ACTIVITES

The reasons for incorporation of CSR into the business structures and in the third party policy can vary for individual business companies. They can be a result of personal beliefs and moral values of company management, or they result from rational thinking with aim to indirectly support the stability and economic power of the company. The spreading of theoretical foundations and practical experience is supported also by consumer pressure on industrial companies, which has roots in consumers' interest in getting relevant information related to e.g. technological processes and materials used for production of the offered goods. CSR can be characterized as "continuous and voluntary commitment of business entity to behave ethically, contribute to sustainable economic development and to environment protection, take care of improving the quality of life for its employees and their family members, as well as for the local community and society as a whole". [1] Identification of individual tasks depends on strategic plans of the entity, area of its operation in the marketplace and existing legal framework, which can help in setting the minimal degree of activities corresponding with the provided definition. Respecting the law and moral practice alone do not make the business socially responsible (everyone without exception must respect the law). Decision-making and acts of a business should therefore aim to meet not only the requirements contained in legislation (as its primary duty), but also to attempt to implement further similar activities in favor of the public interest on the basis of its own autonomous will. The aim is to maintain continual growth and progress that would be able to efficiently satisfy the existing needs, without endangering the opportunities of future generations to profit from the societal goods.

A business convinced about the importance of CSR perceives its role in a much wider context than just only getting the maximum profit. [2] Its management prefers the long-term optimal profit to irregular and short-term revenue. It defines new tasks aimed at increasing safety standards in a workplace, improving citizen awareness in field of respecting fundamental human rights and freedoms, or supporting international programs and initiatives targeting improvements to standard of living for citizens, or maintaining the natural resources. Definition of CSR can be summarized as intersection between the applied economic, social and environmental policy, placed beyond the legal framework and presented as a comprehensive strategy.

3. LEGAL DIMENSION OF CORPORATE SOCIAL RESPOSIBILITY IN THE SLOVAK REPUBLIC

Despite the fact that the concept of corporate social responsibility is in the original Member States of the European Union already relatively well established institute, in the Slovak Republic, with a reference to the historical and economic development of the country, it is developed only in a very limited way. The public regularly interprets the term CSR as philanthropy. The primary determinant lies not only in the economic issue related to the lack of available resources, which enable different approach to solving incurred situations, but also in existing inadequate understanding of the importance of customer (consumer) for the economic success of the company. Therefore, CSR traditionally appears primarily in companies with foreign capital, adopting management models from the parent company (possibly with the help of their capital), which are well established in other countries. CSR has limited scope in the Slovak Republic also with regard to the different

areas in which its application is stated. Generally, it focuses exclusively on environmental and consumer issues, or issues of working conditions of employees.

Similarly to its practical implementation, the legal bases for the concept do not represent a more significant shift in the application of CSR in the Slovak Republic. The National Strategy for Sustainable Development, approved by resolution of the Government of Slovak Republic under No. 978/2001 Coll., can be considered as the basic document on CSR. The National Strategy for Sustainable Development defines the key strategic objectives and criteria for assessing sustainable development in the Slovak Republic. Following the national strategy, several action plans and strategic documents for individual areas have been adopted, e.g. The Action Plan for Sustainable Development in Slovak Republic, The National Strategy for Biodiversity Preservation until 2020. Currently, there is in force the document aimed at strengthening the so-called information society and sustainable development named The Horizontal Principle of Sustainable Development 2014 – 2020. The problem these actions are facing come the fact that there were no dedicated financial resources for their implementation and the proposed measures were expected to be put into practice within the budgets of individual ministries, to which they belong. In practice, this means there are no subsidies dedicated to CSR, as the ministries utilize the allocated budgets for their own operation rather that for supporting voluntarily socially responsible activities of businesses.

The outlined legal framework is marginally complemented by the adopted National Program of Reforms in the Slovak Republic. In the document approved after the parliamentary elections held in 2016 is mentioned: "*More efficient decision-making will be aided by creation of Environmental Strategy, Low-Carbon Strategy, and Analysis of Implementation of Tighter Reduction Targets until 2030. Overview of reduction potential of various measures and estimated costs for their implementation will be included in the Low-Carbon Strategy of Development until 2030.*" [3] The reform program counts for the future with supporting the usage of renewable energy sources (national project Green to Households targeted mainly at installation of small devices and subsidized from European and state sources with 115 mil. EUR). In accordance with the program, The Government of the Slovak Republic undertakes to support the development of electric cars, mainly by supporting the building of necessary infrastructure. The reform program also covers areas aimed at increasing energy efficiency, building energy connections between countries, waste management and circular economy.

In the legislation on corporate social responsibility, the division of competences among the individual central government authorities was until recently non-conceptual and fragmented. Original authority that should provide standardization and coordination of actions in the field of CSR until March 2011 was the Government Council of the Slovak Republic for Sustainable Development. By resolution of the Government of the Slovak Republic No. 135/2011, all of its competences passed to newly created Ministerial Council, which represents an inter-ministerial consultative, advisory, active and coordinating authority of the Government of the Slovak Republic (led by the Prime Minister of the Slovak Republic). CSR agenda is to some extent covered also by the Government Council of the Slovak Republic for Human Rights, National Minorities and Gender Equality, which since March 2011 took over the competences of the Government Council of the Slovak Republic for NGOs, the Government Council for Seniors, the Government Council for people with Disabilities, the Government Council for Gender Equality and the Ministerial Committee for Children. [4]

In terms of differentiation of professional competence of individual ministries, some measures in the area of CSR also fall under the Ministry of Labor, Social Affairs and Family (social inclusion and social exclusion, working conditions of employees), or under the Ministry of Environment in addressing various environmental issues and popularization of environmental responsibility.

Despite the existence of several state bodies overseeing the corporate social responsibility, the key actors in promotion of CSR are considered to be the non-governmental organizations, which mostly independently engage in informational activities regarding the promotion of CSR, organize seminars and conferences, give awards, coordinatively and methodologically support companies in implementing CSR or issue relevant publications. The most significant ones include e.g. Centre for Philanthropy, Integra Foundation, the Pontis Foundation and the Institute for Economic and Social Reforms. The most significant achievement within the activities of non-governmental organizations can be also considered the establishment of the Business Leaders Forum, which brings together companies following the CSR principles. The founding members of this association signed a Memorandum of Corporate Social Responsibility, thus declaring their interest to voluntarily integrate the set of principles reflecting social, ethical and environmental aspects of business into their corporate strategy and also inspire other entities operating in Slovakia to socially responsible actions. [5]

The existing gaps and space for improvement and solving of the current issues are continually subject of international talks and summits. To a great extent, Slovak legislation is also subordinate to other legislations, mainly to legislative initiatives by organs of the European Union. The latest conference aimed at common management of development and sustainability, was the conference COP21 – CMP1 held in December 2015 in Paris. Among its attendees were the Prime Minister Róbert Fico and the then Minister of Environment of the Slovak Republic Peter Žiga, who both by their presence confirmed the interest to participate on so-called Paris Agreement, which from 2020 will replace the Kyoto Protocol.

4. PROTECTION OF ENVIRONMENT AS PART OF CORPORATE SOCIAL RESPONSIBILITY APPROACH

Problems of creation of environment and its protection currently belong to one of the most serious societal topics. There is still an unfavorable situation in the field of excessive air pollution, rising production of municipal waste or high noise pollution on the population. Seizure of land for construction of new residential units and the risk of environmental accidents in most cases has repeatedly threatened the biodiversity of the environment. So the public interest heads towards the restoration of ecological balance and restoration of harmony between man and nature.

Rational use of natural resources is becoming a decisive factor for the expression of living standards and conditions for the overall development of society. Urgent appears to be a requirement for a radical change in consumer lifestyle, simplification of production processes and abandonment of senseless waste of raw materials. However, the relatively small number of companies with active ecological policy is getting into contrast with the majority, who do not attach much importance to the issue. [6] Yet everybody will in the future directly feel the impact of environment degradation. Selected solutions from the competent must therefore be purposeful, comprehensive and systematic. Finding universal

principles leading to the target is impossible without the support of the public debate about the nature of *welfare* in society. [7] Important is the ongoing dialogue between the leaders of the country, its people and business sector. Despite the fact that economic growth associated with the acquisition of material goods is part of the development of the entity, it can never be itself the sole aim. Subsequently, the basis for social welfare seems to be creating optimal conditions for the growth of personal qualities of an individual with an emphasis to dignified and fulfilling life (as well as securing future generations). We must learn to accept, evaluate and subsequently use the information in such a way that we protect the unique structure and diversity of natural systems on which the human race depends.

The influence of individual industrial sectors on environment differs based on the type of manufacturing, type of provided service, or used technology. Despite the fact that often there is no other solution than to cope with the existing conditions, we need to relentlessly seek for efficient measures for subsequent regeneration process and preservation of nature. In general, businesses try to retain the produced harmful substances, remove the caused issues, and prevent their future occurrences. Here arises the opportunity to repeatedly process the waste as a co-called secondary material (recycling) as a part of ecological manufacturing of products in line with internationally recognized standards (family of basic standards of environmental management ISO 14000, system of environmental management and audit EMAS, and others). Modernization of processes leads to economical usage of electric energy and preferring the renewable natural resources. A difficult task get to the foreground: to compose optimal relation between the admissible level of immediate consumption and long-term gradual usage of ecological materials.

The environmental policy of business entity can after all result in obtaining the right to label the final product or service with a special sign that notifies consumer about the responsible business activities of the company. The label is placed on a visible part of each product, because such goods is subject to strict rules of certification and control and guarantees the high quality and environmental-friendliness. In the Slovak Republic, the ecological goods are labelled with national environmental label "*Environmentally friendly product*" and manufacturers can also request to obtain the European label "*EU Ecolabel*" (also known as "*European flower*"). There are also other popular certification systems with special focus, such as national or European label for plant and animal products created in ecological agriculture (so-called bio-products and organic food).

Ecological aspect of CSR brings several provable positives to businesses. The implementation of innovative management forms, cost savings together with wise economic activities, as well as revealing the new business opportunities are becoming the pre-requisites for increasing their market value. In practice, we paradoxically see the situation, where the bigger is the total contribution of selected area to society, the smaller is the willingness of authorities to identify the negative impacts on environment and fight against them.

5. CONSIDERATION OF ENVIRONMENTAL ASPECT IN SHOPPING BEHAVIOR OF SLOVAK CUSTOMERS

Presented output is the result of the empirical research conducted on a sample of respondents living in the Slovak Republic. Its realization in the form of a questionnaire and structured interviews was focused on finding relevant data regarding relationship between consumers' shopping behavior and the current offer of green products on the market. Research statistical sample was formed only by respondents addressed on the so-called random selection. In summary, there were 452 questionnaires distributed among the consumers throughout the Slovak Republic. Total return rate of completed questionnaires was 86.3%. The achieved percentage of returns may be considered unusually high and the actual realization of the data collection as successful. We believe that the presented results are not only related to the sample of respondents, but have potential to outline more general conclusions and tendencies in shopping behavior.

To the final processing and evaluating of the survey results were finally included all 390 returned questionnaires. It was possible because of the responsible approach of all who participated in this empirical research, as well as because of their willingness to fill in this questionnaire properly and truthfully. A significant contribution to the smooth running of empirical research has understandably the interviewer, who provided additional information to interested parties, in particular in relation to the criteria of inclusion into the sample, filling rules or the use of the collected data. With regard to the differentiation of respondents according to their sex, it may be noted that the research was attended by 58% of women and 42% of men, especially of economically active population. At the same time, they were respondents in the range from fifteen to sixty-two years, who are expected to participate in public life and they have an adequate financial resources to engage in the surveyed activities.

Everyday human activities carried out in the environment where we live or spends time clearly relate to our ability to take the responsibility for any impacts that arise. Therefore, we were interested in our survey in the opinions of respondents regarding the purchase of environmentally friendly goods with regard to the used manufacturing process or the proposed way of consumption. The so-called level of engagement, respectively consumer interest in environmentally friendly products, has reached a limit of 72% of respondents. The other 18% of respondents were not able to take a clear position on the question raised. We believe that especially the deteriorating climatic conditions affecting quality of life encourage consumers to change their economic behavior on the market. People are beginning to increasingly worry about increasing the value of their own finances, as well as public finance management. A positive finding is that almost 85% of respondents expected from Slovak producers and sellers of goods active environmental policy towards the offered range of products. In practice, unfortunately, businesses often do not care about the quality and origin of products encountered by customers on the shelves of their stores. Consumers themselves often do not know how to recognize whether the product is really an ecological one. More than half of respondents (57%) do not know or have not yet encountered an environmental label on the product. The research also pointed on the relatively strong dissatisfaction of respondents (66%) with the location and amount of information available on the packaging of products that should emphasize the respectful treatment of the environment in their production and subsequent consumption. In

particular, older consumers often do not understand the simple graphic indication (without further explanation), and therefore they do not pay special attention to this product group.

A basic pre-condition for successful mastering of this deficiency is to raise public awareness. Social communication through the media is significantly involved in shaping its value system. Only 5% of respondents think that the media in Slovakia sufficiently present environmentally friendly products. 24% of respondents did not know how to answer this question. We must realize that the role of the mass media is only to mediate prepaid content to the potential customer. The very structure of the advertising message depends entirely on the outlined requirements by the advertiser, who is usually in a role of a producer of the product. He unfortunately regularly favors promotion of the goods associated with presenting relatively unrealistic visions of life with intention to immediately increase the sales volumes. As a result, his decisions are repeatedly becoming the bad and even worse concepts that rarely represent needed change.

The results of the survey also showed that more than three quarters of respondents (78%) are willingly prepared to educate themselves on environmental issues with intention to acquire new knowledge on the fundamental principles of rational use of natural resources and reducing consumption. More broadly, it is about developing and understanding necessary transition to sustainable development of society, which allows continuous monitoring of interactivity and dynamics in the relationship between man and nature. It is important to find a mechanism that integrates not only the prescribed minimum in the form of notice to ecological product or recommended procedure of consumption, but would also provide the space to general public for sharing their individual experience, interesting ideas and good tips when working with purchased goods. It is well-known that when the public participates on any project, this increases the likelihood of its positive acceptance.

When assessing the current state and progress of sustainable development in the Slovak Republic, we must also keep in mind that the final shopping decision of an individual is at the same time affected by several factors. We can only guess the reasons why consumers prefer one product to another. However, we believe that especially undesirable consequences of the global economic crisis are the cause of their much greater alertness and vigilance when entering into business relationships. It is understandable that because of an ongoing unfavorable social situation, many people primarily seek refuge in acquisition of an economic benefit. According to our findings, an average Slovak with an average salary, in the selection of the goods in the store pays attention primarily to product price (74%), subsequently to brand of the product, which corresponds to the subjective perception of quality (46%) and only then he pays attention to other characteristics, such as operating costs (40%), the material used to manufacture the products (18%) or the possibility for ecological treatment of waste (14%), and others. Previous arguments regarding affection of consumers to ecological products and green innovations are unfortunately finally marginalized in favor of seemingly outwardly saving measures concerning the volume of initially incurred expenses. Change can be expected only in case the overall living standards of the population improve in the coming years.

6. CONCLUSION

The persisting negative impacts of the global economic crisis repeatedly point to failures made by lack of respect of moral values in interpersonal relationships and with the relatively isolated development of entities in economic market in the past. The growing demands on responsibility in business are becoming inseparable part of company management in order to secure the integrity and stability in the times of strong competition. Implementation of the principles of social responsibility into practical execution of business activities of entities on economic market represents long process that is not only determined by the potential economic costs, but especially by the complexity of legal regulation at the national and European level. Moreover, the reflections on acceptable solutions to the problems related e.g. to environmental protection are no longer only part of ecology, but also have been dealt with within economics, geography, philosophy or law. Understanding the interdependence of human progress with existing resource constraints of our planet is becoming a standard belonging to general education and the maturity of any nation. Man must rediscover the "lost" respect for nature, which has over the years considerably fallen under the influence of his selfishness and arrogance. Knowing the relevant connections contributes to the re-assessment of planned interventions in the natural environment, as well as to the prevention of disruption of its equilibrium. The important thing here is that the corporate social responsibility will not be manifest itself only in formal actions, which have only declaratory character.

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CORPORATE SOCIAL RESPONSIBILITY: ENVIRONMENTAL ASPECTS

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Abstract

Corporate Social Responsibility (CSR) is a new business practice that reflects the idea of fulfilling both economical imperatives and social consequences of business. In recent years this topic has spread among businessmen, scientists, politicians, customers and NGOs. The purpose of this paper is to determine and explain the dimensions of CSR while focusing on the environmental issue of the topic. Companies, nowadays, accept their responsibility for the negative environmental impact of their business activities so they try to change the way of doing business in order to mitigate the damage. It is always the question of whether companies are taking CSR action because of the need to act proactively, because of image, or imposed by the law. Methodology of research is based on literature review of European legislation and previous researches about implementation of CSR.

Keywords: Corporate Social Responsibility, environmental impact

1. INTRODUCTION

The main purpose of companies is making profit, "the business of business is business", according the Friedman's view [1]. Is the profit the only purpose of it? Can a business exist without consumers, resources, society? Therefore, do the companies have a responsibility to make positive influence on the surroundings in order to provide conditions for better business? Should companies make decisions about additional activities by themselves or should those activities be stipulated? Are the consequences of those actions justified? In recent years companies have been viewed as major cause of social, environmental and economical problems [2]. Internal stakeholders may have some doubts about sacrificing profit for social interests. On the other hand, external stakeholders and society put a lot of pressure on companies to do their operations transparently and do not operate in a harmful manner. The answers to those questions are given through Corporate Social Responsibility (CSR).

The term Corporate Social Responsibility (CSR) came into common use in the early 1970s and it refers to a form of corporate self-regulation [3]. Although the CSR is concept often mentioned, there is no definition of it that is completely accepted.

In July 2001, the European Commission presented a Green Paper "Promoting a European Framework for Corporate Social Responsibility" [4], CSR is "a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis". The goal is to manage CSR activities in a strategic manner and to set the instruments and measurements for this.

Business for Social Responsibility (BSR) defines CSR as "…operating a business in a manner that meets or exceeds the ethical, legal, commercial and public expectations that society has of business [5].

All definitions of CSR can be compiled and presented through five dimensions of CSR [6]:

1. **The Environmental dimension**, which refers to the natural environment and sustainability of business practice.
2. **The Social dimension**. This dimension refers to relationship between business and society in general.
3. **The Economic dimension**. Refers to socio-economic or financial aspects, including describing the CSR in terms of its impact on the business operations.
4. **The Stakeholder dimension**. Refers to consideration of all stakeholders or stakeholder groups.
5. **The Voluntariness dimension**. This dimension refers to actions not prescribed by law. Actually it can be described as doing more than is required by law.

International Organization for Standardization ISO 26000:2010 provides guidelines on how businesses and organizations can operate in a socially responsible way. This means acting in an ethical and transparent way that contributes to the health and welfare of society. There are seven core subjects, which ISO 26000:2010 is considering:

1. Corporate governance and management
2. Human rights
3. Labor conditions
4. Environment
5. Fair enterprise
6. Consumer care
7. Involvement and development of local community [7].

In most cases the responsibility for a negative impact and irresponsible company's behaviour is being attributed to large companies while neglecting SME sector. The fact is that SMEs are a very important part of the economy, as they represent around 99 % of all enterprises and employ an increasing number of persons [8]. Concerning this, it can't be neglected that SMEs could have a potentially high impact on the environment if the nature of SMEs' industrial activities were taken into account. SMEs in most cases were not covered by laws and regulations of mandatory reporting on the impact on the environment. A lot of companies in Europe already apply a good social and environmental practice,

particularly SMEs, without precise knowledge of the concept. The benefits from CSR are not easy to measure and SMEs do not use them systematically and do not pull out value from their engagement, which could pose a serious barrier for broader recognition of CSR value. Large companies undertake formal CSR strategies more, while SMEs increasingly introduce environmental management systems but the solutions are not often implemented [9].

Another important question is whether companies are implementing CSR practices because of the rules and regulations or because of altruism. Companies often use CSR practice to gain better public opinion about their practice, and not with an honest intention of acting good. Numerous scandals have revealed deceptions and provoked that different external groups put pressure on companies to establish patterns and rules for proper practice of CSR. Due to a pressure from stakeholders that companies be more transparent about the company's business, some legislations and obligatory reports are being laid down. CSR benchmarks against which the social and environmental performance of businesses can be measured and compared are useful to provide transparency and facilitate an effective and credible benchmarking. The interest in benchmarks has resulted in an increase of guidelines, principles and codes during the last decade [4].

Environmental CSR activities cause additional expenses for companies and financial benefits of them are not immediately visible and easy measurable. A large number of researches have a goal to investigate connections between environmental CSR activities and their economic performance and public opinion. Some results show that business-environment trade-offs have positive impact on economical results in companies [10]. Other authors criticize these results because they find that companies do not sacrifice their profit for environment protection on voluntary basis, because there is no positive connection between present expenses and later gains [11]. External stakeholders insist that companies apply the environmental standards in their operation. They are expected to take responsibility for current activities and do not jeopardize the needs of future generations. Porter and Linde suggest that in a broader sense, CSR environmental activities can trigger innovation, reduce costs, save resources thus making competitive advantage and loyal consumers [12]. Aside from pollution prevention, companies must think about environmental improvements in order to achieve higher resource productivity. Resource productivity means energy savings, labour improvements and efficiency in the use of raw materials as well as control and reduction of waste. If investment in environmental protection actually increases profitability, is it necessary to have regulations? Regulations should be enacted and improved by companies, governments, different organizations and international counterparts.

External stakeholders put a lot of pressure on companies to apply the environmental standards in their operation. They are expected to take over responsibility for current activities not jeopardizing the needs of future generations.

Multinational enterprises (MNE) are a special area of concern due to the transfers of their old and dirty technologies in "pollution havens", countries where regulatory standards are weaker [13] and they can use old equipment that are no longer environmentally acceptable in developed countries with strong environmental regulations. A lot of questions arise regarding this topic. Whether MNE should stick to standards they use in their own countries and establish environmental CSR practice globally? The gains in this case would be quality of products that can have better prices, positive environmental and social

performance, higher market values and ameliorative effects on reputation. Many new technologies, which are in accordance with the Porter's theory, can lower operational cost and increase employee morale and efficiency. Results show that, even in developing countries, companies who adopt higher environmental standards than prescribed have higher market values than those who do not do that [14].

The reporting in companies has been moved from tracking financial indicators of success to new forms of reporting, adopting triple bottom line approach [15] that includes observations concerning financial, social and environmental performances. Some initiatives provide guidelines and forms for CSR reporting. One of them is OECD Guidelines for Multinational Enterprises, which recommends companies to disclose financial as well as non-financial information. The Global Reporting Initiative (GRI) offers Sustainability Reporting Guidelines which aim at providing globally applicable guidelines for reporting on economic, environmental, and social performance [16]. Regulations are needed to set measurable goals. They should give the standards, but companies have to find a way to achieve them. Companies are obliged to collect data, establish reporting systems and provide reporting results to interested stakeholders. Companies very often conceal the reports about ecological incidents and real impacts of their business actions and reluctantly admit responsibility for ecological impact. Regulations force companies to limit their unfair or destructive practice.

On the other hand companies try to gain some benefits of CSR engagements such as good reputation, consumers loyalty, brand recognition, so they need to communicate with their stakeholders. They usually publish reports about CSR commitments on web pages, in their strategies, and in sustainability reports [17]. Four the most often used types of communication between companies and consumers are: 1) certification and labeling, 2) reporting, 3) consumer guides and 4) marketing strategies. OECD conducted a survey about consumer perception of CSR dependent communication, information schemes, purchasing behaviour, and business perspective [16].

2. ENVIRONMENTAL POLICY IN EUROPE

European environment policy dates back to the European Council held in Paris in 1972, at which the European Heads of State and Government (in the aftermath of the first UN conference on the environment) declared the need for a Community environment policy flanking economic expansion, and called for an action program. The Single European Act of 1987 introduced a new ‘Environment Title’, which provided the first legal basis for a common environment policy with the aims of preserving the quality of the environment, protecting human health and ensuring a rational use of natural resources [18].

Although today hundreds of laws, regulations and directives at the level of the European Union are in force, the implementation is conditioned by terms on national, regional and local levels. There is an evident lack of enforcement and adequate monitoring. In order to improve the enforcement of EU environmental laws in 2014, criminal sanctions are prescribed for serious environmental violations.

EU environment policy rests on the principles of precaution, prevention and rectifying pollution at source, and on the “polluter pays” principle, implemented by the Environmental Liability Directive (ELD) [19]. The fundamental principle of this

Directive is that the company pollutants should be financially liable for the environmental damage caused by their activities. They are forced to make risk assessment plans and undertake measures to prevent the occurrence of ecological problems. As companies have to pay for mitigating the damage if they caused one, they are very interested in developing better practices which can reduce that risk.

The EU's newest strategy is the Europe 2020 Strategy. Europe 2020 sets out a vision of Europe's social market economy for the 21st century.

Europe 2020 puts forward three mutually reinforcing priorities:

– Smart growth: developing an economy based on knowledge and innovation.

– Sustainable growth: promoting a more resource efficient, greener and more competitive economy.

– Inclusive growth: fostering a high-employment economy delivering social and territorial cohesion [20].

The Commission pointed seven flagship initiatives for efficient Europe. One of them sets inter alia targets for climate and energy: "Resource efficient Europe" to help decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernize our transport sector and promote energy efficiency.

Implementation of European environmental laws is under the jurisdiction of Member States whose legislatives may vary, economic development and environmental standards are on different levels. That is why the Commission proposed relevant targets and different paths for Member States to adjust adoption of the Europe 2020 strategy to their situation. The Commission proposes numerous activities for helping the Member States to achieve sustainable growth.

Concerning the public participation in the environmental impact assessment, in 1998 the Aarhus Convention under the auspices of UNECE (the United Nations Economic Commission for Europe) was signed. The convention ensures consultation with the public about environmental protection questions and decision making as one of the three guarantied rights. Another two are: the right of access to environmental information held by public authorities and the right of access to justice where the other two rights have been disregarded [18]. This provides a framework for governments to engage the public effectively in sustainable development.

2.1. ISO 14001 – Environmental management system

The ISO 14000 family of standards provides practical tools for companies and organizations of all types and sizes, be they private, non-profit or governmental, who are trying to regulate their environmental responsibilities [21]. By implementing the standards of ISO 14001:2015 companies may set up the frame for sustainable operations with the involvement of management, employees, as well as external stakeholders in the process. The standardization enables theme assuring of environmental impact and as a result of it adopting appropriate activities for improving the utilization of resources, reducing air pollution, protection of water sources, solid waste management and climate change

mitigation. By introducing this standard the companies gradually improved environmental impact.

There are many reasons why an organization should take a strategic approach to improving its environmental performance. Users of the standard have reported that ISO 14001 helps:

- Demonstrate compliance with current and future statutory and regulatory requirements
- Increase leadership involvement and engagement of employees
- Improve company reputation and the confidence of stakeholders through strategic communication
- Achieve strategic business aims by incorporating environmental issues into business management
- Provide a competitive and financial advantage through improved efficiencies and reduced costs
- Encourage better environmental performance of suppliers by integrating them into the organization's business systems [22].

2.2. EMAS – Environmental management system

EMAS (Environmental Management and Audit Scheme) is a tool created for organizations located in the EU who register an online database hosted by the European Commission. The system EMAS was developed in 1993 and presents a voluntary environmental management system that is used by companies to assess, manage and continuously improve their environmental performance. The European Commission has recognized that ISO 14001 can provide a stepping stone for EMAS, Figure1. EMAS takes into account additional elements to support organizations in continually and significantly improving their environmental performance.

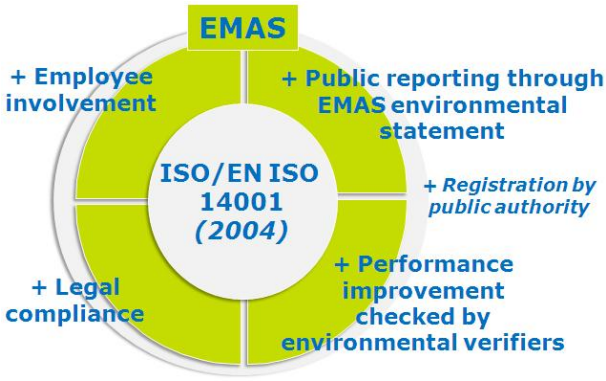

Figure1. **EMAS and ISO 14001** [23]

The key elements of EMAS are:

- Performance - constant monitoring, evaluating and reducing environmental impact on voluntary basis.

- Credibility – registration process is independent and credible. Organizations publish the environmental statements with information about their operations.
- Transparency – providing information on an organization`s environmental performance. The EMAS logo can be displayed on products to demonstrate orientation of the organization towards environmental protection.

To receive EMAS registration an organization must comply with the following steps:

- Conduct an **environmental review**
- Adopt an **environmental policy**
- Develop an **environmental program**
- Establish an effective **environmental management system (EMS)**
- Carry out an **environmental audit**
- Provide an **environmental statement**
- All documents must be approved before an organization can use th**e EMAS logo** [23]**.**

The introduction to the EMAS standard requires certain costs. Various studies show that management of companies perceive that costs of EMAS implementation overcome the financial benefits, however, they adopt EMAS to develop corporate culture, to take the right direction of environmental concerns and gain non-financial benefits [24].

Besides potentiating of environmental sustainability there are, also, several others environmental initiatives as:

- European Eco-Efficiency Initiative (EEEI),
- The Recommendation of the European Commission on the recognition, measurement and disclosure of environmental issues in the annual accounts and annual reports of companies,
- "Environmental Technology for Sustainable Development"

European Commission suggests that EMAS be a key tool to implementing all the above mentioned principles and approaches.

As it was mentioned before, the implementation of the environmental CSR depends on the particularity of countries, governments, societies, economics and the level of awareness about CSR. These elements set different formal and informal rules that are accepted by a large group of people with different interests toward businesses. Governments have a mission to provide legal and administrative conditions so that companies could take a part in various social, environmental and economic issues. For companies who are trying to generate and maintain the trust of consumers it is not enough to simply follow legal rules and avoid incidents. They should be more proactive and define appropriate strategies for the enhancement of their own influence on the surroundings through a sustainable development of their business. Sustainable growth with environmental awareness brings resource efficiency, sustainable economy, the development of new processes and technologies, green technologies, reinforcing the competitive advantages of businesses, building consciousness among costumers about the value of resources and energy

efficiency, pursuing the reduction of CO2 emissions, preventing biodiversity harm and climate resilient economy.

3. SOME PRACTICES AND RESEARCH IN EUROPE

In order to present differences between EU member states and Serbia in the implementation of CSR, a literature review was made in the next section. Some comparative surveys were conducted [25].

Finland. CSR, as a defined practice is new in Finland and formal documents and regulations have been adopted in recent years. However, Finnish companies have been operating in a socially responsible manner for a long period of time. The Finnish Government considers CSR as voluntary engagement and basically lets the companies decide about the way and level of involvement in SCR. The main governmental forum for CSR is the Committee on International Investment and Multinational Enterprises (MONIKA) that was established within the Ministry of Trade and Industry to promote the OECD Guidelines for Multinational Enterprises.

Top management in companies accepts CSR as generators of corporate reputation and economic value for a longer period of time. The expectations of customers were viewed as a very important motivator for engaging in CSR by 46 % of the respondents [26]. One of the important motivations for implementing CSR is the international cooperation with both Russia and European countries in sustainable market-based economy.

Concerning the environmental context, two thirds of the land area of Finland is covered by forests and one third by peat lands, so the forest industry is the main economic and export strength. Finland is a cold country so great attention is given to the way the energy and fuel are used. Finnish companies pay attention to sustainable management of domestic natural resources and fuel sources. The energy supply system in Finland is connected with coproduction of heat and power (CHP) where waste is used for heating in an eco-efficient manner. Approximately 70 % of the fuels used in the national forest industry are derived from domestic wood waste and 94 % of the fuels used are utilized in CHP (coproduction of heat and power) [27]. The EU average for CHP from national electricity generation is less than 10 %, while this figure amounts up to 35 % in Finland [28].

The development of environmental management systems in Finnish industry has influenced the emergence and development of corporate social responsibility in general. Many companies have first conducted their environmental reviews, audits, environmental reports and gathered these under environmental management systems that nowadays take the familiar forms of the EU Eco-Management and Auditing Scheme (EMAS) or the International Standardization Organization's ISO 14001 standard [26].

It can be expected that, in the future, Finland will have a leading role in the environmental and energy matters considering the know-how and technology that Finland already has and develops.

Germany. Actually, there is no official CSR process in Germany. Researches show lack of public response concerning the dimensions of CSR. However, Germany is viewed as a "white spot" in Europe. This situation developed as a consequence of strong connections

between trade unions and business associations, religion-based institutions, professional associations and chambers with a goal to develop a strong country with participative structures for the benefit of all. Society is based on the belief that state should ensure that businesses behave in a responsible manner and these engagement of companies resemble Corporate Citizenship or Corporate Social Responsibility.

The European Commission's Greenbook of 2001 highlighted the following points in the attitudes of German business:

- CSR is defined as the ecological, social and ethical responsibility of companies. It goes beyond legal requirements, i.e. CSR activities are voluntary and depend on the company's individual sense of responsibility.
- Regulations have to be promoted and organized by the relevant international organizations.
- Companies are not able to make up for the shortcomings of governments. It is the responsibility of politicians to make sure that the individual countries as well as partners adhere to ecological and social legislation.
- German business does not agree to additional European regulation on CSR since this would have a negative effect on the success and increasing proliferation of voluntary activities.

Since the 1970s Germany has engaged in environmental protection. Over the years, environmental legislation was introduced, and also Agenda 21 had a major impact in Germany. The Green Party has continually gained importance on the German political scene and today it is a well-established force making part of the present government [26]. The most important point in Germany concerning the environmental issue is actually in context of sustainable development. Environmental departments in companies have the task of dealing more with sustainability than ecology.

N**etherland**. The National Dutch CSR Policy (2008-2011) is coordinated between the Ministry of Economic Affairs (focusing on national CSR policy) and the Ministry of Trade and Development (focusing on international CSR policy). The government supports the development of CSR in companies through various instruments that include:

- The government explicitly and consistently states its expectation that Dutch companies comply with the OECD Guidelines for Multinational Enterprises;
- The Dutch government's Transparency Benchmark is meant to assess companies' annual public CSR reporting. The benchmark criteria are regularly updated to reflect international developments in CSR.
- In accordance with the European Reporting Directive, large Dutch companies are legally obliged to disclose non-financial information and are expected to be able to perform better than SMEs in relation to CSR implementation (SMEs are not obliged to report non-financial information) [29].

France. More than 50% of French companies with more than 50 employees are involved in some form of CSR activity. This is considered to be, at least partly, the result of a proactive CSR policy in France where a regulation on this issue has been in place since 2001. France was the first country that introduced triple bottom line reporting as mandatory [23]. The legal framework changed in 2010 with the expanded scope of companies that are required to deliver CSR reports. This now also includes public

companies, companies whose turnover exceeds a certain threshold and who have more than an average of 500 employees, co-operatives as mutual assurance companies and others [30].

Hungary. In Hungarian economy there are still a few large-scale public corporations. Privatization was carried out by large public enterprises sold to strategic partners without placing the shares on the market. The majority of Hungarian firms now are small and medium-sized enterprises. They are not public corporations and they are not obliged to publish quarterly financial reports, social and environmental accountings and other public documents relating to their activities.

The owners of companies are at the same time the managers and many of them do not accept values of responsible behaviour and additional expenses for CSR practice. Although the CSR theme becomes more widespread, there is still a lack of institutional control of ethical, social and environmental issues. According to a survey made in 1997 only 15% of small and medium-size enterprises have codes of conduct, value or policy statements. Stakeholder management, partnership programs, ethics officers, social and environmental reports were practically unknown institutions to them [26].

Multinational corporations are another form of business that is very present in Hungary. There are observations that these corporations do not even implement the standard policy and reports as they usually do in other countries.This is a common situation for post-transitional societies where multinational corporations look for cheap workforce and benefits provided by EU or local governments.

Hungary's Ministry of National Economy launched the drafting of the CSR NAP in June 2012, and the Government's CSR decree was adopted in March 2014. With this background the following CSR priorities have been developed:

- Developing the economy
- Labor and equal opportunity
- Environmental protection.

In **Slovakia**, there is no specified government institution dealing with CSR. Both the Ministry of Social Affairs and the Ministry of the Economy are represented on the High Level Group. CSR networks exist, but they are driven by NGOs [31].

Serbia. Serbia began the political and socio-economic transition later than many other countries, and many companies still have too little awareness of the benefits of CSR practices. The context of business in Serbia is constantly loaded with two features: the perpetuation of high uncertainty and weak institutions [26].

Business model has been changed from socialist to market economy. At this moment CSR is to be located within the unfinished transition process. Transitional period is not over yet due to numerous state and public enterprises that have monopolistic position in some very important areas such as energetics, telecommunications, mining and metallurgy, gas and oil, etc. The national companies are very non-transparent regarding their involving in society problems.

On the other hand, citizens do not consider CSR as an existing concept that they consider when buying something or dealing with some organizations and companies. A large

number of companies are already starting to think about the benefits of social responsibility, mainly as a way to market performance as companies that take care of the interests of stakeholders.

Sustainable management of natural resources and environmental protection in Serbia is governed by Law on Environmental Protection. It regulates rights and regulations for companies, citizens and the government concerning:

1. environmental impact assessment of plans and pollution control;
2. pollution prevention and control;
3. nature protection;
4. protection of air, water, land, forests, geological resources;
5. management of chemicals;
6. waste management;
7. ionizing and ionizing radiation;
8. protection against noise and vibration, etc. [32].

This law contains provisions on obligations to monitor indicators of environmental impact, create monitoring plan and keep records of monitoring. The law provides keeping of the register of polluters and reporting on the state of the environment.

In practice, things are a little bit different. Before the transition, most large industrial production facilities were highly operational in Serbia. However, the environmental monitoring was not established on a systematic level. After 2000, the Serbian government decided to adjust its ecological regulative to EU standards. Researches were conducted in industrial areas where episodes of high concentration of pollutants in air were measured and results showed much higher concentrations than it was allowed by EU regulations [33, 34].

There are various strategic documents as primary direction for environmental protection, sustainable growth, promotion and implementation of green economy: National Sustainable Development Strategy, National Strategy on Sustainable Use of Natural Resources and Environment, National Millennium Development Goals, National Economic Development Strategy of the Republic of Serbia, National European Union Integration Strategy of the Republic of Serbia, National Environmental Protection Program, National Environmental Approximation Strategy of the Republic of Serbia, National Energy Development Strategy until 2015, etc. [35].

The Republic of Serbia submitted its application to join the European Union (EU) in December 2009 and in March 2012 gained candidate status for membership. The European integration process involves further adoption of EU standards regarding the use of SCR activities in all areas included in environmental protection. Future engagement is expected of all interested stakeholders in increasing the awareness and practical implementation of CSR practice, either as a legal obligation or voluntary.

Review of some researches conducted across the Europe is presented in Table 1.

Table 1. Table name

Author(s)	Headline	Theme	Year
P. Castka & all.	How can SMEs Effectively Implement the CSR Agenda? A UK Case Study Perspective	The case study research demonstrates how the CSR agenda has been implemented using ISO 9001:2000 as a platform and what benefits the case study organization has gained from this approach [36].	2004
D. Matten, J. Moon	'Implicit' and 'Explicit' CSR , A conceptual framework for understanding CSR in Europe	This paper presents a conceptual framework of corporate social responsibility (CSR) prompted by the need to understand its changing status in Europe [37].	2004
A. Konrad & all.	Empirical Findings on Business–Society Relations in Europe	This paper empirically analyses which issues of SD are taken into account by corporations and stakeholders, in what way, and to what extent the concept of sustainable development (SD) can be achieved through stakeholder relations management (SRM) on the corporate level [38].	2006
B. Fliess & all.	CSR and Trade: Informing Consumers about Social and Environmental Conditions of Globalised Production: Part I	This study investigates how consumers are informed about the social and environmental conditions under which products have been produced [16].	2007
U. Golob , J. L. Bartlett	Communicating about corporate social responsibility: A comparative study of CSR reporting in Australia and Slovenia	This paper examines how two countries on opposite sides of the world, Australia and Slovenia, are addressing corporate social responsibility (CSR) reporting issues [39].	2007
O. Delbard	CSR Legislation in France and the European Regulatory Paradox: An Analysis of EU CSR Policy and Sustainability Reporting Practice Corporate Governance	The aim of this paper is to investigate the corporate social responsibility (CSR) policy orientations in the European Union (EU) by focusing on the specific case of the French legislation on compulsory sustainability reporting for publicly-listed companies [40].	2008
B. Letica	Three CSR Models in New European Union Member States and Candidate Countries	This paper uses UNDP and other existing research findings and takes them a step further by distinguishing between three distinct developing CSR models in new EU members and candidate countries [41].	2008
R. Steurer	The Role of Governments in Corporate Social Responsibility: Characterizing Public Policies on CSR in Europe	The present paper is concerned with the political side of the management approach. By systematically characterizing the public policies on CSR throughout Europe, it complements the existing, often unsystematic, accounts of how governments address CSR and it brings the issue closer to political science [42].	2010
I. Jindrichovska, I. Purcarea	CSR and Environmental Reporting in the Czech Republic and Romania: Country Comparison of Rules and Practices	The article analyses the short tradition of Corporate Social Responsibility reporting in both countries and the current state of development, as well as its future perspectives [43].	2011
J. Morris	The Five W's of France's CSR Reporting Law	[44]	2012
W. Bönte , C. Dienes	Environmental Innovations and Strategies for the Development of New Production Technologies: Empirical Evidence from Europe	This study empirically investigates whether firms' improvements in energy and material efficiency are related to the extent to which external partners are involved in the development of process innovations, covering 14 European countries [45].	2013
A. Calabrese , R. Costa, F. Rosati	A feedback-based model for CSR assessment and materiality analysis	This paper proposes a CSR model that classifies customers on the basis of their CSR feedback, measuring both their perceptions and expectations [46].	2015
K.Moravcikova , Ľ. Stefanikova , M. Rypakova	CSR reporting as an important tool of CSR communication	This article points out how the CSR report is used by businesses and how socially responsible activities through CSR reports are perceived by Slovak customers [47].	2015
C. Crişan-Mitraa , A. Borza	Approaching CSR in Romania: An empirical Analysis	Through this article the authors underline the Romanian context where companies must implement and develop CSR practices [48].	2015

E. Bonsón, M. Bednárová	CSR reporting practices of Eurozone companies	The aim of this empirical study is to analyze the extent to which Eurozone companies report on CSR indicators, according to the Integrated Scorecard Taxonomy Scoreboard of the Spanish Accounting and Business Association (AECA), and the factors that can influence its use [15].	2015
M. Pružinský , J. Tkačiková	Corporate Social Responsibility in Slovak Small and Medium Sized Enterprises	Current views on corporate social responsibility with a focus on small and medium-sized enterprises [49].	2015
R. Kučerová , R. Skýpalová	Corporate Social Responsibility in the Czech Republic and Slovakia	The research was conducted in the Czech Republic in the year 2013/2014 The results are compared with the results of the similar research conducted in Slovakia in 2009/2010 [50].	2015
H. Patrycja	External Verification as an Important Factor Improving Credibility of CSR Report	The study included separate CSR reports as well as annual reports with CSR sections and integrated reports published in 2012 in selected EU Member States [51].	2015
I. Lock , P. Seele,	The credibility of CSR (corporate social responsibility) reports in Europe. Evidence from a quantitative content analysis in 11 countries	This paper focuses on the credibility of CSR reports The results show that European CSR reports do not score high on credibility [52].	2016

4. CONCLUSION

Conclusion of this work would be that for further development of sustainable business, through the implementation of CSR, the following is necessary: informing and education of all stakeholders, communication and transparency, cooperation, strengthening the legal framework and institutions, and voluntary commitment to the long-term preservation of the environment.

By reviewing a lot of conducted researches on CSR topics it is notable that Western European countries are more sensitive about the environmental and voluntary dimensions of CSR while Eastern and Southern European countries give more attention to social, stakeholder and economical dimensions of CSR.

Due to the lack of precise definition of CSR and there being a lot of researches with different dimensions, views and even opposite results, this area of research is still in a focus. Many researches on the economic justification of CSR activities are conducted and they rather reflect opinion and perception of CSR than provide real data evidence about the implementation of results. Also, the existence of different state policies, regulations and acceptance levels, complicates attempts for establishing universal framework monitoring, measurement and reporting systems.

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NOBODY LIKES POISON
The Importance of Long-termism, Stakeholder Values and Environmental Awareness in the Operation of Companies

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Abstract

Environmental responsibility has become an important keyword for more and more global companies, not only in their mission and communication message, but also in their actual processes. While in the past the shareholder value dominated business operations, in the present – and certainly in the future even more so - the stakeholder value is the clue to long-term-thinking, which serves as the basis of market position and the brand of the companies. Consumers do not want chemicals inside their bodies and within their surroundings any more. What is more, due to the information revolution, and especially the social networks, the information about unhealthy food, clothes, environmental damage caused by factories and processes can spread very quickly, which causes more and more people to become aware of them. As consumers need for toxic-free and environment friendly products grows, companies have to adapt to these new requirements. CEOs ought to manage their companies according to consumer expectations. The article aims to present the reason of using ISO 14001 environmental management system and provides a case-study form the fast-fashion industry to verify the applicability of green thinking even in a dominantly environmentally unfriendly business.

Keywords: ***Environment, EMS, ISO 14001, stakeholder value, consumer requirements***

1. INTRODUCTION

Environmental responsibility has become an important keyword for more and more global companies. Not only in their mission and communication message, but also in their manufacturing processes. Due to the information revolution, and especially owing to social networks, the information about unhealthy food, clothes, environmental damage caused by factories and processes can spread very quickly, which causes more and more people to become aware of them. Consumers do not want chemicals inside their bodies and in their immediate surroundings. Since consumers need for toxic-free and environment friendly products grows, companies have to adapt to these new requirements. The article aims to present the reason of using ISO 14001 environmental management system based on the case-study of Zara.

2. LONG-TERMISM AND STAKEHOLDER VALUE

While in the past the shareholder value dominated business decisions, in the present– and certainly the future - stakeholder approach equals long-term-thinking, which is the basis of the market position and brand of the companies. The success of companies depends on not only the decisions of managers, proprietors but the behaviour and decisions of the suppliers, consumers, local and state governments. 20-30 years ago the thinking about environment was changed due to the recognition of limited resources. Non-government organizations draw attention to the environmental problems. [1]

According to the S&P Dow Jones Indices the short-termism mostly exists among the investors, managers, and in everyday thinking. The key for change is with the large asset owners who has realized the need for change to long-termism. "In transitioning to long-termism, an important constant is incorporating long-term metrics. Long term metrics are both industry specific and sustainability oriented, and they are just as important as GAAP financial measures in following long-term, value-creation investment process." (Tang-Greenwald, 2016 p 1) The decisions of governance has already become one of the most important variables for corporate performance because of their long-term effect, [2], however other stakeholders also play a key role in a company's future success.

A major group of stakeholders consists of consumers: they buy the product or service, offer their opinion about the company and brand. Income of company depends on the consumers' decisions. Due to non-government organizations (eg. Greenpeace), social network and other media, the information about unhealthy products, pollution by manufacturing process and logistics and released chemicals can spread very quickly and affect general opinion. That's why dealing with environmental issues means both short-termism and long-termism: the consumers dislike poison and the present actions concerning environment along with natural resources are not sustainable for long-term period without changing.

3. CONSUMER EXPECTATIONS IN HUNGARY

Environmental awareness was first scientifically researched by Michael P. Maloney and Michael P. Ward which was published in 1973 [3] They stated that most of the people think that although the environmental protection is one of the most important key to the future, their behaviour and their knowledge indicate the opposite of their opinion.

In the last twenty years there were several researches on environmental behaviour among Hungarians. According to the surveys, the effects of pollution, food safety and wasting are the most attention-grabbing environmental topics in Hungary.

Consumer requirements have been changing nowadays. According to the Eurobarometer [4] 43% of the Hungarians are worried about the impact of chemicals used in everyday products on health. Ten years ago this percentage was "only" 35% [5] If we just investigate our immediate surrounding we will find that there are more "natural" goods, and less –

officially – artificial ingredients in foods, more people are looking for eggs and vegetable from countryside and real, traditional handmade goods. Is it the product of a deliberate change, or just a coincidence?

As displayed in Figure 1, the Hungarian online searches with Google (which is the search engine used by 97% of all net users) indicates a very definite increase in using Hungarian keywords "természetes" ("natural" with blue line) and "mérgező" ("toxic" with red line). This fact means that people are more interested in consciousness related topics more than ten years ago. They want to have natural things and want to know about toxins more.

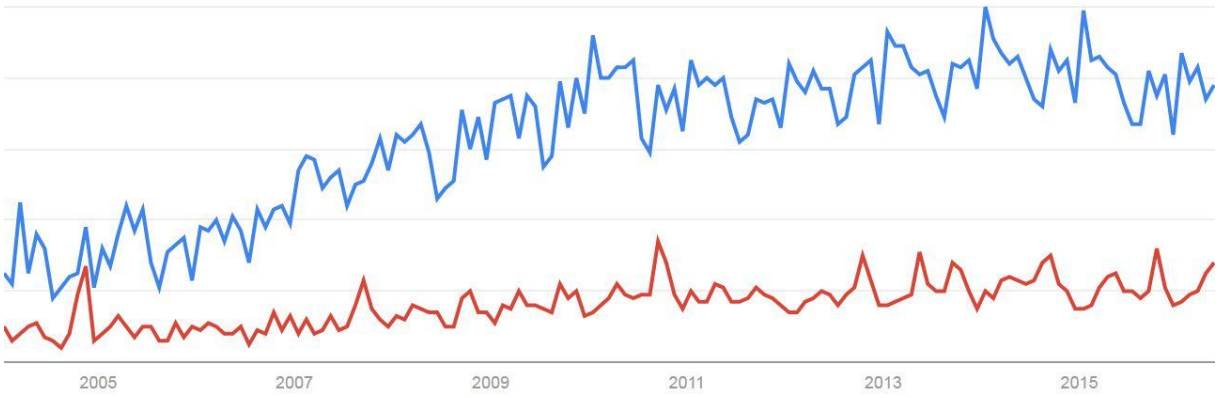

Figure 1. Hungarian online searches with Google using keywords "természetes" ("natural" with blue line) and "mérgező" ("toxic" with red line) [6]

Accordingly, the consumer side of the market is clearly and visibly changing. However, it is not clear, how a company – especially those with low profit margins and no spare resources to dedicate to the necessary change could do. What is more, how can they ascertain return on their environment friendly investment, if it is not visible for their consumers?

For these questions ISO 14001 seems to be the answer, providing guidance and visibility for those with "green" intentions.

4. ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) – ISO 14001

ISO 14001 is an internationally accepted standard that outlines an effective environmental management system inside an organisation. By adopting this standard businesses remain commercially successful without neglecting environmental responsibilities and impacts. It also offers a possibility to grow sustainably while reducing the environmental impact of this growth. [7]

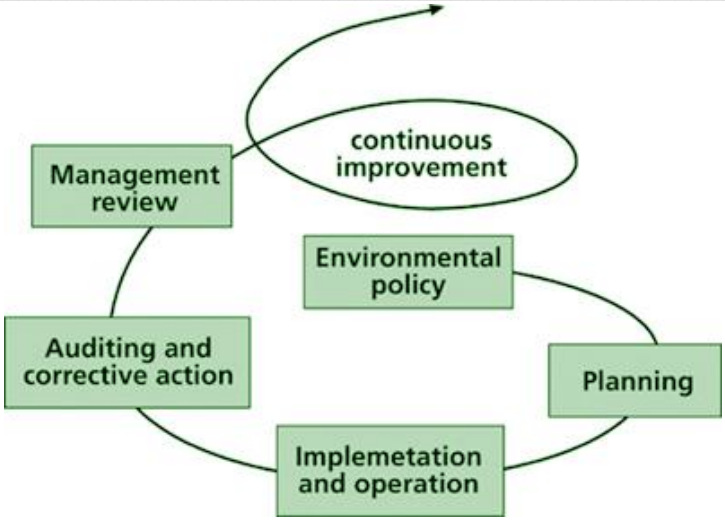

Figure 2 Operation of ISO 14001-based EMS [8]

Figure 2 represents the progression of an ISO 14001 based management system. After laying down the fundamental principles of the company's environmental policy the second move is to create a plan which contains the actions needed to achieve the required goals of this strategy. Afterwards the company has to develop the skills and supporting mechanism which are necessary to implement the EMS. The most important condition of the effective application is the regular control and audit to ensure the required standards. The final step is the constant evaluation and development of the environmental management system in order to improve the results. When a company has adopted an EMS which fulfils the requirements of ISO 14001, it can apply for a certificate.

What are the main benefits of EMS? It can be used to:

- Reduce waste and energy use;
- Improve company reputation and the confidence of stakeholders;
- Create a competitive advantage against business rivals;
- Produce new possibilities by attracting wider scale of consumers.

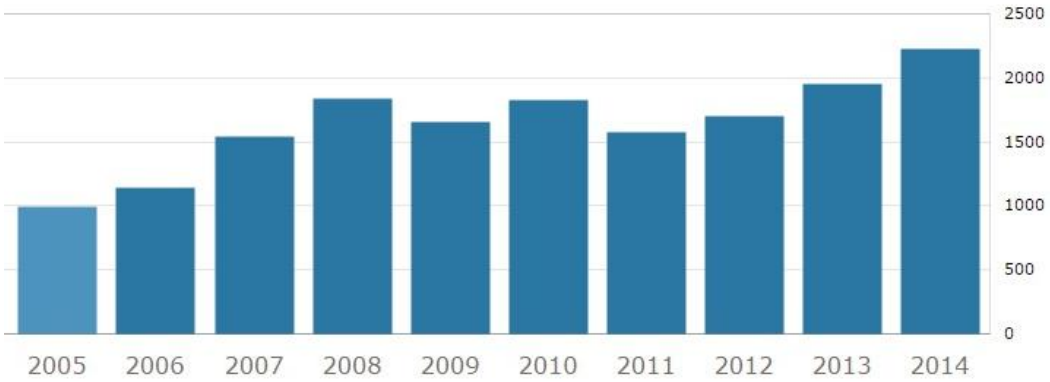

Figure 3 Number of 14001 certificates in Hungary (2005-2014) [9]

Data of Figure 3 shows a constant growth of ISO 14001 certificates in Hungary. During these ten years the number of certificates have been doubled, which means that more and more company has recognised the benefits of EMS. Implementing this system is a step forward to meet the growing need of sustainable development and remain commercially successful at the same time.

5. ANSWER OF ZARA FOR THE NEW CHALLENGE

Fast fashion's fundamental problem is its low quality/high turnover business model. Thus, there are several serious problems associated with this area that are caused by the pressure for low price and speedy production on supplier factories. Hence, it is especially hard for them to turn green. The industry itself mostly operates along stakeholder interest violating procedures. The main problems are unsafe workplaces, violation of human rights, chemical pollution, high carbon footprint and water use. [10] [11] Present case study of Zara shows the development of their environmental policy, the effects of non-govermental organisations and consumers requirements, and finally, it presents the way of "green-thinking"; proves that it is possible to combine market interest with sustainability and environmental responsibility, thinking with long termism.

With over 2000 stores worldwide, Zara (member of Inditex group) is one of the largest fashion company of the world. Zara opened its first store in Coruña in the northwest of Spain in 1975. What is Inditex Group and Zara doing to minimalize their impact on the environment and biodiversity? [12]

In 2001, the Group launched The Code of Conduct for Manufacturers and Suppliers. This document is based on the principles of the OECD, the Ethical Trading Initiative Base Code, the principles of the UN Global Compact and several conventions of the International Labour Organisation. [13] However internal reorganisation has also started.

Starting from 2006 Inditex Group started to create the foundations of sustainable development, by working out an Environmental Strategic Plan, aiming at reconciling the economic growth of the Group and the protection of social and natural environment. [14]

Traceability of the supply chain: We identify all processes and stages in the supply chain through an online system that requires supplier transparency and is checked by sustainability teams.

Evaluation: We measure the level of compliance of the Code of Conduct through social and specific pre-assessment audits, among other audits for worker health and safety.

Training and awareness: We carry out direct and ongoing work with providers to train them and raise their awareness in best practices so that they are responsible for their own supply chain.

Continuous improvement: We work on Corrective Action Plans that are based on supplier responsibility and aim to encourage continuous improvement in all its factories, involving the sustainability and purchasing teams in the Inditex Group. To carry out these plans of action, we

Figure 4 Strategic plan of Zara 2014-2018. [15]

The internally initiated process has gained increased momentum in 2011, when Greenpeace campaigners began a dialogue with Zara and other fashion companies to find a solution for the serious toxic pollution problem. After a year of negotiation the fast fashion

giant (and seven other brands[2]) has committed themselves to eliminate all hazardous chemicals discharged through their supply chain and products by 2020. This commitment has a respectable impact on the environment, and is also a breakthrough for the public's right to know what is being released into the waterways. Transparency is possible via the publicly disclosed[3] data about the company's suppliers and their releases of hazardous chemicals into the environment. [16]

Nowadays, Zara emphasizes the sustainability of every part of its operation from the manufacturing process to the eco-efficient stores. Its logistics centres have a certified Environmental Management System in accordance with international regulation ISO 14001:2004.

In order to respond to the expectations of their stakeholders, Zara and other members of Inditex Group maintain constant communication with their stakeholders, so that the most important issues of their interest can be identified.

	Dialogue tools	Objectives
Customers	• Specialised customer care teams • Stores, on-line stores, social networks • Product Quality and Safety Department	• Rapid response to customer demands • Customer care that is segmented by country (10 languages) and service (the stores themselves and on-line sales) which allows to offer the customers
Suppliers	• Clusters of suppliers • Ethics Committee • Commercial and CSR Teams • Agreement with IndustriALL • Compliance Programme for the Code of Conduct for Manufacturers and Suppliers	• Guaranteeing the Code of Conduct for Manufacturers and Suppliers is adhered to on the supply chain
Employees	• Ethics Committee • Agreement with UNI Global Union • Training, internal promotion, internal communications and newsletters, volunteer programmes	• Having a highly-motivated team • Strengthening employee commitment to the Code of Conduct and Responsible Practices
Community	• Social Council • Cooperation with NGOs • Sponsorship and Patronage Committee	• Ensuring the programmes developed have the broadest possible reach and impact
Shareholders	• General Shareholders' Meeting • Sustainability ratings • Investors relations	• Consolidation in sustainability ratings • Corporate transparency
Environment	• Social Council • Commitments with NGOs	• Application of the Environmental Strategy Plan

Figure 5 Dialogue with Stakeholders [17]

[2] Pull & Bear, Massimo Dutti, Bershka, Stradivarius, Oysho, Zara Home and Uterqüe
[3] https://www.inditex.com/sustainability/suppliers

As an answer for the new challenges, Zara created an environmental policy and took part in several programs and is a member of organizations for the "green future". Hence the behaviour of Zara and the Inditex Group could serve as a best practice for every company from small and medium enterprises to the large companies.

CONCLUSION

This paper aims to emphasise the importance of long-termism, stakeholder values and environmental awareness in the operation of companies. Sustainability is not only a well-known notion of environmental protection, but it's a very important keyword for modern business models. Considering the Hungarian data, both companies and consumers are conscious of the environmental issue – the consumers consciously search for polluting agents inside and outside; while companies want to respond to the changed expectations. One of the answers can be the Environmental Management System, which is a complex and efficient tool for environmental-friendly companies – not only in global size.

Due to the extensive effects of environmental impact on stakeholders, dealing with environmental problems and searching the sustainable solutions are the primary interest of companies on a long-term. The case study of Zara shows the best practice of a global company: proving that even a company from an environmentally unfriendly industry can change and turn into a "green-thinking" entity in its every part of operation without giving up the main business activity.

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SOME ELEMENTS OF ENVIRONMENTAL MANAGEMENT DESIGN BY USING INTERNATIONAL FAMILY OF STANDARDS ISO 14000

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Abstract

Management system standards, also called meta-standards, have been adopted by an increasing number of organizations across the world [5]. Organizations of all kinds are increasingly concerned with achieving and demonstrating sound environmental performance by controlling the impacts of their activities, products and services on the environment, consistent with their environmental policy and objectives. International Standards covering environmental management are intended to provide organizations with the elements of an effective environmental management system (EMS) that can be integrated with other management requirements and help organizations achieve environmental and economic goals [6]. Experience shows that implementing an environmental management system in a company can bring a number of benefits, not only for the company itself but also to the whole surrounding environment. Prevention of pollution, which is the idea underlying the concept of an environmental management system, generates mechanisms aimed at minimizing material, resource and energy consumption [18].

Keywords: *Environmental management, ISO 14001, environmental policy, environmental labels, environmental audit, life cycle assessment*

1. INTRODUCTION

ISO 14001 does not fix environmental goals or environmental targets to be achieved (requirements for the prevention and reduction of the impact of pollution, for instance), as a result of the possible attainment of which a certificate would be obtained. Rather, this standard establishes requirements defining the operational systems to be complied with within companies in relation to activities which have an environmental impact [3, 14]. It is a model which provides a systematic framework within which to incorporate environmental concerns into a company's day-to-day operations [**5**].

International standard ISO 14001 specifies requirements for an environmental management system to enable an organization to develop and implement a policy and objectives which take into account legal requirements and information about significant environmental aspects. It is intended to apply to all types and sizes of organization and to accommodate diverse geographical, cultural and social conditions. The basis of the approach is shown in Figure 1. The success of the system depends on commitment from all levels and functions of the organization, and especially from top management [6].

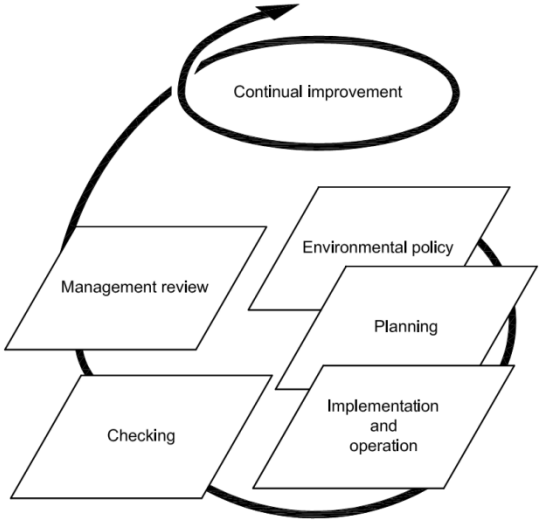


Figure 1. Environmental management system model for ISO 14001 [6]

2. BASIC PRINCIPLES OF ISO 14001

ISO 14001 responded to concerns about the relationship between trade and environment, and the lack of oversight by global trading institutions over environmental issues. There was also recognition that traditional regulatory approaches were inadequately addressing environmental challenges, and the regulatory structure did not offer sufficient opportunities for businesses to invest in environmental stewardship. ISO 14001 offered a voluntary, non-traditional approach to environmental governance which complemented the extant regulatory structure [19].

It is generally hoped, and often assumed, that implementation of ISO 14001 or EMAS leads both to improved environmental management and to enhanced economic competitiveness of the organization [20]. Both EMAS and ISO 14001 are formalised EMS standards that compete to gain the favour of companies and organisations - at least in the EU [4]. Unlike some other voluntary environmental programs, ISO 14001 requires participants to receive an initial certification audit and subsequent annual recertification audits to verify that their EMS is of ISO 14001 caliber. Both types of audits are conducted by third-party auditors who themselves have been approved and accredited by their domestic national standards body. Even if certification is a purely symbolic act, it is an act that provides real information about the existence of a management system [15]. The audit and certification measures are designed to prevent participants from shirking their ISO

14001 program responsibilities. Establishing an EMS and having it audited by a third party can cost from $25,000 to over $100,000 per facility [2, 16].

A system of this kind enables an organization to develop an environmental policy, establish objectives and processes to achieve the policy commitments, take action as needed to improve its performance and demonstrate the conformity of the system to the requirements of ISO 14001. The overall aim of this International Standard is to support environmental protection and prevention of pollution in balance with socio-economic needs. It should be noted that many of the requirements can be addressed concurrently or revisited at any time [6].

ISO 14001 requires participants to establish a written environmental policy approved by senior management that lays out quantifiable environmental targets with plans for regularly reviewing them, and to designate a top manager to oversee implementation of the firms' EMS. In some respects, ISO 14001 is primarily a compliance tool because noncompliance with law is often rooted in ignorance of law (Brehm & Hamilton, 1996; Winter & May, 2001) [19].

The adoption and implementation of a range of environmental management techniques in a systematic manner can contribute to optimal outcomes for all interested parties. However, adoption of ISO 14001 will not in itself guarantee optimal environmental outcomes. In order to achieve environmental objectives, the environmental management system can encourage organizations to consider implementation of the best available techniques, where appropriate and where economically viable, and fully take into account the cost effectiveness of such techniques [6].

ISO 14001 is applicable to any organization that wishes to [6]:

a) establish, implement, maintain and improve an environmental management system,

b) assure itself of conformity with its stated environmental policy,

c) demonstrate conformity with this International Standard by:

1) making a self-determination and self-declaration, or

2) seeking confirmation of its conformance by parties having an interest in the organization, such as customers, or

3) seeking confirmation of its self-declaration by a party external to the organization, or

4) seeking certification/registration of its environmental management system by an external organization.

Top management must define the organization's environmental policy and ensure that, within the defined scope of its environmental management system, it [6]:

a) is appropriate to the nature, scale and environmental impacts of its activities, products and services,

b) includes a commitment to continual improvement and prevention of pollution,

c) includes a commitment to comply with applicable legal requirements and with other requirements to which the organization subscribes which relate to its environmental aspects,

d) provides the framework for setting and reviewing environmental objectives and targets,

e) is documented, implemented and maintained,

f) is communicated to all persons working for or on behalf of the organization, and

g) is available to the public.

3. OTHER STANDARDS FROM FAMILY ISO 14000

The ISO 14000 family comprises a number of standards that complement ISO 14001, some of which are listed below [13]:

• ISO 14004 provides guidance on the establishment, implementation, maintenance and improvement of an environmental management system and its coordination with other management systems.

• ISO 14006 is intended to be used by those organizations that have implemented an environmental management system in accordance with ISO 14001, but can help integrate eco-design into other management systems.

• ISO 14064-1 specifies principles and requirements at the organizational level for the quantification and reporting of greenhouse gas (GHG) emissions and removal.

Environmental labels[4] and declarations are one of the tools of environmental management, which is the subject of the ISO 14000 series. Environmental labels and declarations provide information about a product or service in terms of its overall environmental character, a specific environmental aspect, or any number of aspects. Purchasers and potential purchasers can use this information in choosing the products or services they desire based on environmental, as well as other, considerations. The provider of the product or service hopes the environmental label or declaration will be effective in influencing the purchasing decision in favour of its product or service. If the environmental label or declaration has this effect, the market share of the product or service can increase and other providers may respond by improving the environmental aspects of their products or services to enable them to use environmental labels or make environmental declarations, resulting in reduced environmental stress from that product or service category [8].

The overall goal of environmental labels and declarations is, through communication of verifiable and accurate information that is not misleading, on environmental aspects of products and services, to encourage the demand for and supply of those products and services that cause less stress on the environment, thereby stimulating the potential for market-driven continuous environmental improvement [8].

[4] environmental label (environmental declaration) - claim which indicates the environmental aspects of a product or service [8].
NOTE An environmental label or declaration may take the form of a statement, symbol or graphic on a product or package label, in product literature, in technical bulletins, in advertising or in publicity, amongst other things.

***Table 1**:* Environmental labels and declarations—General principles [8]

Principle 1	Environmental labels and declarations shall be accurate, verifiable, relevant and not misleading.
Principle 2	Procedures and requirements for environmental labels and declarations shall not be prepared, adopted, or applied with a view to, or with the effect of, creating unnecessary obstacles to international trade.
Principle 3	Environmental labels and declarations shall be based on scientific methodology that is sufficiently thorough and comprehensive to support the claim and that produces results that are accurate and reproducible.
Principle 4	Information concerning the procedure, methodology, and any criteria used to support environmental labels and declarations shall be available and provided upon request to all interested parties.
Principle 5	The development of environmental labels and declarations shall take into consideration all relevant aspects of the life cycle of the product.
Principle 6	Environmental labels and declarations shall not inhibit innovation which maintains or has the potential to improve environmental performance.
Principle 7	Any administrative requirements or information demands related to environmental labels and declarations shall be limited to those necessary to establish conformance with applicable criteria and standards of the labels and declarations.
Principle 8	The process of developing environmental labels and declarations should include an open, participatory consultation with interested parties. Reasonable efforts should be made to achieve a consensus throughout the process.
Principle 9	Information on the environmental aspects of products and services relevant to an environmental label or declaration shall be available to purchasers and potential purchasers from the party making the environmental label or declaration.

Self-declared environmental claims may be made by manufacturers, importers, distributors, retailers or anyone else likely to benefit from such claims. Environmental claims made in regard to products may take the form of statements, symbols or graphics on product or package labels, or in product literature, technical bulletins, advertising, publicity, telemarketing, as well as digital or electronic media, such as the Internet [9].

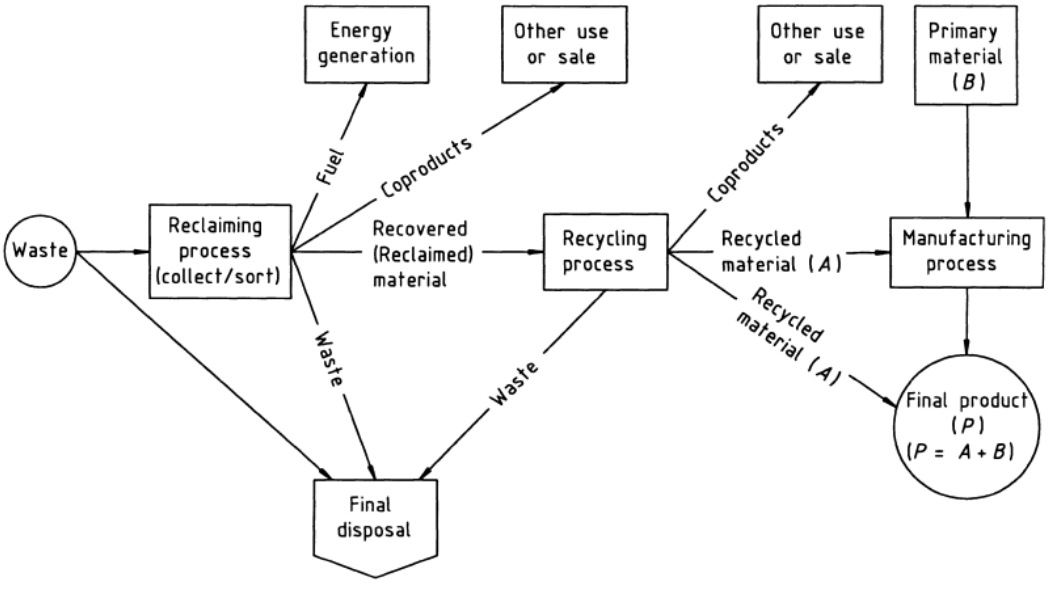
In self-declared environmental claims, the assurance of reliability is essential. It is important that verification is properly conducted to avoid negative market effects such as trade barriers or unfair competition, which can arise from unreliable and deceptive environmental claims. The evaluation methodology used by those who make environmental claims should be clear, transparent, scientifically sound and documented so that those who purchase or may potentially purchase products can be assured of the validity of the claims [9].

Type I environmental labelling involves an iterative process which includes [10]:

- consultation with interested parties;
- the selection of product categories;
- development, review and modification of product environmental criteria;
- the identification of product function characteristics; and
- the establishment of certification procedures and other administrative elements of the programme.

Environmental performance evaluation (EPE), the subject of ISO 14031, is an internal management process and tool designed to provide management with reliable and verifiable information on an ongoing basis to determine whether an organization's environmental performance is meeting the criteria set by the management of the organization [11].

An organization with an environmental management system in place should assess its environmental performance against its environmental policy, objectives, targets and other environmental performance criteria. When an organization does not have an environmental management system, EPE can assist the organization in [11]:



Recycled content of product $(X\,\%) = (A/P) \times 100$

Some recovered (reclaimed) materials may go directly to a manufacturing process, which includes the recycling process, without having a separate operation called the "Recycling process", in the system. When this is done, coproducts and waste are still likely to be generated in that manufacturing process. These coproducts and waste shall be accounted for when determining the mass of recycled material to be used in the formula for calculating recycled content.

NOTE This diagram represents a simplified example of a recycling system and is intended to provide information for clarity on recycled content calculations. For more complete examples refer to ISO/TR 14049, *Environmental management — Life cycle assessment — Examples for the application of ISO 14041.*

Figure 2. Simplified diagrammatic representation of a recycling system [9]

- identifying its environmental aspects;
- determining which aspects it will treat as significant;
- setting criteria for its environmental performance; and
- assessing its environmental performance against these criteria.

Examples of other tools that management can use to provide additional information for EPE include environmental reviews and life cycle assessment (LCA). While EPE focuses on describing the environmental performance of an organization, LCA is a technique for assessing the environmental aspects and potential impacts associated with product and service systems. Further guidance on LCA is provided in ISO14040, ISO14041, ISO14042 and ISO14043 [11].

EPE and environmental audits help the management of an organization to assess the status of its environmental performance and to identify areas for improvement as needed. EPE is an ongoing process of collection and assessment of data and information to provide a current evaluation of performance, as well as performance trends over time. In contrast, environmental audits are conducted periodically to verify conformance to defined requirements. Further guidance on environmental auditing is provided in ISO 14010 and ISO14011 [11].

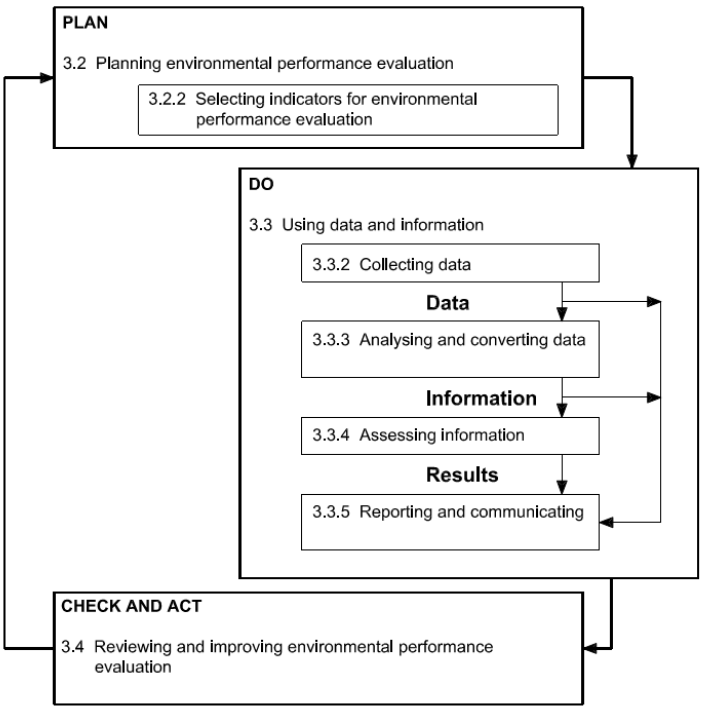


Figure 3. Environmental performance evaluation [11]

4. NEW VERSION OF ISO 14001

Standard ISO 14001:2015 now requires [12]:

- Environmental management to be more prominent within the organization's strategic direction
- A greater commitment from leadership
- The implementation of proactive initiatives to protect the environment from harm and degradation, such as sustainable resource use and climate change mitigation
- A focus on life-cycle thinking to ensure consideration of environmental aspects from development to end-of-life
- The addition of a stakeholder-focused communication strategy.

5. REASONS FOR AND BENEFITS OF ISO 14001

Care for the environment is considered one of the most important premises underlying implementation of environmental management systems compliant with ISO 14001 [18]. Edwards write that there are four reasons why every organization should take environmental factors into account in its management processes [18]:

• ethical – as human beings we have a duty to look after the world in which we live and to hand it on to our children,

• economic – conserving resources and not generating waste products or wasting energy means we save on cost,

• legal – more and more governments including our own are passing laws to control how we interact with the environment,

• commercial – more and more large organizations are taking control of their environmental responsibilities and they expect their suppliers and subcontractors to do the same.

Other authors [1] have identified two broad categories of benefits that could be achieved from an effective environmental management system such as ISO 14001: economically quantifiable benefits and economically non quantifiable benefits.

Economically quantifiable benefits include the following [1]*:*

• raw materials saving,

• energy saving,

• improvement in production system availability,

• reduction of rejects,

• reduction of waste treatment costs,

• exploitation of rejects,

• reduction of idle times,

• public incentives,

• health care,

• insurance cost reductions,

• increased in capacity,

• decreased some logistics costs,

• increase in resource usage efficiency.

Economically non-quantifiable benefits, including the following [1]*:*

• company image,

• liability and risk reduction,

• market opportunities,

• reduction of contamination risk,

• better knowledge of job and production system,

• product image toward customers,

• relationship with authorities,

• reduction of human risk,

• flexibility of management system,

• pro-active attitude to the environmental question,

• compatibility with ISO 9001 and ISO 14001.

In addition to improved environmental performance, the potential benefits associated with an effective environmental management system include [8]:

- assuring customers of commitment to demonstrable environmental management,
- maintaining good public/community relations,
- satisfying investor criteria and improving access to capital,
- obtaining insurance at reasonable cost,
- enhancing image and market share,
- improving cost control,
- reducing incidents that result in liability,
- conserving input materials and energy,
- facilitating the attainment of permits and authorizations and meeting their requirements,
- promoting environmental awareness among suppliers, contractors and all persons working for or on behalf of the organization,
- fostering development and sharing of solutions to environmental problems, and
- improving industry-government relations.

6. CONCLUSON

Organizations using ISO 14001 have found success across a range of areas, including reduced energy and water consumption, a more systematic approach to legal compliance and an improved overall environmental performance. Like all ISO management system standards, ISO 14001 includes the need for continual improvement of an organization's systems and approach to environmental concerns [13].

Users of the standard have reported that ISO 14001 helps [13]:

- Demonstrate compliance with current and future statutory and regulatory requirements
- Increase leadership involvement and engagement of employees
- Improve company reputation and the confidence of stakeholders through strategic communication
- Achieve strategic business aims by incorporating environmental issues into business management
- Provide a competitive and financial advantage through improved efficiencies and reduced costs
- Encourage better environmental performance of suppliers by integrating them into the organization's business systems

Countries with a higher salience of manufacturing sectors also tend to have higher pollution levels given the reliance on fossil fuels for manufacturing activities. Alongside economic activities, urbanization is often viewed as influencing pollution levels. Some believe that urbanization leads to more pollution while others suggest that urban areas can lead to lower pollution levels given the economies of scale in confronting environmental problems (Torras & Boyce, 1998) [19].

The number of ISO certificates in the world notes a significant growth in the number of issued ISO certificates confirming compliance of the environmental management system in use with ISO 14001 requirements. Today about 300,000 certificates were issued in the world according to ISO organization. However, the growth in number of certificates is more and more significant year by year, which reflects the growing interest in environmental management system and above all in the benefits an organization can obtain as a result of environmental management system implementation and maintenance [18].

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EXAMING OF STUDENTS' POPULATION ATTITUDES TOWARDS ENVIRONMENTAL PROBLEMS

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Abstract

This article presents the results of examination of students' attitudes towards environmental issues. For data collection was used questionnaire "The Attitude Scale of Environmental Problems" [1] adapted to the conditions in Serbia. The survey was conducted at Technical faculty in Bor, on sample of 106 students. For data processing descriptive statistics, T test and ANOVA were used. It has been concluded that students have a positive attitudes towards environmental issues, while correlation analysis of demographic characteristics (gender, study year) didn't show any statistical significance.

Key words: environment, attitudes, students, environmental problems

1. INTRODUCTION

Some of the most prominent problems of the modern era are undoubtedly those related to the environmental protection. During the period between the first and second industrial revolution, it was not paid enough attention to the human environment. Careless treatment of nature has led to numerous negative phenomena in the form of ecological disasters that threatened to considerably endanger humanity. The last few decades, only after the situation has become alarmingly, individuals, organizations and institutions have massively become more committed to solving the environmental protection problems. Ecology becomes a more prevalent scientific discipline that aims to develop the knowledge necessary to neutralize the negative consequences of industrialization.

The process of institutionalization of environmental issues has started during the 60's of the last century. The most important contribution to the improvement of intergovernmental cooperation regarding the environmental problems has given the United Nations Conference held in 1972 in Stockholm. On that occasion, as the primary tasks of the humans, proclaimed the protection and improvement of its environment. On that occasion, the protection and improvement of the environment was proclaimed as primary tasks of humans. However, the mere implementation of institutional mechanisms cannot provide the expected results if individuals do not adopt the ecological values and, in accordance with that, change their behaviour. The only non-institutional area of activity

recommended in the strategy prescribed by the current Action Plan for of environmental protection is the education of citizens about the importance of the environment.

During the recent decades, in the world and in our country, it has been intensively worked on the development of the educational process in the field of environmental protection, through the planned development of interdisciplinary and multidisciplinary knowledge [2]. Ecological education and upbringing of people ensures their active engagement in the solution of problems in this area. The basic aim of environmental education is to develop environmental awareness consisting of the following elements: ecological knowledge, environmental attitudes and environmental performance. Environmental awareness is an "awareness of the environment that includes attitudes, models of behaviour, motives of action, wishes and expectations relating to human natural environment" [3]. Although the younger generations are not responsible for the contemporary problems, improving the environmental awareness and knowledge of young people is one of the most effective ways in which the global community can cope with the consequences of the ecological crisis.

Environmental attitudes can be defined as attitudes "towards the environment that are harmonized and demonstrate a positive or negative attitude manifested in the form of acquired tendencies "[4]. By studying them, it could be determined the degree of concern or indifference towards the human environment as well as its will to participate in actions to preserve the natural values. Population group with the most important role in the preservation and protection of nature are students [5]. Accordingly, there are a number of studies that dealt with the environmental attitudes of young people [6, 7, 8, 9, 10, 11,12].

Based on a detailed review of scientific facts in the field of investigating the environmental attitudes of young people, Rickinson [13] draws the following conclusions: 1) young people fosters positive attitudes towards the environment; 2) young people are less environmentally oriented in relation to specific issues, such as those that are related to their way of life; 3) the attitudes of young people towards the environment is influenced by several factors (gender, socio-economic groups and to a lesser extent, age and academic orientation).

2. RESEARCH AIMS

Despite many problems that threaten the environment, there has not been paid enough attention to the study of this area in Serbia yet. Formation of environmentally unsustainable behaviour patterns, initiatives and policies is, in a great extent, result of the fact that we live in a country which is struggling with problem of unfavourable economic situation and poverty. Having in mind that environmental education is a form of education which affects all spheres of society, it is necessary, firstly, to examine the attitude of young people towards the environment, but also the correlation between this attitude and numerous different variables.

The aim of this study is to examine the attitudes of students from Technical Faculty in Bor towards environmental problems. Based on the relevant literature, the following research questions are set:

1. What are the attitudes of students towards environmental issues?

2. Is there a statistically significant impact of gender on the environmental attitudes of students?
3. Is there a statistically significant impact of the grade level on students' environmental attitudes?

The results obtained in this way can indicate the current level of respondent's sensitivity to the nature values and their awareness regarding environmental issues. In this way, it is possible to lay the groundwork for the successful formulation of ecological educational programs of education.

3. METHODOLOGY

For research purposes, a survey was selected as a methodological procedure for data collection. Information collected by surveying allow gaining a new knowledge about the research problem, by obtaining its description, its understanding and, if possible, establishing causal connections and relationships [14].

The questionnaire used in this research consists of two parts. The first part consists of basic questions regarding the demographic characteristics of the respondents (gender and grade level), while the second part is partially modified version of the questionnaire "The Attitude Scale of Environmental Problems" [1]. The survey was adapted to characteristics of the area and population where survey is implemented, by removing four questions that are not related to the conditions in Serbia. The remaining 18 questions from the original questionnaire [1] have been translated into Serbian and constitute the second part of the questionnaire. Their level of agreement with the specified statements, respondents were expressed by rounding the number on a five-point Likert's scale, where 1 means "strongly disagree" and 5 being "strongly agree".

The survey was conducted in March 2012 at the Technical Faculty in Bor. The sample consisted of 106 undergraduate students of the Department for Engineering Management. Out of the total number of respondents 51 was male and 55 was female. The distribution of respondents by sex and grade level is presented in tables 1 and 2.

Table 1. Distribution of respondents by gender

Gender	Frequency	Percent
Male	51	48,1
Female	55	51,9

Table 2. Distribution of respondents by grade level

Grade level	Frequency	Percent
First	35	33,0
Second	24	22,6
Third	22	20,8
Fourth	25	23,6

Data collected in this way are processed by statistical package "SPSS 18.0 for Windows." The arithmetic mean and standard deviation values were used for exploring the attitudes of students about environmental issues. "Independent samples t-test" was used to determine the existence of significant differences in attitudes depending on the gender. "One way analysis of variance (ANOVA)" was used to test whether the respondents' grade level have an impact on their environmental attitudes.

4. RESULTS

Students' attitudes toward environmental issues are determinated based on the values of standard deviation and arithmetic mean (Table 3). According to the results, students of the Technical Faculty in Bor have positive environmental attitudes. This is supported with high mean value of the given responses (Mean = 4.63).

Question	Statement	Mean	Std. dev.
Q1	Although there are more important projects that should be supported in Serbia, the World Bank to support projects in air pollution measurement is unnecessary.	3,18	1,308
Q2	Using natural gas at residential and commercial buildings would not contribute to the solution of the problem of air pollution.	3,06	,822
Q3	Thinning of the ozone layer threatens all people.	4,52	,784
Q4	The news about sea, river and lakes are contaminated is exaggerated.	2,53	1,259
Q5	The drinking water in big cities is polluted enough to require	3,52	1,205

	the use of water filters at homes.		
Q6	Serbia has no problem of desertification.	2,97	,920
Q7	For enabling to meet the needs of people with clean air, they should be encouraged to make small houses in the forested areas near the cities.	3,18	1,209
Q8	Air, water and soil are inexhaustible resources.	2,80	1,390
Q9	No matter what country engaged in nuclear testing should be protested.	3,79	1,151
Q10	Rapid population growth is a serious environmental problem.	3,37	1,198
Q11	The malnutrition in underdeveloped countries is a consequence of environmental problems.	3,39	1,083
Q12	It should be interfered to the ones who throw rubbish or spit on the ground.	4,68	5,036
Q13	The idea of environmental protection was invented by Western people to prevent the development of developing countries.	2,67	1,185
Q14	Being sensitive to environmental problems does not prevent the development of a country.	3,71	1,219
Q15	The emergence of environmental groups, protecting the environment too, stems from the need to make friends.	2,88	1,093
Q16	Any institution or organization, including the United Nations, should not intervene the use of its natural resources as they wish.	3,70	1,034
Q17	There should be given more space to the programs related to environmental issues in newspapers, magazines and television programs.	4,24	,857
Q18	Countries should set up Ministries of Environment to solve environmental problems.	4,25	1,005

Statements with the highest mean values are:

Q3: *Thinning of the ozone layer threatens all people* (Mean = 4,52);

Q12: *It should be interfered to the ones who throw rubbish or spit on the ground* (Mean=4,68) and

Q18: *Countries should set up Ministries of Environment to solve environmental problems* (Mean=4,25)

Statements with the lowest mean values are:

Q4: *The news about sea, river and lakes are contaminated is exaggerated* (Mean=2,53);

Q13: *The idea of environmental protection was invented by Western people to prevent the development of developing countries* (Mean=2,67) and

Q8: *Air, water and soil are inexhaustible resources* (Mean=2,80).

Is there statistically significant correlation between gender and environmental attitudes?

Impact of gender on environmental attitudes of the interviewed students was examined using "Independent Samples T-test". Correlation between these variables was recognized in two cases (Picture 1):

Q5: *The drinking water in big cities is polluted enough to require the use of water filters at homes.*

Q10: *Rapid population growth is a serious environmental problem.*

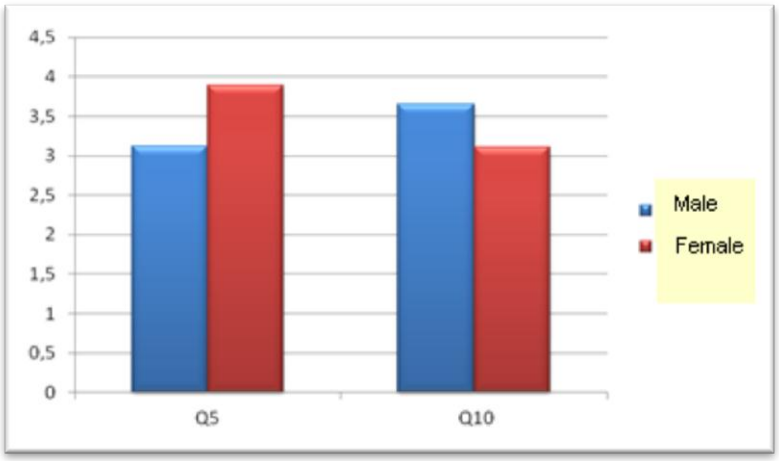

Figure 1. Impact of gender on the answers for Q5 and Q10 questions

Based on the above results, it can be concluded that there is not statistically important influence of the gender on the environmental attitudes.

In order to determine eventual correlation between the year of study and students' attitudes toward environment, it was conducted "One-way Variance Analysis (ANOVA)" test. The results showed that the correlation between these variables is present at following cases (Table 4):

Q7: *For enabling to meet the needs of people with clean air, they should be encouraged to make small houses in the forested areas near the cities.*

Q10: *Rapid population growth is a serious environmental problem.*

Q16: *Any institution or organization, including the United Nations, should not intervene the use of its natural resources as they wish.*

Q17*: There should be given more space to the programs related to environmental issues in newspapers, magazines and television programs.*

Table 1. Mean and standard deviation values for questions Q7, Q10, Q16 and Q17

Year of study		**Q7**	**Q10**	**Q16**	**Q17**
First	Mean	3,14	3,03	3,49	3,94
	Std. deviation	1,287	1,043	1,147	,968
Second	Mean	2,63	3,00	3,79	4,17
	Std.deviation	,924	1,383	,779	,761
Third	Mean	3,36	4,05	3,45	4,45
	Std.deviation	1,093	,785	1,011	,739
Fourth	Mean	3,60	3,60	4,12	4,52
	Std. deviation	1,291	1,258	1,013	,770

From the Picture 2 it can be noticed that the environmental attitudes are more positive if the study level is higher only in the statement Q17.

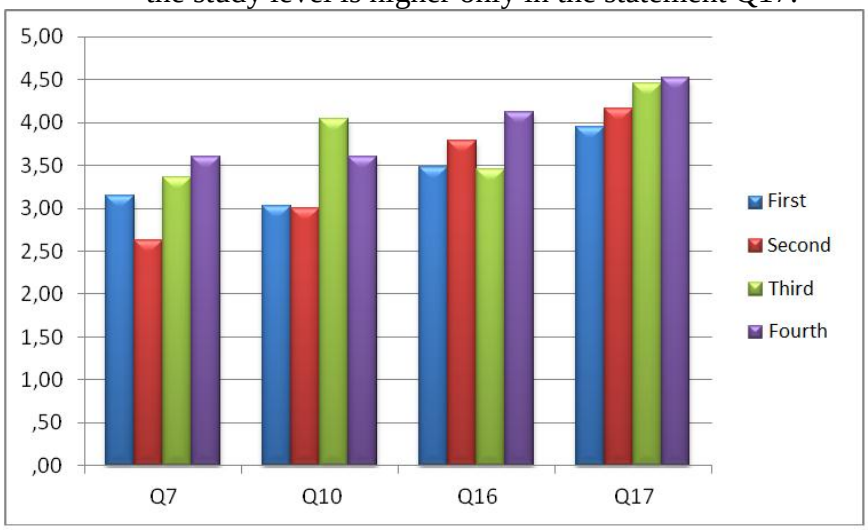

Figure 2. Influence of study year on answers on questions Q7, Q10, Q16, Q17

Besides the influence of study year on four statements from the questionnaire, it couldn't be said that there is statistically significant influence of these demographic characteristics on environmental attitudes of students from Technical faculty in Bor.

5. DISCUSSION

Based on the research conducted at Technical faculty in Bor regarding students' attitude toward environmental issues several conclusions can be drawn. The mean value of the responses is 4.63. This high value indicates that students in Bor are largely aware of the threat to nature and have a positive attitude toward efforts to solve environmental problems. Most preveious research stated that students are more often agree with ecologicaly oriented statements then to be indifferent toward them or do not support them. [1,7, 8, 9,11,13,15,16].

Students in this survey recognized destruction of ozone layer as the biggest ecological problem. This conclusion is drawn based on responses to the statement *„Thinning of the ozone layer threatens all people"*. In existing literature ozone depletion was also stessed as the biggest threat to the environment [17,18,19].

On the other hand, statements with which respondents showed the lowest level of agreement are: *„The news about sea, river and lakes are contaminated is exaggerated"*, *„The idea of environmental protection was invented by Western people to prevent the development of developing countries"* and *"Air, water and soil are inexhaustible resources "*. By analysising these statements, it is evident that they are formulated in such way that a lesser degree of agreement with them suggests a more positive attitude of the respondents to the issue in question. That confirm the above conclusion on the generally positive attitude which students have towards environmental problems.

All relevant studies which analysed differences in responses between male and female regarding this issue found significant correlation between these two variables [8,10,11,12]. Only, Lyoons ad Breakwell [14] didn't found any correlation between gender and environmental issues. However, given that in their research 3 point scale was used, those results should be taken with a grain of salt. Results obtained in present study didn't show differences in students' responses regarding gender. But, it should be noted that a sample of 106 respondents is insufficient to take this results as reliable.

As it was already stated significan defferences in students' responses regarding their gender was not observed. But, some questions are exceptions, such as: *„For enabling to meet the needs of people with clean air, they should be encouraged to make small houses in the forested areas near the cities", „Any institution or organization, including the United Nations, should not intervene the use of its natural resources as they wish", „Rapid population growth is a serious environmental problem"* and „*There should be given more space to the programs related to environmental issues in newspapers, magazines and television programs „.*

Limitation in this research is that all conclusions are drawn based only on answers of students from Technical faculty in Bor. Second limitations is a very small sample (106 raspondents). Such a small sample can not provide reliable results. So, recomendation for future research is to expand sample and to include students from other faculties in survey. Also, impact of some other socio-demographic factors, beside gender, could be analized.

6. CONCLUSION

One of the terms for Serbia, in order to become equal member of European Union is institutionalization of environmental issues, but also taking activities for raising envornmental awereness among people. Beside, this goal is also important for social sustainabilty in Serbia. One of the way to fullfill this goal is to implement ecological issues in educational system.

The process of education should start in the early childhood, by adopting ecological values within the family. And later, schools must strenghten these values for example by giving them information about largest ecological problems, encouraging active participation in cleaning environment, organizing discussion and students conferences. Schools and other relevant institutions should promote development of responsable attitude towards nature.In Serbia, level of ecological awerness is still at a very low level. By including envornmental aspects in development strategies and programs it is possible to provide safe and sustainable future, which will as a result produce generation of environmental awared young people.

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CSR STRATEGY OF SMES IN ENVIRONMENTAL CONDITIONS OF THE CZECH REPUBLIC

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Abstract

Nowadays, when most business players are focused on their own benefits and interests in the area of economic, social and in most cases regardless of the environmental impacts, there is no much space for interest in future development that would be sustainable for future generations. The aim of this paper is to introduce Corporate Social Responsibility in conditions of the Czech Republic with the main strategies of Small and medium sized enterprises and government support.

Keywords: *CSR, SME, Environment, Strategy, Czech Republic*

1. INTRODUCTION

Strategy of Corporate Social Responsibility (CSR) [15, 16] is a strategy highly developed in Western Europe and that slowly but surely enters into subconscious of Czech public. CSR topic is constantly is becoming more important and can therefore be regarded not only as a current topic but also as a future theme. Corporate Social Responsibility of SMEs has become a hot topic in European and global level in recent years. Responsible company cares not only about their profits, but also emphasizes on improving the environment and creating favorable conditions in social area. Such activities can greatly enhance the contribution of companies to environs. In the Czech Republic, the implementation of CSR has been slower than in other countries, but today, this trend continues growing. National and international organizations, but also general public put pressure on companies to act responsibly not only within their business, but also beyond that. Although the concept of social responsibility is still relatively new, it has already been avowed by a large number of companies across all continents. The reason for the company to accept the concept of CSR is not only a selfless feeling of responsibility for the impact of their corporate activities and a fellow feeling to society and the community, but also the opportunity to reach new customers and retain existing customers. In today's highly competitive environment, customer requirements to purchased products or services are growing. It is no longer enough just to offer a discount or second product for free. The public assumes that firms have the chance to influence the environmental and social issues, and asks them to do it. [5] "Business success and social well-being do not need to be a

zero-sum game." The statement, whose author is Michael E. Porter [12], has pointed out that corporate social responsibility do not have to be given only by the amount of resources spent on charity or other socially beneficial actions, but can represent a competitive advantage which has an impact on the company's performance. Due to the fact that in 2015, the share of SMEs was 99.83%, in the total number of business entities, socially responsible activities on the part of those entities are crucial to expanding CSR principles across the business community.

Corporate social responsibility is nothing new. Theoretical origins of this concept could be found about 60 years ago, which is not so long ago. In fact, however, responsible activities towards the nearest neighborhood of the company have been practiced much earlier but they have not been assigned under a rather sophisticated-sounding concept of Corporate Social Responsibility. Breaking year for the beginning of CSR was 1953 when Howard Bowen [21], wrote a book called Social Responsibility of the Businessman which brought into being now a commonly used term CSR - Corporate social responsibility. Bowen [21] came out with the requirement of integrating social aspects of business management in his book. For one of the key definitions can be considered "CSR involves voluntary integration of social and environmental aspects in cooperation with stakeholders in the business activities of the company", which is used by the European Commission [1]. In recent decades, the majority of experts [18, 17, 19] agreed on two basic definitions of corporate social responsibility; CSR is a concept whereby companies voluntarily decided to contribute and the improvement of society as a whole while respecting and protecting the environment.

Corporate social responsibility is according to current theory generally divided into three areas, or pillars - social, environmental, and economical, in English often used as "people, planet, profit". For this division, as for the basic orientation in the field of Corporate Social Responsibility, John Elkington [20] introduced- taken from a British NGO Sustainability- a widely used term "tripple-bottom-line" in 1996. Within tripple-bottom-line pillars, it is possible to further specify the target groups on which activities in this field should be focused, as well as potentially problematic issues itself, and finally the tools used in the company's management of these areas. [2] All three pillars of corporate social responsibility correspond to the basic elements of sustainable development, which is also discussed in terms of environmental, economic and social development. Relationship with sustainable development explicitly demonstrated by one of the above mentioned definitions of corporate social responsibility, as well as the conceptualization of CSR concept in the long term and the view of the European Union, which currently considers CSR as a means to achieve sustainable development. It is important to emphasize that only by taking all three pillars of CSR into account, sustainability (for another life on our planet so important) can be achieved. Basic dimensions:

2. ECONOMIC AREA

A socially responsible company in the economic field is expected to operate transparently and takes care of good relationships with owners, customers, employees, investors, suppliers and other business partners. The company should provide transparent information about their business, it should not approach to any form of corruption or bribery, and should fight against misusage of confidential information. The company also may not use unfair practices in a cartel or advertising. The company shall not misuse

information about their customers and must provide a clear and truthful information about their products and services. The main aspects are summarized in Table 1 in points.

Table 1. Economic aspects of CSR [22, 23, 24]

the creation of obligatory ethical codes	emphasis on innovation and sustainability	innovation and sustainability of products
open communication with the public	intellectual property protection	customer relations
marketing and advertising ethics	rejection of corruption	fair trade and good relations with investors
quality and safe products and services	transparency	

3. ENVIRONMENTAL AREA

Activities within the environmental pillar should take into account both legal environmental requirements and standards, and increasing demands of consumers for organic products. The ecological problem is becoming hotter and hotter topic in recent years and therefore firms should expend considerable effort to environmental activities, not only as a protection of the environment from outside the company, but also from the inside. A company behaving in respect to the environment and minimizing the negative impact of their business activities can profit from these efforts. Such a company has an opportunity to compete for tenders for large corporations and public administration and can gain considerable competitive advantage for customers who care about the environment.

Table 2. Environmental Aspects of CSR [22, 23, 24]

compliance with national and international standards	environmentally friendly production ecological packaging	investments in environmental technologies
reducing negative impacts on the environment	own environmental strategy	monitoring environmental impact
environmental policy of the company in relation to production, products and services	compliance with safety rules when handling hazardous substances	friendly way to transport goods and materials
providing accurate environmental information about products, services and activities	the inclusion of environmental criteria in the selection of suppliers and subcontractors recycling and use of recycled material	adheres strictly to mandatory legal standards in the field of environmental protection of natural resources and careful handling
the introduction environmental management		

The company behaving ecologically saves energy, water and non-renewable resources. Properly and systematically recycles and sorts waste. The company should be interested in the latest eco-friendly materials and use as little packaging materials. The firm can decisively save the environment in area of effective transporting goods, parts, services or company employees.

Many accompanying tools contributes to establishment and preservation of environmental aspects. We rank there the anticipation of legislative steps that have an impact on society and SMEs. The installation of eco-labeling for products or services. Investing in science and research, particularly in the area of more careful usage of resources. Planning not only in terms of transport but also the space and landscape. Finally, formal and informal systems of environmental management.

4. SOCIAL AREA

Third, social pillar focuses on the working environment in the companies and working conditions and the opportunities for the employees. This area is most of all dedicates internal business environment, but it has some impact on the community in business. Operations undertaken within the social pillar can significantly vary in particular companies, because they are based not only on business and financial capabilities of individual companies, but also from the state of labor market. Companies of course do not engage in self-contained world generally. On the contrary, they are part of a large quantity of an interconnected network of relationships, and therefore all their entire activity is often exposed to the critical eye of consumers, employees and other groups.

Table 3. Social Aspects of CSR [22, 23, 24]

adherence to high labor standards	respect for human rights to pursue a career	outplacement policy
equal opportunities	the possibility of variable working hours	healthy corporate culture
development of human capital in the form of lifelong learning	Activities for children and families of employees	prohibition of child labor
contributing needy within charity projects both financially voluntary employee benefits	employment development and local infrastructure work-life balance	cooperative dialogue-management approach

Employee involvement in decision-making of the firms as well as fair treatment of employees, care about their education and development, respectively nonfinancial benefits are related activities in the social sphere of CSR. About the local community, it is very beneficial for the prestige and reputation when the company participates in the organization of local and cultural activities. In this area, the emphasis is placed on long-term positive relationship between the company as an employer and his employees. This is mainly about creating good working conditions which is important for employee loyalty,

which will result in sustainable productivity, lower fluctuation and greater focus on enterprise in the labor market.

On the other hand, the concept of CSR raises many questions and there are opponents who do not attach great importance to CSR concept for the future and take a classical theory that the company should primarily maximize its profit. According to them, the primary business objective would not be filled without that. But the goal of business is a dynamic process of continuous innovation, new strategies, adapting the market in which the company operates.

5. CSR IN THE CZECH REPUBLIC

In the Czech Republic, CSR takes on meaning in the second half of the nineties in the 20th century. But if we look deeper into the past, we find the Czechoslovakian entrepreneur who was a protagonist and pioneer of CSR activities in the first half of the 20th century. This fact was also mentioned by Vladimir Spidla at the European Commission's conference "Corporate Social Responsibility in Enlarged Europe" in 2006 in Brussels: "Corporate Social Responsibility is not novelty in the Member States, in the Czech Republic there has already been such a good example- entrepreneur Tomas Bata [11, 14]. There has already been made more relevant surveys showing a positive trend in the perception of CSR by Czech managers in the Czech business environment. The actual content of these activities in individual companies is always dependent on the industry, size and business sector of companies. In 2003, the Business Leader Forum addressed 265 Czech companies, of which 42% actively participated in the survey. In the years 2010, 2011 there was carried out another investigation. Most of the companies in the survey agreed with the statement that to achieve satisfactory profit company should engage in social activities, which would support its commercial activities. However, there has always been several critics of this theory. [3, 7] Because the CSR concept is still being under development and the society is getting used to it yet, it faces several challenges that with the development and better understanding likely disappear. One of the common mistakes businesses considering the adoption of the concept of CSR are doing is that socially responsible activities are considered to be a burden on their budgets. Unfortunately, many Czech companies because of their ignorance of CSR believe that social responsibility involves mainly philanthropy, a donation of funds for socially beneficial projects. Another common mistake in thinking about CSR is an approach to socially responsible behavior only as a tool for public relations and make them presence felt. This is a problem mainly of retail companies that are trying to sell their products or services through CSR. In the B2B business PR does not reach the equal importance as in B2C, or more precisely, it has not so significant impact on business customers. Cares more about long-term favorable relations, which are conditioned by consequential CSR activities. The third major problem in the area of CSR is called pinkwashing and greenwashing. Both of these terms mean socially responsible behavior "outwards", thus the situation where companies present themselves as socially responsible, even though the reality is unlike.

Positive awareness of CSR does not always mean a practical application. Some companies, especially small and micro, have sometimes negative view on CSR activities, but in the course of more detailed analysis has been revealed that CSR activities are nevertheless implemented, the company only does not realize it and does not know this term. The

explanation is clear, small business, for example operating in the countryside, employs workers from the surrounding area. Poor relations with employees could result in a deterioration of its reputation and could endanger the operation of the company. This fact causes that the company sponsors cultural and social activities in the region. Small businesses can hardly afford bad relations with suppliers, they could then face a situation that supply of the necessary materials or services could be delayed or scarce. [3, 8] Awareness of CSR is dependent on the availability of information. As can be seen from the following table, which comes from more recent 2010 survey, the most important source of information, especially for smaller organizations, represent the media.

It is true that there is no direct mention of corporate social responsibility in any government or ministerial document, perhaps because it is a concept entirely voluntary. Indirectly, however, support from the Czech Republic goes from, for example, the International Competitiveness Strategy of the Czech Republic for the period 2012 - 2020 and the National Innovation Strategy. International Competitiveness Strategy for the Czech Republic for the period 2012 – 2020 was created by the Department of Industry and Trade. This is a document that should prepare the Czech Republic for the future globalized world. The Czech Republic has been facing a loss of competitiveness recently. This is evidenced by the fall in the ranking compiled annually by the World Economic Forum- Global Competitiveness Index. Currently compared to international competitiveness we are at the 38th place at which the Czech Republic fell from 36th respectively 31st place, which occupied during the period 2009 - 2010. And therefore Ministry of Industry and Trade created the strategy, whose vision formulated as follows: "High and sustainable living standards of citizens of the Czech Republic based on the solid foundations of competitiveness" [11, 14]. International Competitiveness Strategy contains forty projects in various fields, such as labor market, infrastructure, institutions, education and innovation, which are developed into concrete action. Projects should help to create friendly conditions for creative businesses and the growth of living standards and innovation. Ministry of Industry and Trade formulated rather ambitious goal in the strategy- to get to the top twenty most competitive countries in the world until 2020. [9] An effort on compliance of ethical business and the inclusion of responsible behavior into business activities could be traced in Export Strategy of the Czech Republic for 2012-2020 or in the national quality policy. These government activities in the Czech Republic in this area are rather insufficient. It lacks a systematic focus on the promotion of the concept, not only towards large and multinational firms, but especially towards small and medium-sized enterprises, which are the driving force and the future of the Czech Republic and their citizens. Previously, there were proposals for the introduction of the office of the Minister for Social Responsibility, as is the case in the UK. Czech citizens have not come to a degree of recognition of the importance of responsible behavior yet, but it is necessary to pursue the principles of CSR, to implement them gradually into the government policy, to promote education and research in the field of CSR. Exemplary conduct of government and heads of state would also be conducive to motivate companies to behave responsibly and to enforce ethical environment. [11, 14]

Studies have shown growing interest of Czech companies in applying CSR activities during the period under review (2004-2011) by way of improving the company's reputation. Dominated activities in the survey were activities promoting higher quality of care of employees in order to maintain and gaining quality of staff mainly through their systematic training. It is essential for companies, because only educated and satisfied

employee can distract quality work and produce high quality products. This implies a relationship to customer whose loyalty is very dependent on the quality of the products on the rebound, and therefore increases the company's competitiveness with other players in the market. A lower percentage in matters relating to the customer is likely does not mean lower interest of managers towards customers. Customer care is so obvious for the managers that it is not considered as special CSR activity by the respondents.

Valuation of the best socially responsible companies is taking place around the world and even the Czech Republic is not in left behind. The longest Czech tradition of announcing and holding competitions of CSR holds contest TOP Philanthropist. In recent years, however, we can see an increase in companies that announce more and more CSR competition aimed at different categories. There are several advantages for companies that behave socially responsibly in all three pillars of CSR because of the growth of these competitions. Responsible company theoretically can enroll in several competitions and achieve such a prestigious award that can bring reputation, more customers, and other benefits that flow from the company's visibility in this area. Benefits constitute motivation and the reasons why a socially responsible company should sign up for the competition and strive to meet the announced criteria, which are a condition for participation.

5.1. ORGANIZATION FOR THE PROMOTION OF CSR ACTING IN THE CR

Probably the most famous initiative that deals with the issue of social responsibility in the Czech Republic is the Business Leader Forum, an association of international and Czech companies operating in the Czech Republic since the early 90s. The aim of Business Leaders Forum, hereinafter referred to as BLF, is to spread awareness and interest in CSR, to help businesses understand the strategy of social responsibility in depth, to present the activities of companies that have already adopted CSR concept as their own and transmission of information resulting from discussions at European level. Another well-known organization in connection with CSR operating in the Czech Republic is the Czech Donors Forum. Another initiative is providing information on Europe-wide debate on CSR. This association is diverse and has direct access to key international organizations dedicating responsible entrepreneurship. This civic association has been present for more than 14 years and the main challenge is to promote philanthropy. Also provides advice in this area. Its main interests are the support of foundations and endowment funds, creating conditions for corporate philanthropy and improving the legislative environment for philanthropy. [25, 26] The main mission of CSR Europe association is to link companies across Europe and sharing of ideas and best practices in CSR and innovation. This organization, founded in 2000, aims to build corporate vision and political agenda in synergy with sustainable development and a high level of competitiveness in Europe. Through the initiative Enterprise 2020 company CSR Europe builds cooperation and innovation activity in companies that are in the best case linking the European Union's strategy for 2020 overall steady growth in Europe. The company also provides extensive consulting assistance to European companies. CSR Europe supports companies in building lasting competitiveness mainly through: - Support Program Innovation - accentuating high degree of cooperation between companies and their stakeholders, searching for new ways of coordination - working closely with the EU institutions and a number of other international organizations. [25, 26]

Donors Forum was founded in 1999. It contributes to the development of environmental philanthropy in the Czech Republic, cooperates with foundations and endowment funds and communicates with international partners. It launched a system of donor text message DMS in cooperation with mobile network providers in 2004. Prize for the largest donor in the country called Top Philanthropist is awarded annually. It is the only nationwide association of the donor. The company was founded over 14 years ago and successfully participates in the building and development of donation environment all the while. During the Forum there were the Association of Foundations, Association of foundations and Corporate foundations, which bring together a total of 66 members. Donors Forum members are significant endowment funds and foundations like The Club of corporate donors Konto bariéry, DONATOR, ADRA Foundation, Civic Forum Foundation and dozens of others. Among other things, they provide CSR consultancy and their aim is primarily the development of philanthropy in the Czech Republic, strengthening of endowment funds and creating conditions for corporate donations, which is an integral part of social responsibility. It is also co-founder of platform for responsible donation of Business for Society. Both of these platforms announce the award named Top responsible company every year together.

OECD Guidelines for Multinational Enterprises, the OECD regularly publishes a document (a set of guidelines last updated in 2011), which contains recommendations in the CSR, formulated by governments for international corporations. The OECD has also created a network of NCPs (National contact points - NCPs), which are the administrative under governmental authorities. Their task is to implement the directives, provide information about CSR and leading a dialogue between businesses and governments.

ISO 26000 This is the standard that is the result of dialogue of enterprises and organizations engaged in CSR with the International Organization for Standardization ISO. Summarizes the area of implementation and management of CSR comprehensively and provides simple and clear instructions. Standardization was established in 2010 and is purely voluntary. [6]

The Association of proper business aims through voluntary compliance with the Code "Fair Business" to separate the honest and reputable entrepreneurs from those market players that harm the reputation of Czech companies internationally. This association was founded by professional organizations of manufacturers and service providers from the Czech Republic, whose mission was to improve the image of entrepreneurship amongst the general public and to cultivate business environment in the country. For the founder, trust of consumers in relation to suppliers, sales and advertising was equally important. The initiative to form an association created between the companies and organizations that were not indifferent to the poor image of business that the Czech public until recently prevailed. This negative image obviously injured and is still partly harming honest and socially responsible entrepreneurs. [10]

Czech Society for Quality, a civic association whose vision is to spread knowledge to support organizations and improving the quality of life throughout society. It is a professional governing body of section of the Quality Council for CSR. Awards annually by the Czech National Award for CSR (The award is given to organizations in the private and public sector). The Council is also expanding quality model governor Prize, which was first awarded in 2009 in the Moravian-Silesian region, and aims to extend to other regions of the country. The company was the main initiator of the publication of the National

Quality Policy and Quality Charter signatory of the Czech Republic. The company has established a certified quality management system according to ISO 9001 National Quality Policy.

AA 1000 Accountability / Assurance standard British Institute of Social and Ethical Accountability created a variety of standards supporting fair business credibility screening of the organization and their approach to CSR in 1999. The main focus of this standard is the social CSR.

Global Reporting Initiative (GRI) is currently the most widely used system of indicators and methods for measuring and evaluating the sustainability of the business. Giving instructions to improve the quality, accuracy and usability of reporting on CSR and creates standardized evaluation mechanisms.

National Quality Policy (NPK) is a collection of methods, tools and targets of influencing the quality of products, services, activities within the national economy of public administration. It was adopted by Government resolution dated 10. 5. 2000. The aim of the program is to create- in an environment of the Czech Republic- conditions so that the quality would be the natural part of life of society and thereby Czech products and services would become competitive on international markets. Ministry of Industry and Trade is entrusted by controlling the policy. The first mention of CSR appeared in strategic materials of Quality Council of the Czech Republic (the supreme body of NPK) in 2004. Among the achievements of the Council ranks the support of creation of the Association of fair trading-of proper business (see previous text) and just from the initiative of the Quality Council the Association of fair business has started to deal with evaluation of CSR issues. Another achievement was the establishment of the first Czech comprehensive methods for measuring social responsibility KORP (it is a booklet with instructions on how to proceed when measuring CSR). In 2007, a pilot project to implement the principles of social responsibility was realized in three companies and a subsequent measurement and evaluation of their CSR Reports according to the KORP method was made. [25, 26]

London Benchmarking Group (LBG) methodology, created in the UK in the 90s, is primary and most concerned on finding ways to measure and compare the relationship of companies with the community (stakeholders).

EFQM Excellence Model EFQM created a tool for increasing competitiveness and improving all activities using self-assessment and benchmarking in 1989.

In the area of CSR, there are tools by which socially responsible practices of company are evaluated. These instruments are the norms, standards and voluntary initiatives. The purpose of their introduction is the systematization, the possibility of benchmarking with competitors and generally creating a framework for corporate social responsibility, which can then be- based on these instruments- reported and generated feedback. Currently, there are many organizations providing information and evaluation of CSR related services. These organizations act as independent observers and evaluators of practices of the company. [6]

5.2. EVALUATION OF STRATEGY

With more and more focus on CSR activities, there are also come questions about how CSR fits into the context of the companies' competitiveness. It creates a new look at this area in the form of so-called strategic approach to CSR. Enterprises within the Strategic CSR identify critical factors and choose such a socially responsible issues which significantly affect the competitiveness and future development of the company.

When creating a CSR strategy it is important to emphasize the fact that it would not only fulfill the role of corporate philanthropy. Unilateral spending of firms to charity (donation) should not be confused with CSR strategy. Donations must be efficient and effective, there must not be wasting of resources and should be beneficial to both parties. An effective CSR strategy leads to fulfilling the economic goals of the company and ultimately should lead to the creation of additional value. Creating a strategy meets classic pyramidal hierarchy, when on the top there is clearly defined vision and at other levels of the individual strategic objectives and measures.

Competitive advantage is holding by those companies that are able to respond flexibly to changing market conditions, to change the expectations of the customer and include socially responsible aspects to their business. CSR activities are considered to be a significant competitive advantage to the company, which differs the company from other companies of the market. Porter dealt with combining CSR and competitive advantages and advised businesses to set with the help of value chain (Value Chain analysis) such factors (Generic social issues) that have an impact on the competitiveness of businesses and to map out the social impact of corporate social responsibility. Porter adapts competitive advantage to CSR strategy and seeks to identify the principles of strategic CSR. [12]

Porter and Kramer cites two main reasons why companies do not use the full potential of social responsibility. The first of these is that business and society are opposed to each other. CSR is not viewed as a competitive advantage, but only on reducing negative impacts of corporate activity. The second problem is that businesses are still thinking about CSR only in general. They should concentrate on applying CSR especially in those areas where they can combine with a competitive advantage. This should be based on the so-called "Shared values", values that are essential for both the stakeholders and the company itself. Porter further distinguishes direction of the factors- influence “inside out” and action “outside to the inside”. Factors affecting the inside out are any activities of the company. Any activity of a company has more or less positive or negative impact on its surroundings. By action from outside to the inside are then meant influences on the company or the demands of the company. Porter also suggests that it is appropriate to define areas of social responsibility, which the company wants to devote its attention. The aim here is not the most economically advantageous solution but finding the above-mentioned "shared values". He divides social responsibility as follows:

- Generic social issues (important to society, but do not affect the competitiveness of the company or the company cannot influence)
- The social impacts of business (impacts of company activities on its surroundings)
- Social impacts of the competitive framework (factors of external environment important for a given location)

- The company should divide problems on each of its business unit separately and thus avoid the general concept

To create a new culture that encourages change of thinking about doing the right thing involvement of employees is crucial. The company should create such an environment where employees want and have the opportunity to come up with new ideas in the field of CSR, they can consult with competent colleagues, or get a subsidy for their implementation. If employees come up with the idea themselves the concept of CSR is more likely to succeed. Implementation is successful, when it becomes an integral part of the vision of the company, its values and when most executives and workers themselves believe in this concept and its utility. Therefore, it is essential that the organization has a clear vision. It should determine what it wants to achieve in the future, what are its preference. After defining the vision and determination of values of the organization the company can proceed to the next step, namely to determine the principles of responsible behavior. Of course it depends on the particular company, what would specify. An example of this principle may be sufficient awareness of employees and their maximum participation in these activities. The organization should also focus on evaluation its current position within the CSR. The company should consider what are the specifics, who are its clients, what is its image and accordingly should evaluate its current activities- what activities will focus on during this activity. [10] Before setting the main topics of CSR, the organization should conduct a comprehensive analysis of itself. It should start with an internal analysis, in which it asks questions regarding its approach to responsible activities. Does it act responsibly towards its employees, business partners, surroundings or environment? At this stage it is appropriate to identify the awareness of CSR of employees of the company. After this self-assessment, the company should proceed to external analysis. Within this analysis the company should recognize CSR activities of its competitors, compare their activities and their results with the best practice in the field or identify the possible effects of certain external initiative, such as the newly adopted laws. [4]

The implementation process of CSR concept into the company's strategy is comprehensive and long-term task, in which it is necessary to change the view of the current operation of the company and which is not possible without active involvement and support of top management of the organization. The entire process consists of several stages. At first, the company needs to define why they want CSR, which form, the current status and what the new CSR concept in the organization should look like. The aim of introducing CSR into the organization is effective involvement of certain CSR activities in the values of the company and its culture.

5.3. BENEFITS

In the last few years, we can hear about CSR more frequently. Many businesses do not realize only the occasional socially responsible activities, but they create a comprehensive CSR strategy. Shareholders are far from the only ones who companies are responsible to. Public awareness about responsible behavior of companies is growing and with this fact also the pressure on businesses to meet the expectations of their customers, subscribers or those residents who live near their factories grows. Corporate involvement in the concept of CSR is also increasing because customers are becoming more demanding,

less loyal and more informed about the quality of products. They care not only about the companies that manufacture products, but are also concerned about how the company acquires raw materials for production. Deciding on a product is no longer based just on famous names of companies, but also on its activities towards society or nature. Customer preferences and overall public is changing and today the emphasis is on the goodwill of the company. [29]

In the first place was the advantage from the general employee satisfaction, then improvement of relationships with partners. The third group most affected by CSR were customers. The importance of implementing social responsibility to employees and customers was also confirmed by the investigation undertaken by Ipsos Tambor, Prague in September and October 2010, which resulted in: - Two-thirds of the Czech population when buying products or services are influenced by the fact whether a company is socially responsible. This finding is consistent with the experience in the international business environment. For example, Matten and Crane [30] found out that 60% of consumers prefer products made by socially responsible manufacturers. Pressure from customers to the companies and their socially responsible behavior is critical. [27]

A number of authors are trying to answer a question why it is important to be a socially responsible company, what are the benefits and what it brings to companies. The aim is to promote this concept and convince about its positives. For example, authors W. B. Werther and D. Chandler [13] distinguish arguments on moral, rational and economical. Moral arguments consist of dependence on their environment and on society. Thanks to them companies achieve business success and generate profits. Activities of the company should be adjusted so that they are compatible with social values. Besides the primary profit the company should generate added value for the society and repay debt of the possibility of the existence and the realization of its goals and profits. Another argument advocating the concept of CSR is identified as a rational argument. Gambling behavior of companies, environmental pollution and endangering consumers in terms of, for example, his health and financial stability push for setting mandatory ethical perspective to business. To gain profit, they are often willing to go beyond the boundaries of ethical behavior and damage the surrounding society. The last argument, according to Werther and Chandler [13] is an economic argument, which concerns mainly the aforementioned creation of added value for the company. The company should follow the expectations of stakeholders and respond to their needs for maintaining its long-term development. Currently, Socially Responsible Investment is becoming very popular, which apart from the parameters of yield, liquidity and risk takes into account the social, ethical and environmental criteria.

It is positive that more and more companies do not see CSR only as a form of philanthropy, although donations and grants are a frequent tool in taking care of stakeholders. Percentage of companies that employ a dedicated person to manage CSR is also increasing (from 10% to 33% in the period). The growth rate of involvement in CSR activities of companies impede their fear of the growth of administrative tasks related to documentation, planning, etc. The growth of bureaucracy then means more time and cost of individual activities. That is why it is important to emphasize the element of voluntariness in the development of CSR in the Czech Republic. If a firm wants its activities to be beneficial, it is essential to inform public about it. Generally, in the Czech Republic a sufficient amount of attention of CSR activities of companies is being paid recently. [28] The biggest pitfall, however, is the lack of promotion of the results. Firms must have the right and the means to show their achievements eg. in the context of

advertising or promotion of their product. On the other hand, such publicity can be perceived as a promotional gimmick. Media activity, which could help to distinguish between surreptitious advertising and promotion of valuable CSR activities should be the solution of it., The Czech Republic, however, still reserves in this regard.

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MACROECONOMIC EFFECTS OF NATURAL DISASTERS - THE CASE OF VISEGRAD COUNTRIES AND SERBIA

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Abstract

The process of global climate changes leads to a situation of increased natural disasters. On one side, the natural disasters are just the product of nature, and the other sides are the product of human beings. The effects of natural disasters on human and society can be devastating, if it does not react on them timely and adequately. This paper uses time series to assess the impact of natural disasters on the country's GDP and other macroeconomic indicators, such as the trade balance and current account balance and the state of public finances. These natural disasters have the greatest impact on agricultural production, especially because agriculture is an economic activity which is largely dependent on natural conditions. With that in mind, this paper will be viewed the situation in the agricultural sector, which had a significant impact on the growth of GDP and the scope and structure of international trade, especially in Serbia, where agriculture is one of the most important economic activities. Comparing the state of natural disaster in the Republic of Serbia and the Visegrad countries and comparative analysis will point the impact of natural disasters, on macroeconomic performance, which should contribute to strengthening the awareness of people about the aspects of this problem and increase the importance of this issue in the general community.

Keywords: *natural disasters, macroeconomics, gross domestic product, Visegrad countries, Serbia, agriculture.*

1. INTRODUCTION

Despite the increased interest and a growing advocating the importance of climate change, they are often wait victims unprepared. Earthquakes, hurricanes, floods and other natural disasters are increasingly affecting all countries and taking an increasing share of its influence. These natural disasters can cause a chain shocks to the environment and society, which can be extended impact on the health, quality of food, quality of life and general living standard.

More and more studies dealing with the analysis of the impact of natural disasters, all of them have aim to increase the environmental awareness of the nation and highlight the enormous impact of climate change on the quality of life and standard of living. With this in mind the overall objective of the paper is to distil the knowledge intensity of economic and financial impact that natural disasters leave, through detailed analysis and review of natural disasters Visegrad countries and Serbia and their influence on macroeconomic

indicators. What we need to come out of this analysis is to increase awareness of the importance of environmental changes have on a people's standard of living.

Perhaps, if this problem is approached deeper and look all its economic consequences, it seemed to increase awareness among people about the importance of natural disasters and that they are working properly and timely. Method of statistical time series will highlight biggest natural disasters in the Visegrad countries and the Republic of Serbia. After identifying key natural disaster, it will be shown their influence on macroeconomic indicators. The hypothesis of the study is that in cases of natural disasters in all countries; there is the impact of these disasters on gross domestic product, whereas this effect more pronounced in less developed countries. One reason for this is certainly the fact that these countries have a significant share of agriculture in GDP and the creation of agricultural products in the export structure.

2. ECONOMIC AND ECOLOGICAL ASPECTS OF THE PROBLEM

Global climate change is a phenomenon that is more and more talk, because we all become directly affected by its consequences: a growing number of lives lost, the collapse of the system of crop production and food production in general, heavy air meteorological disasters and catastrophes, which every day becomes all the more noticeable [5].

Natural disasters for many years include earthquakes, hurricanes, floods and other natural disasters [2]. Many authors have noted the impact which natural disasters leave on economic development. Dilley and associates have pointed out that each year, earthquakes, floods, droughts and other natural disasters continue to be the cause of 10 thousand deaths, 100 thousand injuries and economic losses which are measured by billions of dollars [4]. Benson and Clay pointed out that between 1950 and 1990 the global costs of natural disasters increase 15 times [1]. Natural disasters are a major source of risk for poor and developing countries. Bearing in mind that the risks of natural disasters are growing, they need to be addressed as a development issue and not only as a question of humanitarian aid. It is necessary to develop tools for efficient risk management of natural disasters in the function of development activities.

Climate change will leave more effects on nature and the economy in the future. In the near future will be increasingly devastating effects of climate change [8]. Given the backwardness of the society in the development of defense systems, especially in developing countries, the climate system will leave a huge effect on the higher levels of greenhouse gases, the uncertainty in the development of economic, technological, demographic and health systems [12].

Ecological losses do not always have to be accompanied only with economic losses, but these losses are slowing recoverable. Disasters triggered by natural disasters over time creating the unexpected costs and kill more people, either directly or indirectly [13]. For countries with very low economic growth, even small economic loss can be critical. Economic losses caused by natural disasters can significantly slow down economic development. Most natural changes that lead to environmental and economic disasters cannot be prevented, but their effects can be reduced.

If we consider all the countries, it can be noted that developing countries are not significantly more affected by natural disasters in relation to developed countries, but their recovery is slower. Raddatz pointed out that storms usually cause a fall in GDP per capita

in the less developed countries by 3%, while they have virtually no impact on the developed countries. However, drought and extreme temperatures can lead to a drop in GDP per capita up to 1 -5 per cent, while floods affecting specific groups of countries. The results indicate clearly that the low-income countries are more sensitive to climate change [14]. The difference is that the country has more power to cope with the consequences of natural changes or to be faster and better to respond to the consequences caused by natural phenomena. Toya emphasized that is not important only the ratio of GDP and claims incurred but it should be monitored other indicators such as education, greater openness of the economy, strong financial sector and the smaller administration and management [15].

What is certain is that one of the major challenges that the world faces today relates to how to cope and how to limit the economic impact of large natural disasters, bearing in mind that the frequency of their intention to seriously and dramatically increased since the 1970s [10]. The Food and Agriculture Organization of the United Nations states that in developing countries most affected by agriculture with about 22% of total damage and losses, which are caused by natural hazards [7]. However, it is necessary to observe the overall impact of natural disasters on the growth and development of the nation, in order to increase awareness of the need to reduce the impact of natural disasters.

3. EMPIRICAL ANALYSIS

The methodology used in this paper includes the collection of available secondary information from various sources in order to determine the effect which natural and ecological disasters left on macroeconomics and standard of living.

Data about natural disasters collected from the Centre for Research on the Epidemiology of Disasters (CRED), based on stats EM-DAT (Emergency Events Database). Macroeconomic data were collected from several sources (International Monetary Fund, World Economic Outlook Database, 2015; World Bank national accounts data, and OECD National Accounts data files). CRED databases were restricted to systematically collected information relating to human and/or economic losses due to disaster. CRED uses specific criteria in classifying a natural disaster (ten or more people killed, 100 or more people were affected/injured/homeless, significant damages were incurred). The sample includes annual data for every recorded disaster from 5 countries over the 2008–2014 period.

4. OVERVIEW OF NATURAL DISASTERS VISEGRAD COUNTRIES AND SERBIA

In order to observe the effects that environmental changes have left to the countries of Visegrad Group, this part will be made of natural disasters that occurred in the Visegrad countries: Hungary, Poland, Slovakia and the Czech Republic. To determine where Serbia is when it comes to economic growth and natural disasters, will be carried out a comparative analysis of indicators of natural disasters in these countries and in Serbia over the past 7 years. After identifying the natural disasters in these countries it will determine their impact on key macroeconomic indicators. Table 1 shows the natural disaster it has faced Hungary in the period 2008 to 2014:

Table 1. Top natural disasters in Hungary from 2008-2014 [3]

Year	Disaster subgroup	Total deaths	Affected	Injured	Homeless	Total affected	Total damage (000 $)
2008	Meteorological	17	0	500	0	500	0
2010	Hydrological	1	2000	0	0	2000	440000
2012	Meteorological	16	0	0	0	0	0
2013	Geophysical	0	1800	0	0	18000	0
2013	Hydrological	0	48656	0	0	48565	0
2013	Meteorological	0	14000	0	0	14000	0
2014	Hydrological	0	6500	0	0	6500	0

If we look at the natural disaster in Hungary, it can be noted that the greatest damage comes from the natural catastrophe in the last 9 years, suffered in 2010 when Hungary suffered the consequences of the floods with a one fatal effect (human live) and damage of 440 million dollars. When it comes to human lives, Hungary has suffered the consequences of the cold wave of 2008, which claimed more than 17 lives. A similar scenario was repeated in 2012. What can be concluded is that Hungary was confronted with natural disasters at the beginning of the period, while from 2013 was less affected by natural disasters, i.e., in 2013 there were no deaths and economic consequences.

Next Visegrad country that also faced with natural disasters is Poland. Table 2 shows the natural disasters that occurred in Poland in the period 2008-2014:

Table 2. Top natural disasters in Poland from 2008-2014 [3]

Year	Disaster subgroup	Total deaths	Affected	Injured	Homeless	Total affected	Total damage (000 $)
2008	Meteorological	84	1050	10	0	1060	50000
2009	Hydrological	1	150	0	0	150	100000
2009	Meteorological	306	0	82	0	82	0
2010	Hydrological	19	100700	0	0	100700	3080000
2010	Meteorological	200	0	0	0	0	0
2011	Meteorological	26	0	0	0	0	0
2012	Meteorological	274	300	10	0	310	5900
2013	Meteorological	29	0	53	0	53	0
2014	Meteorological	78	0	0	0	0	0

Poland in the period from 2008 to 2015 faced with natural disasters of large proportions. These are the disasters which have had as a result of the removal of human life in all

observed years, which was a great human loss. The loss was related to the overall economic damage as measured by billions of dollars. The biggest loss of up to 306 human victims related to the cold wave and storm of 2009. Also, most of the other groups of meteorological disasters were caused by cold waves and storms. However, economically speaking, the biggest loss caused the floods that occurred in 2010 that were related to riverine flood.

Table 3. Top natural disasters in Slovak Republic from 2008-2015. [3]

Year	Disaster subgroup	Total deaths	Affected	Injured	Homeless	Total affected	Total damage (000 $)
2010	Hydrological	4	850	0	0	850	25000
2010	Meteorological	122	0	0	0	0	0
2012	Meteorological	5	0	0	0	0	0
2013	Hydrological	1	0	0	0	0	0

In the past 7 years, Slovakia has not faced large natural disasters, if one may say so. Compared to other observed countries, in Slovakia are recorded the 4 natural, of which the most difficult of human lives was cold wave that has claimed 122 human lives. If you look at all the natural disasters that occurred in Slovakia, we can see that each of them had at least one death. Riverine flood of 2010 brought a large-scale economic damage which has been affected and 4 850 deaths.

In Table 4, according to the methodology EM-DAT shown natural disasters in the Czech Republic, which recorded 9 in the past 7 years:

Table 4. Top natural disasters in Czech Republic from 2008-2014. [3]

Year	Disaster subgroup	Total deaths	Affected	Injured	Homeless	Total affected	Total damage (000 $)
2008	Meteorological	2	0	0	0	0	50000
2009	Hydrological	13	14450	0	0	14450	150000
2009	Meteorological	2	0	12	0	12	0
2010	Hydrological	11	1400	0	0	1400	347560
2010	Meteorological	12	0	0	0	0	0
2013	Meteorological	32	0	0	0	0	0
2014	Hydrological	1	15	1300000	0	1300000	828552

Czech Republic, like Poland, faced with the enormous number of natural disasters that have a significant influence on the damage and losses. And in the case of disasters of this

country had taken a large number of human lives and the damage is enormous. The greatest damage (828552000 dollars) and human lives (32) was created in 2014, while largely due to human life left in 2013.

In Table 5 we can see the overall effects of natural disasters in recent years in the Republic of Serbia. Since 2009, Serbia was in constant struggle with natural disasters. In 2009, Serbia was hit by two adverse natural events: floods and extreme winter temperatures were not large scale, but they pose a great reminder of nature. The biggest disasters in 2010 were related to as much as 6 adverse natural events of which Serbia 3 times afflicted floods, 2 times of extreme winter temperatures and the earthquake that caused extensive damage of 132.26 million dollars, left people without homes and took people's lives. Ice wave in 2012 took as many as 25 lives. In 2013 began pouring river to 2014 to pouring into a real disaster with the greatest economic and human consequences in the period. This disaster followed by a torrent overflowing of rivers and even took 56 lives and caused extensive damage and the consequences of economic development.

Table 5. Top natural disasters in Serbia from 2008-2014. [3]

Year	Disaster subgroup	Total deaths	Affected	Injured	Homeless	Total affected	Total damage (000 $)
2009	Hydrological	0	3210	0	0	3210	0
2009	Meteorological	0	0	500	0	500	0
2010	Geophysical	2	25440	120	1470	27030	132260
2010	Hydrological	2	4900	0	0	4900	0
2010	Meteorological	5	0	0	0	0	0
2012	Meteorological	25	88234	0	0	88234	0
2013	Hydrological	0	3000	0	0	3000	0
2014	Hydrological	56	59600	0	0	59600	2048262
2014	Meteorological	0	3000	0	0	3000	0

5. COMPARATIVE ANALYSIS OF NATURAL DISASTERS IN VISEGRAD COUNTRIES AND SERBIA

In this part of the work will be illustratively shown certain parameters of natural disasters based on EM-DAT statistics. As specific parameters it will separated: sum of total affected by natural disasters country, sum of total deaths and homeless caused by natural disasters and total sum of damage caused by natural disasters.

The Figure1 shows the sum of all who are affected by natural disasters during the period 2008-2014 year:

On the basis of Figure 1 it can be seen that the Czech Republic had the largest number affected by natural disasters (1,315,862). Immediately behind her are Serbia and Slovakia.

Poland and Hungary were somewhat less affected by natural disasters. Certainly none of the observed countries should not ignore the situation, bearing in mind that the survey covers the period of 8 years.

If we look at Figure 2, we can see that the greatest number of human lives carried off in Poland (1094) and Slovakia (1128), when it comes to natural disasters in the past 8 years. Serbia recorded a record number of homeless people and that's all the result of the floods in 2014. Other countries which are observed had not the homeless as a result of natural disasters.

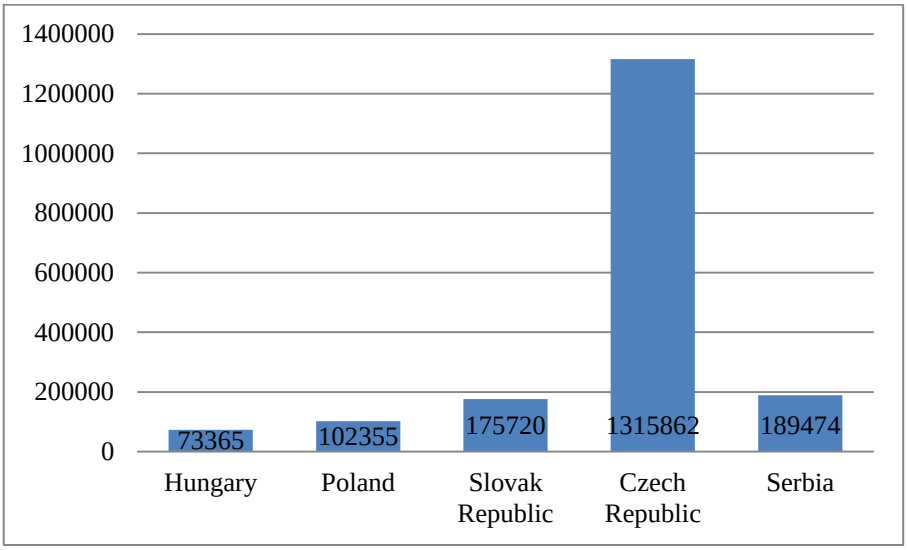

Figure 1. Sum of total affected natural disasters by country from 2008-2014

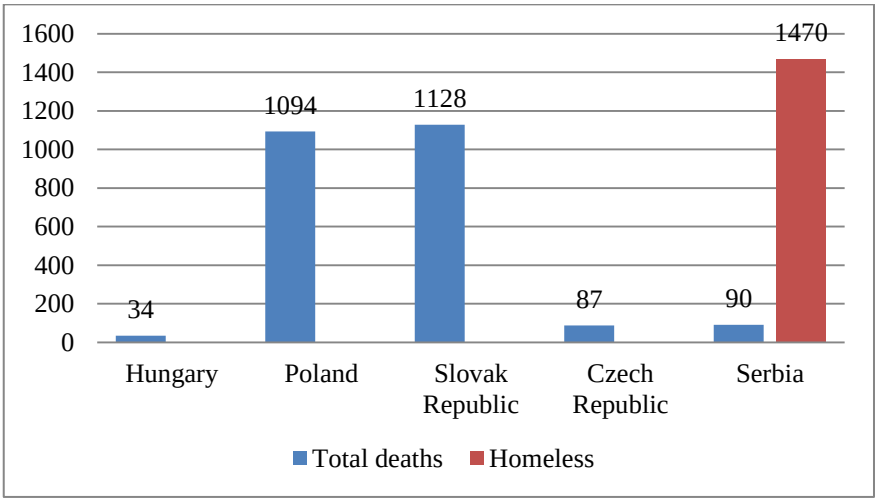

Figure 2. Sum of total deaths and homeless caused by natural disasters from 2008-2014

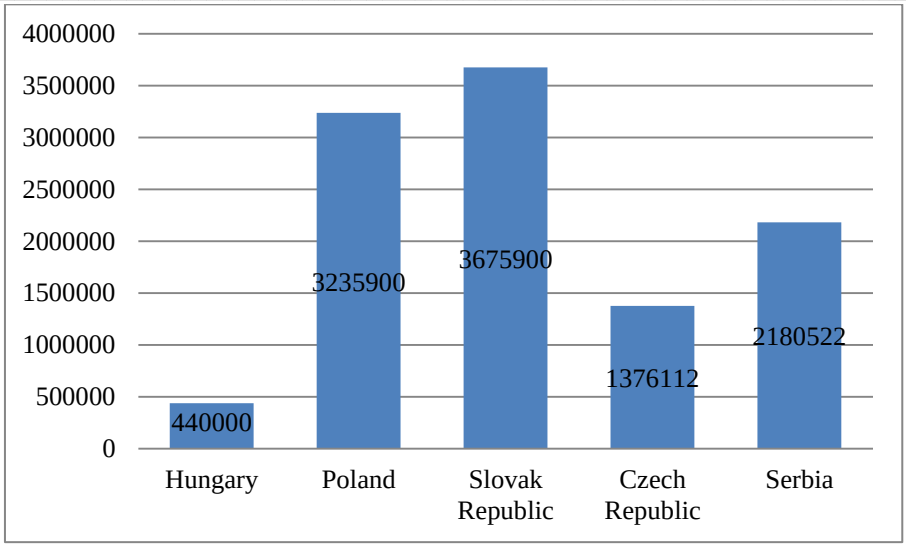

Figure 3. Sum of total damage caused by natural disasters from 2008-2014 (000$)

Finally, the figure 3 shows the total damage caused by the 000 dollars by natural disasters. Economically speaking, the greatest damage to the 000 dollars had Slovak Republic (3.6759 billion dollars). Immediately behind it is Poland (32359000 dollars) and Serbia (2180522 dollars). Serbia, as a small and underdeveloped country, compared to other countries of the Visegrad Group had huge losses that have left their impact on economic development. Bearing in mind that each of the surveyed countries has its own level of development, it is necessary in this analysis include the participation of the damage in the main macroeconomic indicator - GDP. To create a picture which the natural disaster formed on macroeconomics, the analysis should include the impact on other macroeconomic indicators.

6. IMPACT OF NATURAL AND CLIMATE CHANGES ON MACROECONOMIC INDICATORS OF VISEGRÁD COUNTRIES AND SERBIA

This part of the paper will be based on the major macroeconomic indicators in the period 2008-2014, in order to determine whether the natural disasters have had an impact on the trends of those indicators, or, in other words, whether the indicators, such as share of agriculture gross value added in GDP, indices of agricultural production, growth rate of GDP, value of imports and exports, share of the agricultural products in total exports and imports, trade balance and current account balance, share of material damage caused by natural disasters in GDP and budget balance, had a negative trend during the years when the natural disaster occurred.

Having in mind that natural disasters have had the greatest impact on agricultural production, due to great dependence of this type of production from natural conditions, Figure 4 presents trends of the share of agriculture gross value added in GDP. It should be emphasized also that this figure presents the trend of mentioned indicator during the period 2008-2013, because the data for 2014 are not available.

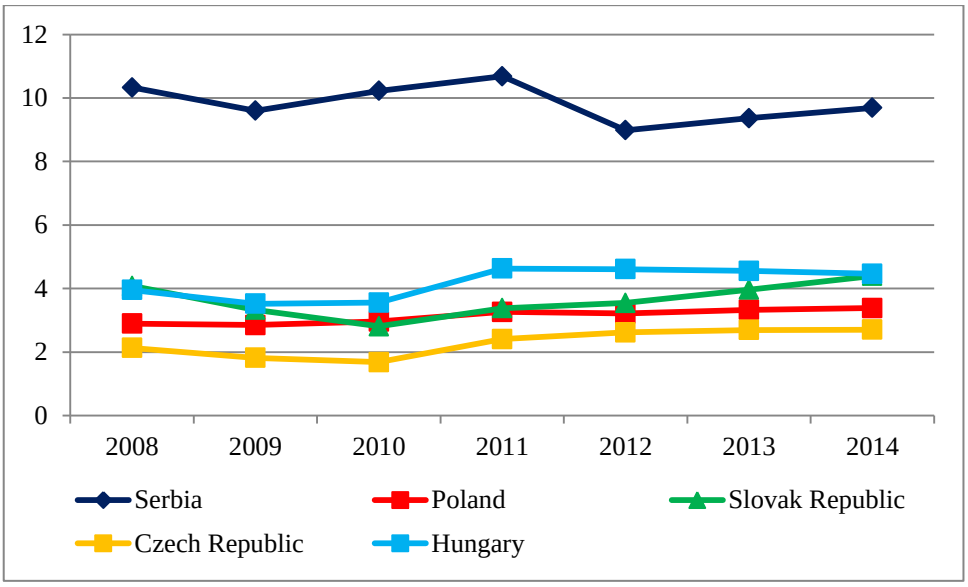

Figure 4. The share of agriculture gross value added in GDP during the period 2008-2013 for the observed countries [18]

The first thing to note from Figure 4 is that the share of agriculture gross value added in GDP was the highest in Serbia and it was around 10% throughout the period. This indicates the fact that the agriculture has much greater significance for the creation of GDP in Serbia than in the countries of the Visegrad Group, whose have effectively implemented appropriate transitional processes and reformed their economies, so they have the highest share of secondary and tertiary sector in the structure of GDP like in developed market economies. On the other hand, the Czech Republic, which has carried out the greatest part the necessary reforms on the way to establish a market economy, recorded the lowest share of gross value added generated in agriculture in GDP, which in the reporting period was around 2%. Somewhat higher share was recorded in Poland amounting about 3%, followed by Slovakia (about 4%) and Hungary with approximately 5%. Also, fluctuations of this indicator were much lower in Visegrad countries than in Serbia, because of minor importance of agriculture in this group of countries.

Considering that given indicator cannot adequately present the changes in agricultural production, but rather to point out the importance of this economic activity for observed economies, Figure 5 presents the trend of gross agricultural production index in these countries during the period.

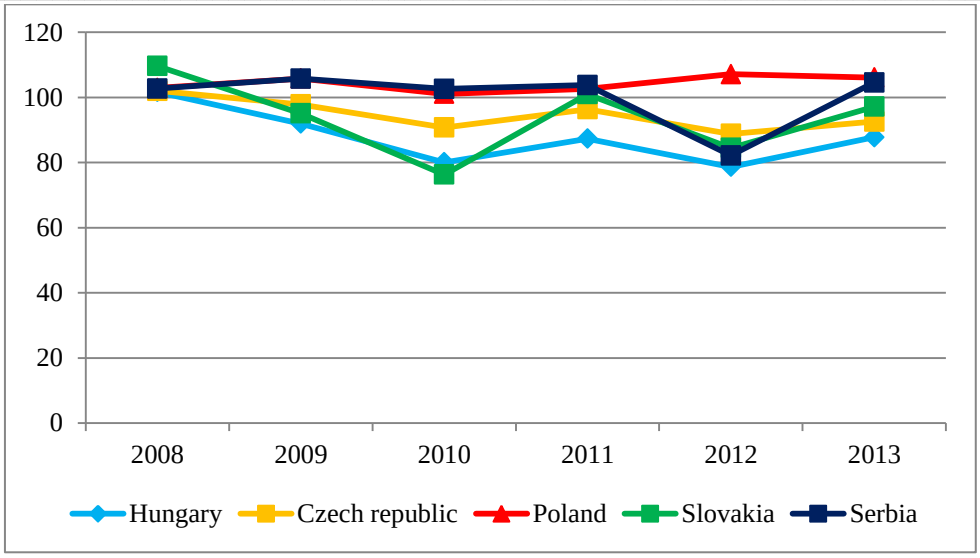

Figure 5. Trend of gross agricultural production index for observed countries during the period 2008-2013 [6]

From the presented figure it can be concluded that the highest fluctuations in a given indicator were recorded in Slovakia, where the significant decline of agricultural production in 2010 and 2013 was result of the floods in this country. Significant decline of agricultural production was recorded Hungary in 2010, also due to floods, which have led to significant material damage in this country. A slight decrease in agricultural production in this country was recorded again in 2012, which has been largely caused by the cold wave, affecting the production of field crops. There was a slight decline of observed indicator in 2009 and 2010 in the Czech Republic, although this country has been afflicted by floods during these years. Also, a slight decrease in production was recorded in 2012, but it was not a result of natural disasters, because this country in that year there were no such events. The lowest oscillations of agricultural production indices were recorded in Poland, although this country has been hit by a number of large-scale natural disasters, thanks to the introduction of a number of mechanisms, instruments and strategies to reduce the risk of flooding, with the aim of implementation of the EU Floods Directive. [11] The gross agricultural production index in Serbia has not recorded significant fluctuations, except in 2012, when agricultural production recorded a significant decline, due to unfavourable natural conditions. Firstly, winter temperature reached record low values, and then, drought occurred in the summer. [17]

Such situation in agriculture was also reflected in the value of GDP. In this regard, Figure 6 shows the growth rate trend in the observed economies.

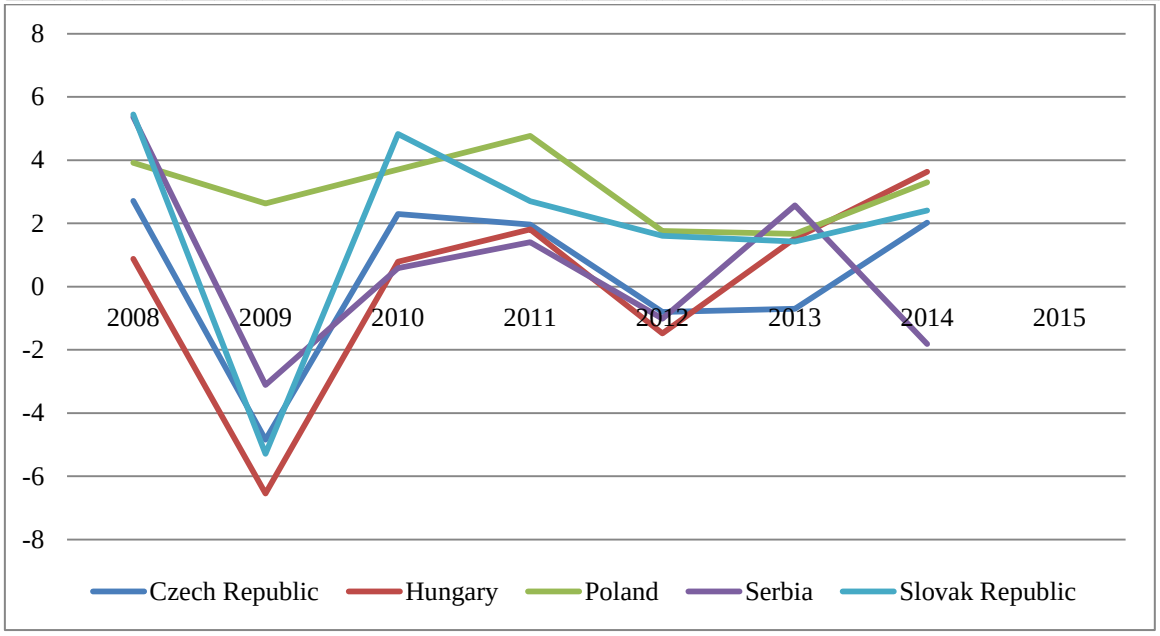

Figure 6. Growth rate by country in the period 2008-2014 [9,18]

By the analysis of data from Figure 6 it could be concluded that Hungary recorded the lowest growth rate in 2009, followed by rapid recovery during the next year. One should not ignore a fact that natural catastrophes with huge consequences occurred in Hungary during the 2008 and 2009, so it can be concluded that, in addition to the economic crisis, the ecological crisis has had a negative impact on the growth rate, too. As the share of agriculture in GDP creation in this country is the highest compared to other countries of the Visegrad Group, significant decrease of agricultural production in 2009 had a particular impact on the growth of GDP. Significantly lower decline of growth rate was recorded in 2012 and, after that, this indicator continued to follow a growing trend. Other countries have a slightly lower share of agriculture in GDP creation than Hungary, so they had a significantly lower impact of natural disasters on value of GDP. Poland, in turn, has had high growth rates, although it has been faced with the greatest natural disasters in relation to other observed countries. Slightly lower growth rate was achieved in 2009, partly because of the global economic crisis, partly because of severe flooding that hit this country, but also in 2012 and 2013, when the low growth rate was caused by natural disasters to a lesser extent.

Slovak Republic, as a country that has been hit by natural disasters in the least extent during the reporting period, registered a drastic fall in the growth rate in 2009, as a result of the global crisis, because it was no any natural disaster during this year. After that, the growth rate recorded a significant increase, indicating that the floods that hit this country and caused decline in of agricultural production have not had the impact on the value of GDP. Since 2011, the growth rate was slightly lower and in 2012 and 2013 recorded an additional decline which can to some extent be attributed to the natural disasters that have occurred in this country, especially in 2012 when the decline of agricultural production was recorded. Already, in 2014 the growth rate in this country recorded a slight increase.

Czech Republic also recorded a sharp decline of GDP in 2009, whereby the decline was partly result of the global economic crisis (which has had a great influence on its economic activity due to high openness of the economy) and partly the result of the natural disasters

that have befallen this country. In addition, these natural factors did not affected the value of GDP through the decline of agricultural production, bearing in mind that this country has not recorded a decline of agricultural production in a given year. After that, decrease of growth rate was recorded in 2012 and 2013, and then, despite the severe flooding in the country, the growth rate recorded a significant increase in 2014.

Table 6. Trends of exports, imports and trade balance for observed countries in the period 2008-2013 [16]

Country	Trade indicators	2008	2009	2010	2011	2012	2013	2014
Hungary	**Export**	108504	83008	95483	112312	103570	107503	110619
	Import	108940	77761	88178	102440	95176	100111	104923
	Trade balance	**-436**	**5247**	**7305**	**9872**	**8394**	**7392**	**5696**
Czech Republic	**Export**	146799	112955	132982	162939	157041	162274	175095
	Import	142038	105048	126652	152125	141412	144259	154375
	Trade balance	**4761**	**7907**	**6330**	**10814**	**15629**	**18015**	**20720**
Poland	**Export**	170458	136503	159724	188696	185374	204984	220152
	Import	208804	149459	178049	210597	199060	207607	223675
	Trade balance	**-38346**	**-12956**	**-18325**	**-21901**	**-13686**	**-2623**	**-3522**
Slovak Republic	**Export**	71142	56082	64664	79830	80612	85750	86460
	Import	73912	55650	65026	79842	77398	81735	81953
	Trade balance	**-2770**	**432**	**-362**	**-12**	**3214**	**4015**	**4507**
Serbia	**Export**	10972	8345	9795	11779	11229	14613	14845
	Import	24331	16047	16735	19862	18925	20543	20609
	Trade balance	**-13359**	**-7702**	**-6940**	**-8083**	**-7696**	**-5930**	**-5763**

Serbia, as well as other observed countries, recorded a decline in growth rate in 2009 due to the effect of the global economic crisis, but it was significantly higher than in other countries of the Visegrad Group (except in Poland). This is certainly result of the fact that it was not recorded decline of agricultural production in 2009, bearing in mind that agriculture has a significant share in the structure of Serbian GDP. The next reduction in

the rate of growth occurred in 2012, which, among other things, was a result of falling of agricultural production caused by cold wave, which affected the production of most crops. After a recovery of the economy in 2013, GDP declines again in 2014, which is largely a result of the devastating floods that have occurred this year.

Natural disasters have had a great influence on the external trade flows. In this regard, Table 6 shows trends of exports, imports and trade balance for observed countries.

Based on the indicators shown in Table 6, it can be concluded that only Czech Republic had the trade surplus throughout the entire observed period. In addition, the surplus recorded continued increase throughout the period. Bearing in mind that the share of agricultural products in total export was around 4%, it can be concluded that in case of of this country natural disasters have not affected the trade balance. Hungary recorded a deficit only in 2008 and after that it had a trade surplus. The surplus was increasing until 2010, and then the period of its constant decline occured. As the share of agricultural products in total exports and the exports of these products were increasing during the period, it can be concluded that the natural disaster did not affect the volume of exports of this country. Slovakia is characterized by significant fluctuations in trade balance during the period. The country recorded a deficit in 2008, 2010 and 2011. Bearing in mind that the share of agricultural products in total exports was around 4%, It can be concluded that the deficit is to a lesser extent result of decrease in exports due to falling agricultural production, and to greater extent result of increase in imports of these products due to insufficient domestic production. Trade deficit in Serbia was decreasing until 2010, then recorded a sharp growth in 2011 and after that it continued to fall. The share of agricultural products in total exports in Serbia was around 20%, so the export of these products definitely has affect the balance of trade balance. Long-term stagnation and reduction of the agricultural production in 2012 and 2014 due to floods in Serbia, resulted in slower growth of exports than imports, so this country recorded a significant deficit of foreign trade throughout the period.

Such a situation in the trade balance reflected on the state of the current account, which is shown in Figure 7.

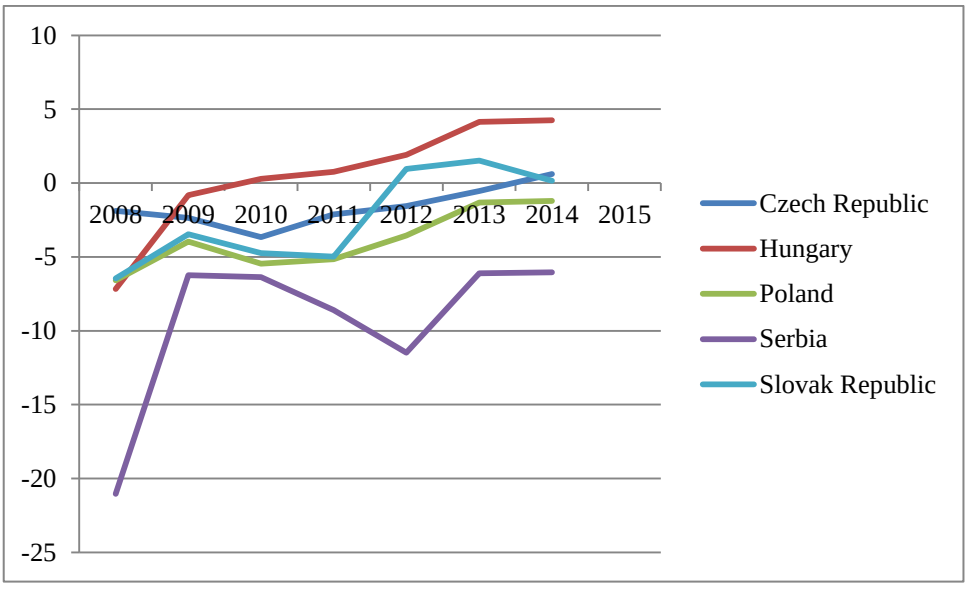

Figure 7. Current account balance (percent of GDP) by country [9, 18]

Figure 6 shows the current account balance (as a percent of GDP) by country. After the deficit recorded in all observed countries in 2008 and 2009, Hungary was the first country that recovered from the global crisis and recorded some surplus in 2010. After that, this country recorded a constant increase in the surplus of the current balance. Slovakia also recorded a current account surplus since 2012, although a significant decline occurred in 2014. Another economy that has managed to record a current account surplus in 2013 is the Czech Republic, where the surplus recorded growth next year. Only Poland and Serbia recorded a current account deficit during the entire period, which points to the fact that the situation in the trade balance largely reflected in the current account. At the same time, Serbia was in a far worse position compared to Poland, although the deficit during the period declined significantly.

***Table 7*.** Share of total damages of natural disasters in country GDP

Year	Hungary	Poland	Slovak Republic	Czech Republic	Serbia
2008	-	0.01%	-	0.02%	-
2009	-	0.02%	-	0.07%	-
2010	0.34%	0.64%	0.03%	0.17%	0.34%
2011	-	-	-	-	-
2012	-	0.00%	-	0.40%	-
2013	-	-	0.03%	0.66%	-
2014	-	-	-	-	9.64%

Source: Authors calculations.

Bearing in mind that they cause significant pecuniary damage, natural disasters lead to an imbalance of public finances, primarily due to the growth of public expenditure. In order to obtain the more detailed analysis of the natural disasters impact on the macroeconomics of a country it is necessary to analyse the share of pecuniary damage in GDP (Table 7).

In Table 7 it can be seen the impact that natural disasters have had on the observed countries. Empty cells in the table show that there was no any economic impact of natural disasters. Looking at the data for Poland and the Czech Republic, as countries with the largest-scale natural disasters, it can be concluded that only a natural disaster in 2010 in the case of Poland and natural catastrophes in 2013 in the case of the Czech Republic had a significant share in the GDP of these countries. In other observed years, natural disasters have had little or no participation in the GDP of these countries. Share of pecuniary damage from natural disasters in the GDP of Slovakia was also negligible, while the slightly larger share (0.34% of GDP) had a natural disaster in Hungary in 2010. However, the share of pecuniary damage of only one natural disaster in Serbia was almost 10% of GDP. This can confirm the assumption that the effects of natural disasters are much higher in less developed countries. This is also indicated by the fact that natural disaster in Poland, which was almost twice higher economic consequences, participated in GDP with 0.64%, while in Serbia this percentage is 9.64%.

Now, when the damages that caused by the natural disaster have been discussed, it should be analysed how they reflected on the budget. Figure 7 shows trends in the budget balance in the reporting period in the countries of the Visegrad Group and Serbia.

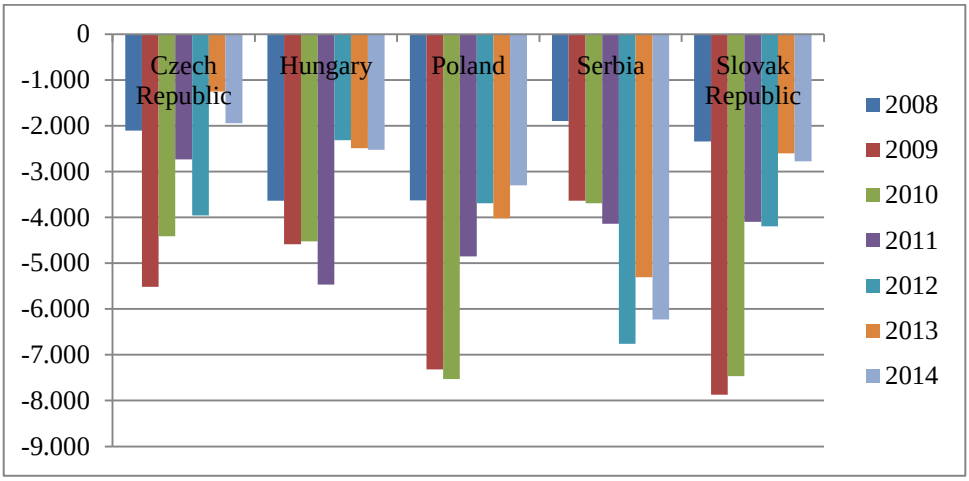

Figure 8. Budget balance of observed countries during the period 2008-2014 [9]

Based on the data from Figure 8, it can be concluded that all economies recorded a budget deficit. Czech Republic recorded a significant increase of deficit in 2009 and 2010, when this county had significant pecuniary damage, while pecuniary damage occurred in 2008 and 2014 did not have a significant impact on the budget, due to faster growth of budget revenues and inflow of international assistance. Hungary has recorded the significant material damage from natural disasters only in 2010, when it had a high budget deficit, and in other cases, this deficit is the result of other factors. Poland recorded a high budget deficit, particularly in 2009 and 2010, when it had a significant pecuniary damage caused by natural disasters. Material damages during 2008 and 2012 were not so pronounced, so they did not influence the emergence of budget deficits to a great extent. Budget deficit in Serbia was constantly growing until 2012, when this growth was interrupted in 2013, and already in 2014 it recorded the growth again, which result of significant material damage is caused by the floods. The damage caused by the catastrophic earthquake in this country has affected the growth of the deficit to a lesser extent, due to the significant inflow of international assistance. Finally, Slovakia, as a country that is in the least degree been affected by natural disasters, recorded an extremely high deficit in 2009 and 2010, having in mind that material damage caused by the floods of 2010 had a significant influence on the deficit.

7. CONCLUSIONS

Natural disasters have a devastating effect on the natural, economic and human capital, measured by economic losses through a reduction in the rate of GDP growth and loss of human lives. This paper described the particular impact of natural disasters on agricultural production and trade balance. Small and trade open economies suffers heavy recovery and the consequences of natural disasters and that is so difficult for them because this countries are dependent on the primary forms of production and international trade.

This paper was created an initial picture of the characteristics and impacts of natural disasters on 5 countries. The findings of this research indicate that awareness of the growing importance of environmental catastrophes have to grow since it increases their impact on the cost of human life and economic development. It is particularly important to increase awareness of the strength of the negative impact of natural disasters in agriculture produce. In this regard, the management of natural disasters must become part of an independent planning of economic development, not only as part of humanitarian aid.

But there are several limitations of this investigation. This research is based on economic damages (damages / GDP) in which the damage value is the estimated damage in real US $ at the moment of the event. First, damages include only direct costs and not indirect costs of the disaster. Secondly, comparing the developed and developing countries, it should be noted that these second are in challenge because they are often without insurance, bookkeeping and formal markets. However, statistical data CRED in the best way shows the link between economic development and economic damages.

Bearing in mind that this analysis included only one bit of large global human and economic problems of climate change for future research can be recommended research related to the indexes of risk of natural disasters on the economy, developed by Dilley and associates. These are three risks: mortality risks, risks of total economic losses and risk of economic losses expressed as a proportion of GDP per unit area. These risks can be very interesting and can demonstrate a high precision impact of natural disasters on economic development.

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MARKETING SUPPORT FOR GREEN INNOVATIONS IN THE SLOVAK SMEs

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Abstract

Innovative solutions generate positive contribution by improving businesses´ production processes, decreasing environmental impact and simultaneously communicating social responsibility. Green innovations seem to be the medicine for solution of unfavourable situation in all fields of business environment, but they must be supported by marketing communication, which directs customer to the right way, builds ecological awareness in it, helps him to decide for the right products, in accordance with sustainable development. The paper deals with the theme of green innovations and their support through marketing communication tools while presenting the results of the research aimed at small and medium-sized enterprises operating in the Slovak business environment.

Keywords: *environment, social responsibility, innovation, communication, marketing.*

1. INTRODUCTION

Green innovation, as a good way of distinguishing from the competition and as an exhibition and result of creative work of innovative actors, are a suitable means of bringing positive change. Benefits of eco-innovative solutions have mostly positive potential for organizations, companies and overall for the society, mainly when it comes to solutions by which we improve production processes, lower the impact on environment and also communicate the activities of social responsibility together with elements of awareness. For this positive change to take place in form of successfully finished eco-innovative process, it needs to be preceded by the implementation of all phases of eco-innovation process with massive support of marketing communication.

Green innovations needs to be supported by suitable communication strategy, which will direct the customer to the right path, develop an ecological awareness in him and help him decide for the right products that are commodities that are in accordance with the sustainable development. On the other side is the company, which should not underestimate conscious customers and should focus as well on marketing communication, which will convince the customer that their ecological products are the right alternative to conventional products. Marketing communication in promoting green innovations is yet specific regarding to segment, target group and subject of eco-innovative process.

2. GREEN INNOVATION

These days, the ability of countries and companies operating there to innovate presents so much more than just one of the economic parameters. It represents one of the parameters of economic power and security of the country at the same time. Alongside the energetic or food security, the ability to innovate is becoming an important geopolitical parameter, which is also emphasized by the activity of countries known as traditional "innovation leaders", as well as tendencies of developing countries to boost the innovation performance of their economies. It is obvious, that in relation to global transfer of factors of production the position of Slovakia, as a country with an advantage of cheap labour force, is not sustainable in a long term. That is why it is important to search for strategies of not only maintaining but also for increasing competitiveness of Slovak companies and entire industries.

Determinant of the future sustainable development of Slovakia, as a small open economy, must be the ability of economy to respond flexibly to global changes and demands. From the long-term aspect it is the innovation that will enable achieving technological changes and stimulate new economic-technology cycles. First of all, the countries that were able to identify and support perspective innovations or technologies at the right time were the ones to ensure boom [1].

Currently, ensuring a sustainable economic system does not depend only on economic growth of the country but it is also necessary to focus on ecological aspects and sustainable development of the country. Recently, there are more and more talks from this point of view on connection of innovation and ecology, which gave rise to a new term – green innovation or ecological, environmental innovation. The concept of green innovation is rather young. Based on the deterioration of our environment, the environmental question became an important political topic as a part of corporate strategy for businesses in the 60s of the 20th century. The green innovation alone start to attract attention at the beginning of the 21st century in the field of social-scientific research or practical economic policy [7].

Consumer lifestyle along with continuous hunger for material wealth and its collection are both responsible for great imbalance in the environment. All these actions have resulted in draining natural resources with a continuous lack hereof (either current or anticipated), environmental pollution and over-consumption placing enormous burden on production processes, factories or causing permanent over-exploitation of natural resources. We are currently facing a challenge to change behaviour of world population and replace it with the alternatives which are much more favourable both to a human and the environment as such. Green innovation represents one of the possibilities how to contribute to change to human thinking.

The definition of a green innovation draws from that of an innovation while taking into account a different perspective, which is positive impact on the environment either as a direct result of an innovation process or as a secondary effect of implementation of a production process or a services.

By the very definition of green innovation, it is accurate to build on general definition of innovation. Since the beginning of the 90s the concept of innovations within the European Union framework was based on Frascati Manual of OECD. From this manual it shows that

innovations are scientific, technical, organizational, financial and commercial steps, including investments into new knowledge, which in reality or potentially lead towards implementation of technologically new or improved products and processes [12].

There are numerous definitions of the notion, having different wording, but bearing the same characteristics. Let´s state only some of them.

According to the European Union *"green innovations are any innovations focusing on significant and obvious improvement to sustainable development by way of eliminating negative impact on the environment or reaching more efficient and more responsible exploitation of natural resources including energies [6]."*

Ritomský defines green innovations green innovations as *"innovations with provable progress resulting in sustainable development notably by way of lowering negative impact on the environment or by reaching greater effectivity and responsibility when exploiting natural resources including energies [13]."*

According to Kemp *"green innovation presents production, assimilation or usage of product, production process, service or management or business method, which is new for the organization (developing or in a process of being adopted), which results in its course is reduction of environmental risks, pollution and other relevant negative impacts to use of resources (including energy use) compared to relevant alternatives [9]."*

Bezáková and Zaušková claim, that *"green innovations include innovations aiming at significant or demonstrable progress towards the goal of sustainable development through reduction of impacts on environment or to achieve greater efficiency and accountability in using natural resources, including energy [2]."*

Based upon the above mentioned definitions we may observe that the notion of a green innovations relates to innovation products, processes, innovations of marketing activities or organisational innovations with the aim to lower environmental costs, increase social acceptance and contribute to sustainable development. We can also mention that green innovations represent implementing new or considerably improved products, production processes, marketing or organisation methods which generate positive impact for the environment.

Green innovations can bear various forms, but their core idea is reflected in positive changes to the environment. Such a change, either it relates to products or business processes, is currently much needed. It may appear that green innovations occupy the same position as green innovations related to saving natural resources, energies, innovation eliminating impact on air pollution because even day-to-day activities such as waste treatment may generate benefits in terms of reducing waste treatment plants thanks to recycling.

The term green innovation is thus link to products, processes that are innovative or to organizational innovations that reduce companies´ environmental costs, intensify acceptance of the company and contribute to sustainable development. Through green innovations material demands are reduced, material flows are used or new materials are created or used. At the same time they are focused on reducing energy requirements or creating or using alternative sources of energy, reducing overall emissions into the environment, promoting healthy lifestyle [11].

In the context of growing population of Slovakia, by reducing capacity of non-renewable resources and environmental degradation, the pressure for rationalization of economic resources with the aim of reaching sustainable development is rising. Slovak consumers are being more and more aware of this situation, as they started to change their purchasing behaviour and favour products that are ecologically environmental friendly. The effort of companies and marketing managers is to inform consumers about their green innovations and protection of the environment [14].

3. INTERACTION OF GREEN INNOVATION AND MARKETING

Effective and efficient targeting of green innovations is not possible without sufficient development of marketing activities and functions of the company [4]. It is indisputable, that innovation and marketing communication are two important activities that must go hand in hand within the business projects. Ongoing eco-innovation process should be in each of its stages supported by appropriately chosen marketing strategy, so that its success is secured, and consequently the final phase, which is diffusion or market penetration, is successfully completed. Every company has at its disposal a wide range of marketing tools, which appropriate choice and timing within the eco-innovative process should be part of their eco-innovative plans and later on projects.

The concept of using marketing communication should stem from traditional marketing communication tools however, with regard to product innovation, while some of the tools are more appropriate with certain type of products than others. Traditional marketing communication tools need to be enriched as much as possible through using the tools of online marketing and other tools of modern marketing communication.

For green innovation to be successful it is not enough to bring new product or a service on the market, as a result of eco-innovation process, give him the right price and make it available to customers.

Key to success of green innovation is communication with customer. Through appropriately chosen marketing communication strategy the company informs customers that it offers products, which can satisfy their needs and meet required quality attribute, which is in case of green innovations also reflected in the price. The way how the message get to the recipient so it does not get lost in the spectrum of information, and for it to attract attention, requires flexible thinking, creativity, constant search for new products and ideas [10].

When it comes to green innovations it applies twice as much, since ecological product is still only searching for its segment of consumers that can vary depending on the individual product, and therefore it is always necessary to sensitively choose appropriate communication tools, which use most also be timely. Successful communication between the sender and receiver happens when recipient gets clear and unambiguously interpreted message, which leads to the behaviour according to wishes and conditions of the sender. Message needs to go through all the phases of communication process without changing its substance during passing the communication channels. Communication campaign, which fulfils the above stated conditions can be considered as effective because it is efficient.

Marketing communication is a specific set of interpersonal and business to business activities that seek to use personal, team or business knowledge in collaboration with social and market information for effective satisfaction of social as well as business needs, through fulfilling given marketing goals [8]. Marketing communication strategy in eco-innovation process is very important and is related to overall environmental orientation and communication of a business. According to Borgul'a, the number of businesses that take into account environmental criteria when making decisions on purchase is still rising. As next the states: *"Businesses that observe this trend and offer more ecological alternative can get an opportunity to differentiate through organizational factors instead of support of solely marketing factors, which will be appreciated by customers, employees and employers seeking for opportunities to insert individual efforts into positive spheres [3]."*

Nowadays, individuals and businesses do not purchase only the brand. Their purchase gets a deeper meaning, as they purchase also philosophy of the company and its policy. They are aware of narrower and broader context of their purchasing behaviour also occurs in other important activities of human existence, for example in choosing employment, investments, when individuals more than ever base their decisions on environmental and social consequences of these decisions.

Green innovations are extremely important, so regardless of their size the companies should invest significant amount of finance, effort and energy to creating inventions and consequently to eco-innovation process, with massive support of marketing communication. This creates an opportunity for influencing opinion of customer through using marketing communication tools by installing and educational influencing of ecological awareness, yet as well the purchasing behaviour, in favour of ecologicallyinnovated products.

Current state suggests that companies consider creation of inventions and their following implementation in eco-innovation process as important however, they do not use enough all marketing communication tools. Trend is to use online communication channels and new access to information, through variety of digital technologies, which complement traditional marketing communication tools.

4. ANALYSIS OF THE CURRENT STATE OF GREEN INNOVATION IN SMALL AND MEDIUM-SIZED ENTERPRISES IN SLOVAKIA

The main element of innovation business in Slovakia is the small and medium-sized enterprises. It is because they are characterized by high flexibility of the way how they respond to market situation. On the other hand, in most cases these enterprises do not have enough financial resources for implementing innovations. A suitable solution is then a state support together with instruments of the European Union (structural, community and framework programs).[5] In recent years, Slovak enterprises have started to devote themselves increasingly to green innovations, also thanks to the membership in the European Union.

We conducted a pilot survey in the period of months February – April 2015, whose implementation and evaluation is one of the partial stages of the first year of solving the project VEGA 1/0640/15 called *"Concept Phygital and its application in sustainable integrated environmental management in companies."* In this survey our aim was to find

out which of the surveyed enterprises implemented green innovations and whether these green innovations were supported by marketing communication tools. Altogether, there were 500 questionnaires distributed on an online form.

The concept of green innovation is currently a trend, while this fact is also confirmed by enterprises understanding of this term. As much as 86.67 % of surveyed enterprises know the term green innovation or they have come across this term, yet this term was not given much attention to this date for the enterprises to know it good enough, that they are not afraid to invest and implement their ecological initiatives within the defined innovation strategy. It is also caused by the fact, that currently green innovations are not paid so much attention in Slovakia as abroad, there is no general definition of this term available, and ultimately there is not enough research conducted on this issue. Therefore, when implementing green innovations many enterprises in Slovakia rely on examples and patterns from foreign practice.

The surveyed showed that 57.22 % of surveyed enterprises implemented green innovations in the given period of years 2011 – 2014. In their answers companies stated that the most frequently they recycled products, introduced new technologies saving environment, implemented production process, that requires less natural resources and used new ecological materials as well (see Figure 1).

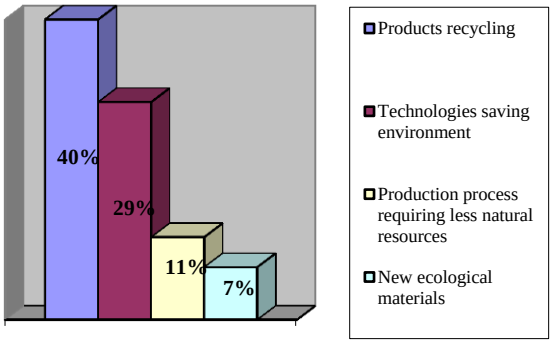

Figure 1. Implementation of chosen types of green innovations [own processing, 2016]

By the survey we tried to find out the relation of an enterprise towards environmental protection in everyday reality. Figure 2 shows, that most of the surveyed enterprises – 58.00 % take an active stance on environmental protection and the minimum of enterprises – 4.00 % take a proactive stance.

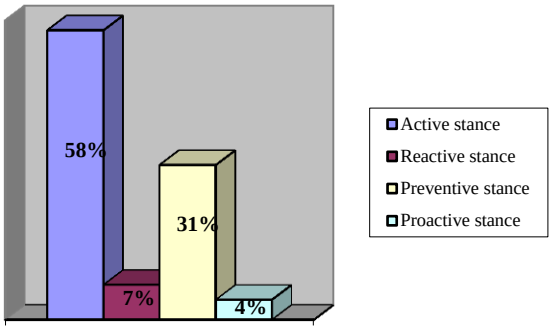

Figure 2. *Relation of businesses to environmental protection* [own processing, 2016]

By accumulation of these opinions we came to conclusion that 89.00 % of surveyed enterprises take a positive stance towards environmental protection. Underlying knowledge of the term and active approach towards environmental protection are a prerequisite for the ecologically thinking enterprises to decide to implement their ecological initiatives.

Environmental sentiment and focus of enterprises that realized green innovations is reflected also in their attitude towards implementing green innovations and they justified their actions by having a possibility to contribute to environmental protection (80.58 %). Another main reason was gaining competitive advantage (20.39 %) and last but not least it was also the effort to react to needs and requirements of customers (14.59 %). On the other hand, after evaluating available data it shows that the greatest barrier of implementation of green innovations appear to be mainly financial resources (48.00 %) and lack of time to deal with this issue (29.00 %).

The existence of these barriers of implementation of green innovations also justifies the fact, which was proven in the survey that 77.78 % of surveyed enterprises do not plan to realize green innovations within their innovation strategy in period of 2016 – 2018.

In the survey, we focused on analysing relations between gaining competitive advantage of an enterprise, which implements green innovation and the interest of customer in ecological side of the products or solution. Despite the fact that 20.39 % of surveyed enterprises implemented green innovations in order to gain competitive advantage, our survey showed that externally the customers do not show their interest in individual ecological-friendly products in a sufficient manner (18.00 %).

Therefore, we conclude that within the awareness of businesses and customers there is an established need for protection of nature and environment, saving of resources or mitigation of consequences of consumerist lifestyle, yet is reflected in purchasing behaviour and purchase decision rather slowly and up to now, the customer is rather insecure in questions of purchase of eco-innovated products.

The survey showed, that only 35.00 % of businesses use some of the marketing communication tools for marketing support of implemented green innovations. Enterprises use more an online environment (51.43 %) instead of an offline environment (48.57 %). Figure 3 explains the use of individual marketing communication tools in communication support of implemented green innovations.

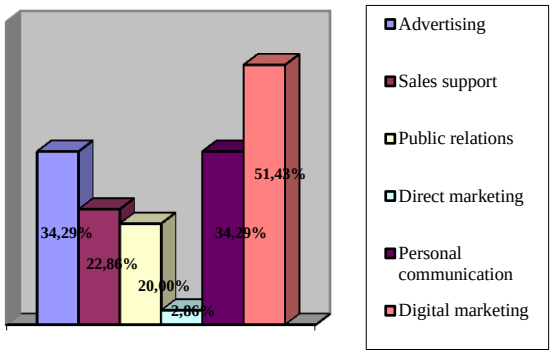

Figure 3. Using the marketing communication tools in support [own processing, 2016]

Enterprises, which use digital marketing in communication support of green innovations, realize its potential and advantage that stem from it. Figure 4 shows, which techniques of digital marketing are used most by the respondents.

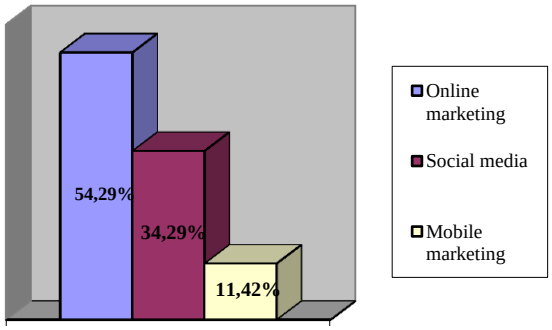

Figure 4. Using the digital marketing techniques in support [own processing, 2016]

The survey showed that 51.11 % of surveyed enterprises plan to implement marketing communication support of green innovations through digital marketing. However, 48.89 % of enterprises retreat from this step.

Enterprises, that use digital marketing in communication support of green innovations, stated as the most common reasons:

- monitoring and measurement of communication activities,
- obtaining feedback from customers,
- availability,
- overall efficiency.

On the other hand, enterprises that do not use, or do not plan to implement digital marketing stated a number of reasons for this fact, including:

- lack of trust from customers,
- demanding implementation of digital marketing.

By concluding the pilot survey we managed to find out important facts, which will help us in further research problem solving. Since we conducted the pilot survey on a smaller base set, after implementation of corrections we will conduct a survey, in which will try to

analyse the use of marketing communication tools and also analyse the current state of the use of marketing communication in sphere of creation, implementation and commercialization of green innovations in small and medium-sized enterprises in Slovakia.

6. CONCLUSION

Green innovations are currently a sphere that is becoming a natural part of enterprises´ life. Importance of green innovations can be understood on several levels, for ex. in building competitive advantage, improving enterprise´s image, creating added value and so on.

However, first of all it is about the right thing towards sustainability of business as well as the planet where we live. The current state suggests, that enterprises consider creation of inventions and their realization in eco-innovation processes as important, yet they do not use marketing communication enough, in order to support these innovations. Implementation of green innovation and effective marketing communication focused on these innovations – these are significant factors of success.

The world of digital media is rapidly changing. Its rapidly innovative technologies and the way people use them do not only change manner in which we access the data, but also the way we communicate with one other. The Internet and digital communication serve as a basis for future innovations and growth for each field of business. They bear a key effect – improving information of the society and increasing awareness. Marketing managers and admen are aware of benefits of on-line communication as a core a viable and successful strategy and effectively allocate resources here for, it is crucial to evaluate effectivity of their business in terms of digital world. The question is, however, which businesses are able to implement the benefits digital marketing tools might generate.

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CITIZENS' ENVIRONMENTAL CONSCIOUSNESS AT LOCAL LEVEL: THE CASE OF MINING-METALLURGICAL AREA IN EASTERN SERBIA

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Abstract

Raising environmental consciousness (EC) in urban areas environments causes acceptance and ecological and social responsibility. Industrial plants represent an important source of pollution of urban areas. Industrial plants represent an important source of pollution of urban areas. In that sense, Bor is an interesting urban area having in mind that it represents one of the most important ore and metal production centres in South-East Europe. What defines the EC of Bor inhabitants is derived from the very town and its economy. The research encompasses concrete environmental problems of the mining town Bor and its surroundings. The components of the EC of people living in Bor were analysed according to the AKA model (awareness, knowledge and attitude), having in mind the extent to which the environment has been polluted in this area. It has been concluded that the perception of people living in Bor about the state of the environment depends on numerous factors – first, whether the employee works for the RTB Bor Company or not.

Keywords: attitude, awareness, Bor urban area, environmental consciousness

1. INTRODUCTION

The ethics of environmental protection is based on the moral responsibility of man that does not endanger the environment in which they live, because the only way to create the conditions for a better way of life [1]. It is necessary for the formation of environmental culture and responsibility in overcoming consumer relationship of man to nature's resources [2-5]. In order to achieve this, education must be conducted in all fields, from the earliest age through educational institutions, media, and seminars for the active participation of the individual. The education of environmental protection is not just about exploring the natural and social sciences necessary for understanding and solving environmental problems and environmental pollution [6], but also assumes extension of moral principles and the formation of a new system of values of man in relation to nature and the environment.

The last four decades have seen a significant progress in worldwide environmental consciousness due to growing evidence of environmental threats and risks [7]. At the

beginning of the third millennium special interest is directed towards air quality in the urban areas in Europe, due to the increasing industrialization [8]. Subsequently, environmental policy became a necessity in the urbanized world of developed countries. For instance, the influence of traffic has numerous negative effects on the environment and can be seen on various levels (local, regional and global).

Apart from the traffic, being the one of the biggest sources of pollution of urban areas, according to the scale of pollution there is also pollution from numerous industrial plants. The problem of air pollution in industrial zones is much bigger, especialy in the areas with developed metallurgical facilities for production of nonferrous metals [9]. Special attrention is paid to sulfur duoxide (SO_2) – a traditional air polluter [10]. This substance mosty originates from the oxidation of sulfur compounds.

Figure 1. The region of Eastern Serbia with the location of copper smelter in Bor [9]

The town Bor (settlement with nearly 40,000 inhabitants) is in that sense a very interesting urban area, having in mind that it represents one of the most important centres of ore and metallurgy production in South-East Europe. The Bor Copper Mine, that is, the town of Bor is located in Eastern Serbia, 220 km away from Belgrade and about 30 km and 100 km away from the borders with Bulgaria and Romania, respectively (Fig. 1).

The city has developed over a short period of time, a century, from a small village to a colony of miners and into an urban centre of Eastern Serbia. Mining of copper ores in Bor began in 1903 by underground mining. Almost a decade later, the open pit operations started in 1912 and were continued until 1986. A few decades ago, two more copper mines

were opened in the vicinity of Bor - at Veliki Krivelj (1979) and Cerovo (1990). The mine is suitated on the north-eastern rim of the town so that the open pit, metallurgical smelting complex and the flotation tailings pond make a boundary between the urban and the industrial zone (Fig. 2). The border with Romania is the river Danube while in the vicinity of this mining area the river Timok flows.

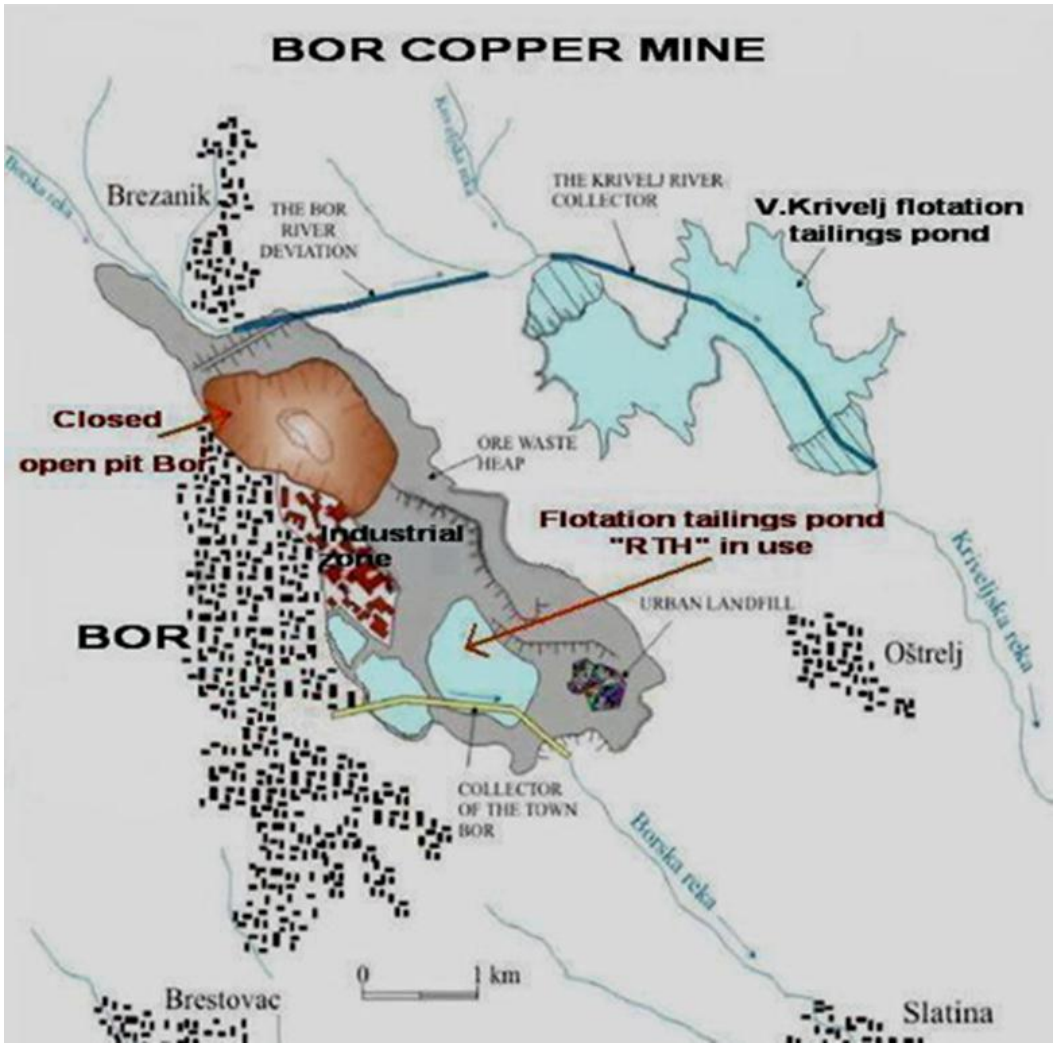

Figure 2. Location of the town with all the mining-metallurgical facilities [12]

Taking into account the fact that this town exists in the vicinity of the mine, as well as the location of the copper smelting plant and two more mines nearby, which make RTB Bor (*the Copper Mining and Smelting Complex Bor*), the town itself (Fig. 3) represents a serious environmental problem of Serbia and this region [11].

Consequently, the economy in Bor is extremely homogenous because 80% depends on mining and metallurgy. This causes the most degrading effects to the environment, obvious to all the citizens. The numbers speak for themselves – in 2002, for instance, 207 Mt of flotation tailings, 450 Mt of overburden and 23 Mt of slag were disposed of on the territory of Bor municipality (nearly 11333.3 t of waste per inhabitant of the municipality [12]. At the same time, mining and metallurgy have been providing the development and survival of the town and a relatively high standard of living.

Figure 3. The town of Bor – nice weather (above) and cloudy weather (bellow)

It is known that in Bor, a unique urban area, possibly the most important centre of the mining and metallurgy in the South East Europe, the environment and its surroundings are seriously endangered. The concentrations of sulphur-dioxide released from copper smelting process are too high. For instance, the total emission of SO_2 from *Bor Smelting*

Plant in 2007 was 370 t SO_2 per day, i.e. about 140,000 t per year – this amount corresponds to the average values from several years of 170–250,000 t [13]. At the same time, the distance between the down-town and the first smelter chimney with SO_2 emission is approximatelly 500 m. On the other hand, the concentrations of sulphur-dioxide released from copper smelting process are too high.

Moreover, the air pollution in Bor and its nearby setlements, could cause an international or transboundary environmental problem as winds reportedly carry emission to nearby Bulgaria and Romania. It is obvious that the biggest long-term problem is the air pollution. Thus, the first association of Bor is grey sky and the town wrapped up in smoke.

Apart from the polluted air, the town and its surroundings are endangered by the waste waters which pollute the soil, also the waste and the dump sites located near the city. Intensive exploitation and processing of copper, with the sole aim of gaining the most profit, resulted in degradation and pollution of the environment, which can be described as a local ecological catastrophe. The current state of the environment is the limiting factor to development, not only of Bor, but of the whole Timočka Krajina area.

Having in mind the above said, it can be assumed that the environmental consciousness (EC) of the citizens who live in Bor is influenced by the characteristics of the very town. From the standpoint of this study, the problem of low public awareness in Bor concerning the environment should not be undermined. It is well-known that in attempts to improve and solve problems (including environmental ones), one of the most important way is citizen awareness, knowledge and attitude to different issues.

Having in mind the fact that the inhabitans of Bor have been exposed for a long time to the high concentrations of SO_2 and other pollutants (including particulate matter and heavy metals), this study attempts to present the results of recetnly (2014) measured environmental consciousness of Bor citizens. Three different groups took part in the survey conductred in this particular urban area, including the respondents employed in the mining-metallurgy production. Also, the reasons and consequences of low degrees of envioronmental consciousness among various groups as well as the course of their control are analysed.

The local community is trying to find the solution and resolve the environmental problems by using all of the resources and potentials at hand. In relation to that the Local Environmental Action Plan is being implemented and all of the parties are interested in the process [13]. The Local Environmental Action Plan of Bor represents the consensus of the most favourable methods for the sustainable development and resolving the problem of environmental problems. The process of drafting LEAP was started by the Ecological club of the young researchers in 2001, and in 2002 the local self-government supported its development. The successful realization of LEAP depends on the realization of numerous tasks, goals and activities. The fields are: legal issues, application of technological and technical measures, economic relations, organization, management, institutional capacity building, education and health. Educational institutions comprehended LEAP as a possibility for expanding their educational programmes and directed their work towards raising EC and forming of new way of environmental behaviour of future generations. This document is only the first step towards resolving environmental problems in Bor. It is the result of experts who were willing and ready to share their knowledge, experiences, ideas and visions and transform them into concrete actions and become useful to their community in order to resolve the problems which had been piling up over the past

century. If this trend continues there is hope for this city to stop being the synonym for ecological disaster but an environment which might boast of historical, cultural and tourist attractions.

The EC of Bor citizens and its surroundings is quite contradictory. On one hand, there is a high concern about the scope and causes of environmental problems in Bor, but, on the other hand, there is not enough knowledge about the consequences of pollution [14]. Also, people know the fact about environmental pollution but there is not enough motivation and action towards solving these problems.

2. ENVIRONMENTAL EDUCATION AND ENVIRONMENTAL CONSCIOUSNESS

The environmental awareness of an individual consists of (1) ecological knowledge, (2) ecological values, and (3) ecological behavior. All three components are required for the knowing, adopting and practicing the pro-ecological way of life. Environmental education and the formation of the ecology sensitive way of thinking starts very early in life, during the formative years, therefore, that is why the role of educational organizations at all levels of acquiring knowledge (elementary, secondary, university education) is very important. That is why the aim of the education is to acquire knowledge about contemporary problems of the environment, about the character and the nature of the endangered environment, and about the way of eliminating negative consequences caused by the ecological misbalance [15].

The environmental awareness represents the "awareness of the environment which encompasses interpretations, behavior, motives of actions, wishes and expectations related to our natural environment" [16]. The change of the man towards nature and his behavior is mostly caused by environmental education. Generally speaking, the environmental awareness can be interpreted as the consequence of the development level of one's specific environmental culture. Ecological culture requires a special level of quality towards the environment and people, therefore, it requires "comprehension of value systems and orientations". Thus, it can be said that the level of development of ecological culture depends on the state of the general culture [17].

Ecological behavior is an important foundation element of the environmental awareness, both of an individual and the social group. The ecological behavior is being shaped by different factors which can be objective and subjective such as [18]:

- the level of ecosystem pollution;
- the level of technological and technical development of certain environments as well as the level of ecological value system;
- the level of social and ecological infrastructure development (subjects, legal regulation, life quality, institutions);
- individual character traits (sex, age, category of workers, professional belonging, life quality);

- subjects as actors (science, environmental policies with instruments, state institutions, ecological movements, political parties).

Environmental education (EE) and upbringing greatly influence the behaviour and attitude of people towards nature [19, 20]. The basic rule of EE is portrayed in the tendency that this area of education should not only consist of informing people about environmental facts, but that students gain knowledge, which is not only informative but to tangle with the environmental issues throughout formal education. It is generally believed that education, relying on the findings of science and technology, should have a decisive role in creating awareness and a better understanding of environmental problems [21].

EE and the formation of the environmentally sensitive way of thinking starts very early in life, during the formative years, therefore, that is why the role of educational organizations at all levels of acquiring knowledge (elementary, secondary, university education) is very important. That is why the aim of the education is to acquire knowledge about contemporary problems of the environment, about the character and the nature of the endangered environment, and about the way of eliminating negative consequences caused by the ecological misbalance.

In order for a person to be environmentally aware it is required to educate him first which is possible only by introducing environmental contents throughout the whole formal education. The environmental education should be considered very seriously and efficiently, by innovating the existing educational plans and programmes and by introducing regular ecological contents as separate subjects [22].

Most researchers view environmental consciousness (EC) as a general attitude that relates to citizens' cognitive and affective evaluation of the attitude object – environmental protection [23-26]. EC of an individual consists of (1) environmental knowledge, (2) environmental values (EV), and (3) environmental behaviour. All three components are required for knowing, adopting and practicing the pro-ecological way of life. Thus, EC consists of representations, ways of behaviours, motives of action, willingness and expectations related to the environment.

The development of EE and activities are related to the new social movements (including environmental ones) which began in 1960s in the Western developed countries. Environmental consciousness was measured as relation between post-materialist and materialist value orientations [27].

Although various measures have been implemented in order to decrease the ecological imbalance, the need for establishing and raising the level of EC is getting more and more attention. The process of one's raising consciousness evolved into EC related to one's own endangerment and fear from self-destruction due to negative effects of people's practical attitude towards nature and their relentless consumption and pollution of the environment. The responsibility towards the environment, including human civilization, flora and fauna, represents the new life philosophy and the comprehension of social movements for the environmental protection. Therefore, the EC represents the awareness of the environment which encompasses interpretations, behaviour, motives of actions, wishes and expectations related to our natural environment. The change of the man towards nature and his behaviour is mostly caused by environmental education (EE). Environmental consciousness is a part of wider philosophy of social movements directed towards securing

and improving the natural environment, which is important both for an individual and the whole civilization and its survival on the whole.

In the wider sense, EC can be comprehended as a consequence of the development level of one's specific ecological culture. Ecological culture requires a special level of quality towards the environment and people; therefore, it requires comprehension of value systems and orientations. Thus, it can be said that the level of development of ecological culture depends on the state of the general culture, including national culture [20].

Environmental behaviour (EB) is an important foundation element of the environmental consciousness, both of an individual and the social group. Therefore, EC is either an individual or collective action directed towards solving identified environmental problems. Individual values may be understood as a sense-making device that shapes behaviours [28]. They affect how citizens perceive and interact with each other and how they solve environmental problems [29]. Hence, the EB is being shaped by different factors which can be objective and subjective such as:

- the level of ecosystem pollution;
- the level of technological and technical development of certain environments as well as the level of ecological value system;
- the level of social and ecological infrastructure development (subjects, legal regulation, life quality, institutions);
- individual character traits (sex, age, category of workers, professional belonging, life quality);
- subjects as actors (science, environmental policies with instruments, state institutions, ecological movements, political parties).

EE and EC of new generations are becoming more required. Human relations and actions represent all that derives from the environment and all which changes that environment. Human sensitivity about negative effects of practical relations with nature has gradually turned into ecological awareness through the process of self-awareness and raising awareness about one's own endangerment and the fear from self-destruction as the consequence of the maximum exploitation and pollution of the natural environment.

Such a perspective is oriented towards harmonic relation between the human society and the natural environment and by being aware of their interdependency. It is related to the change of the traditional anthropocentrical view, which says that a man is the purpose of all being and the planet, which has led to the uncontrolled economic growth and consumption and misbalance of natural balance of catastrophic scales. That is why the new environmental ethics known as ecocentrism, ethically opposing anthropocentrism, was introduced. It puts ecosystem in the centre of everything and a man is equal to nature but he is subordinate only in the sense of higher responsibility to securing natural environment, human kind and the nature itself.

The responsibility was derived from the fact that only a man is given with highly developed consciousness and the possibility to hold moral values. Until 1970s the question of socio-economic framework was more important than the question of the ecosystem. When the second question came through the shape of a new social awareness came into being. It was clear that people had to abandon the thought that natural wealth was

unlimited and that it can be exploited beyond limits. The change of the perspective became a crucial step towards making people's activities and the natural environment at peace with each other.

The development of EC has enabled the creation of an integral system of environmental protection which secures one's right to live and develop in a healthy living environment and balanced relation between the economic growth and the environment globally. The EC influences the creation of a certain life style which takes from nature just the necessary for providing the basic human needs without destroying the balance in the environment. By raising the EC people accept and take environmental and social responsibility.

EC as a manifestation of global attitude about the relation between a man and nature, represents a vital element of all other social and political activities directed towards protecting the environment [30]. Also, without the knowledge about the ecological problems, adopting EV and individual environmentally responsible behaviour, each global attempt in this field would be a failure.

3. RESEARCH METHODOLOGY

The research was carried out on the territory of Bor in April 2015 by using a pool questionnaire and it targeted the environmental awareness of citizens, their attitudes and opinions, their knowledge about burning issues related to ecology.

The questionnaire was designed according to AKA model. The focus is on the correlation between the level of education of respondents and the component of the environmental awareness according to AKA model: ***A**wareness* (environmental sensitivity), ***K**nowledge* and ***A**ttitude* (value systems). The natural environment had been destroyed for decades. The damage cannot be fully reversed but one can stop further irrational exploitation. That is why the UNESCO 1978 contains goals and objectives about education. The model was developed which synthetizes three important components – ***A**wareness*, ***K**nowledge* and ***A**ttitude* (AKA) – into the educational plan for environmental protection. This method, as an instrument, was used solely by experts dealing with ecology (instructors), students and parents. The research showed that other factors such as sex, socio-economic status and long-term experiences in ecology provide the positive outcome of the education and development of the ecologic programme which supports social responsibility towards the environment.

The conducted research in Bor consisted of AKA method with the following meanings [31]:

- *Awareness* includes the attention, concern (mindful or heedful) and sensitivity of the respondents in terms of environmental problems. Such statement might be: "I think water pollution is a serious environmental issue". Closely related term "perception" denotes the ability to perceive environmental problems in the real world, based on memory and influenced by prior experience. For example, "I have noise pollution from the copper smelter located in my town".
- *Attitude* (value system), represents a set of values, emotions and motives towards the environment and is presented through NEP 2000, the questions are related to the balance between the social responsibility and the interest in the environment,

declarations and political measures taken in order to protect the environment [32]. The questions were set in a changing pattern describing pro-ecological attitudes (21, 23, 25, 27, 29, 31, 33 and 35) and anthropocentric attitudes (22, 24, 26, 28, 30, 32 and 34). The results are invers for questions related to anthropocentric attitudes because ecologically wise these attitudes were treated as the lower level or disapproval. For instance, these statements could be written as follows: "I think the air pollution problem requires attention" (ecological attitude) and "The news about contaminated rivers and lakes are exaggerated" (anthropocentric attitude).

- *Knowledge* is defined as the understanding of the environment, and it deals with regional questions and basic ecological terms; for example: "I know the cause of ozone layer depletion".

The questionnaire consists of 44 questions and is divided into three sections. The first section deals with:

(1) influence of the micro environment,

(2) perception and

(3) concern about the living environment.

There are five questions in relation to the influence of the micro environment which reveal whether and how often the respondents are in touch with the nature, how much the working environment inspires them to secure the environment and what the level of their interest and involvement in these activities is. The perception represents the comprehension of the environment by the senses and which is a complex process that involves the interconnection of data acquired by the senses in prior experiences, their categorization and prioritization. In this section the questions were related to the state of the environment (water treatment, waste disposal, air quality, etc.) in which the respondents live and work. There were nine questions. Finally, the concern about the environment is characterized by six questions and they deal with the level of concern about certain ecological problems related to the environment the respondents live and work in. The replies showed how much and whether the respondents think about it, and if they do, their level of concern.

The second part of the questionnaire consists of two sections which determined the level of (1) pro-ecological attitudes and (2) anthropocentric attitudes. Pro-ecological attitudes put the eco-system in the center of everything, way in front of the economic and social development. The respondents were faced with eight questions and answers which rated to which extent they agreed or disagreed with the statements. Anthropocentric attitudes, contrary to pro-ecological, put the economic and social development in the center, and later on the aims in relation to the eco-system. The questions were successive so that the respondents expressed their own attitudes.

The third part of the questionnaire (9 questions) is related to knowing the facts about the influence of mining and metallurgy on the environment. The knowledge is comprised of all information, facts and skills gained by a person through education or experience.

The questionnaire contains also questions related to the socio-demographic characteristics of the respondents. Due to the diversity of companies, work places and working

environments, the analysis was conducted for four socio-demographic characteristics: age, sex, level of education and working experience.

There were 120 respondents divided in three groups with the same number of respondents. The first group consisted of RTB BOR Group workers, the second one of those employed in educational institutions, while the third group consisted of various majors (medical workers, traders, entrepreneurs, etc.). Statistical software SPSS 18 was used in order to conduct this research.

1. RESULTS AND DISCUSSION

The analysis encompassed the concrete ecological problems of the mining town of Bor and its surroundings. The majority of respondents was the age up to 40 (47%), then the age 41/50 (37%), 51/60 (14%), and the fewest over 60 years of age (2%).

The highest percentage of respondents had secondary education (43%), and the lowest with PhD (3%), and there were 38% of those with university education. Based on the research results it can be concluded that the citizens know about the environmental problems, but depending on the group of respondents and their level of education, their answers differed. The two categories, the group and the level of education, were found to be the key indicators of the general opinion and environmental awareness. The collective results, according to groups, are shown in Table 1.

It should be noted that women gave better answers to all questions than men.

Table 1. Research results according to environmental awareness and groups of respondents

	Organization	Mean	Std. Deviation	N
Influence of micro-environment	RTB BOR Group	2.2050	.51538	40
	Educational institutions	2.6800	.66994	40
	Other	2.3500	.67899	40
	Total	2.4117	.65198	120
Perception	RTB BOR Group	1.9722	.56809	40
	Educational institutions	2.2194	.56347	40
	Other	2.0694	.53060	40
	Total	2.0870	.55903	120
Concern about the environment	RTB BOR Group	2.5375	.73136	40

	Educational institutions	2.8750	.64356	40
	Other	2.7417	.76883	40
	Total	2.7181	.72400	120
Knowledge	RTB BOR Group	1.8472	.24996	40
	Educational institutions	1.8611	.19121	40
	Other	1.9250	.19226	40
	Total	1.8778	.21385	120
Value system of pro-ecological attitude	RTB BOR Group	3.0250	.57749	40
	Educational institutions	3.0938	.52253	40
	Other	3.2469	.47154	40
	Total	3.1219	.52945	120
Value system of anthropogenic attitude	RTB BOR Group	2.6964	.62412	40
	Educational institutions	2.3571	.54036	40
	Other	2.3357	.45814	40
	Total	2.4631	.56539	120

The following nine questions deal with the perception of respondents. Those employed in the educational institutions had the highest perception in comparison to the other two groups (2.2194). RTB BOR Group had the worst results one again, while the respondents working in other fields showed better results than them.

The last six questions dealing with ecological sensitivity represent the level of concern about the environment. The situation is the same as in the previous two sections when talking about the highest results. Those in educational institutions had the highest concern (2.8750). Those working in RTB BOR Group once again had the worst results.

RTB BOR Group had similar results concerning the last two analyzed components, environmental awareness – value system and knowledge. It can be concluded that the respondents from educational institutions showed a higher level of environmental sensitivity compared to other two groups.

The second part of the analysis system, represent a value, which consists of:

• pro-environmental and

• anthropocentric attitudes.

When pro-environmental attitudes maximum score is 4, and in anthropocentric attitudes maximum number of points is 1. Questions were asked in turn. The results showed that subjects who belong to the group of other professions, the most accurate answers when pro-environmental attitudes (3.0938), ie mostly agree with these views. A smaller number of points obtained from the subjects of educational institutions, and the worst scores in the subjects of RTB BOR Group.

When anthropocentric attitudes, respondents from other professions were again the closest to the maximum number of points in relation to the other two groups (2.3571). Here are the subjects of RTB BOR Group worst scores in. Respondents from educational institutions showed approximate results to respondents from other professions.

It can be concluded that respondents from RTB BOR Group important economic development of the environmental protection. Although they are a production company, it is no excuse for this kind of survey results. Just because they represent one of the largest basins dealing with mining and processing of ore, should have clear plans and views on the future in finding applicable solutions related to ecology.

The third part of the analysis included questions related to the knowledge of the respondents. The questions were from the mining and metallurgy and to the role of pollutants in urban areas. The first seven questions respondents to choose between two answers (1 disagree, 2-disagree) and their answers can be concluded whether or not they know the correct answers to questions. In the last two questions were multiple choice answers and respondents were to choose only one answer for which they thought was correct. The group in which the respondents gave the most accurate answers represent other subjects of interest (1.9250). The lower level of knowledge showed respondents from the group of educational interest, a slightly lower level of respondents from RTB BOR Group.

The conclusion that arises from the table is that the respondents RTB BOR Group gave the worst answers.

2. CONCLUSION

Environmental consciousness is characterized by awareness of the environment, and the environment that surrounds us. Her condition, undoubtedly, is disrupted and it takes on a global character. In recent years, more and more countries are faced with the consequences of long-term damage to the environment but are increasingly involved in the various programs of its recovery and further conservation.

Based on the research it has been concluded that the perception of Bor citizens about the environmental state depend on the various factors – first of all, whether the respondents work in RTB BOR Group or not. Yet, lately there is a lot of effort to make the air in Bor cleaner and there are active measures addressing the issue of the long-term pollution of the environment. Regarding the size of this region and population (more than 200,000 people), the approach of this mining-metallurgical company's management should be based on global orientation towards resolving pollution problems [33].

The analysis results point out that the level of ecological sensitivity is lower in production organizations. The reason for this is that a big complex, such as RTB BOR Group, puts

economic interest in front of the ecological and bases its positive business results on the exploitation of natural resources. Such a behavior cannot, under any circumstances, be an excuse. Therefore, certain efforts should be made in order to ease the destroyed environment and find environment friendly technological solutions. Most of the respondents have secondary education and they have the best results concerning the micro-environment (2.2286), due to their jobs which make them aware of the constant changes in their working environment. Those with college (1.8148), university (1.9365) and magister (1.8889) degrees had good theoretical results concerning knowledge. In practice, the engagement of this organization, during the past years, concerning the environmental protection was lover than expected.

Only the constant education (starting from the upbringing and family examples) can result in the avoidance of the ecological catastrophe which lurks due to human negligence and irresponsible attitude towards the environment. Acquired knowledge should not only be transferred but should also be improved constantly and one should continuously try to find new solutions for securing the environment. The changes are rapid and the experts should be able to keep up with the problems and always be ready to react in the best way.

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RESEARCH OF AWARENESS OF SOUTH BANAT RESIDENTS ABOUT AIR, WATER, LAND AND FOOD POLLUTION

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Abstract

The process of industrialization and application of agro-technical measures in South Banat, unfortunately, brings about the problem of pollution in air, water, soil and food. Pollution causes disruption of physical, chemical and biological properties of our environment, which - when changed - has damaging effect to all of us.

This paper aims at establishing facts regarding the extent of pollution in the South Banat administrative area as well as the extent of awareness of residents regarding this problem.

Keywords: Environmental problems, pollution, environment, survey, South Banat.

1. INTRODUCTION

Pollution leads to serious health and genetic consequences, as well as the reaction of the organism, and thus the problem of pollution of the South Banat becomes the priority that poses a dilemma before the residents of South Banat: stay at the price of survival or survive by engaging all aspects of civil and rural public opinion and initiative in raising environmental awareness and creating control mechanisms that will actively participate in the environmental fate of South Banat.

With this study we want to find out to what extent the inhabitants of South Banat are familiar with the aforementioned environmental problems and environmental pollution. At the same time, we want to point out just how damaging pollution is to all living beings.

Survey as the method was used as the instrument.of data gathering for this research. The survey includes one hundred participants. The survey polled residents of South Banat from Pančevo toVršac, residents of different gender, age and educational qualifications. When testing we used a questionnaire that contained ten questions and was administered through descriptive method.

The survey results indicate that in the future utmost attention should paid to the development and raising of environmental awareness in South Banat through permanent educational programs on environmental protection.

2. THEORETICAL REVIEW - GENERAL COMMENTARY

The process of industrialization and application of agro-technical measures in South Banat, unfortunately, brings about the problem of pollution in air, water, soil and food. Pollution causes disruption of physical, chemical and biological properties of our environment, which - when changed - has damaging effect to all of us.

Uncontrolled discharge of harmful substances from factories in Pančevo South zone - HIP "Azotara" Pančevo, Oil Refinery Pančevo, HIP "Petrohemija" Pančevo and other sources of pollution in the South Banat causes air pollution. Into the air they emit in huge quantities various and numerous harmful ingredients with substantial emission, such as: carbon monoxide (CO), carbon dioxide (CO2), sulfur monoxide (CO), sulfur dioxide (SO2), hydrogen sulfide (H2S), nitrogen monoxide (NO), nitrogen dioxide (NO2), ammonia (NH3), benzene (C6H6), hydrocarbons (toluene, methyl mercaptan), soot, etc. All these ingredients are prefixed asa pollutants that lead to global and not just local problems.

In our environment, factories and other sources of pollution through their wastewater pollute our rivers too – the Tamiš, the Nera, the Karaš and the Danube.

Circling of substances in nature inevitably pollutes the land too, namely: agricultural land due to uncontrolled application of fertilizers and pesticides used in agriculture; land used for illegal dumping of solid waste as well as land that is threatened by many other pollutants with their waste materials.

All the foregoing leads to pollution of food because the plants, through their root system that is not selective in the process of absorption of water from the soil, absorb everything they are offered. Therefore, food too is contaminated, and people are the last members of the food chain so they take in all this pollution through intake of food.

The consequences to humans of all stated above, are: respiratory diseases, cancer diseases, weakening of the immune system, allergies, cataracts of the eyes, conjunctivitis, increased mortality. In addition to these health consequences there also occur mutagenic and teratogenic changes.

The level of pollution of our environment has increased considerably after the 1999 bombing. During the bombing, simultaneously in a single day all three Pančevo South zone factories were bombarded causing a major emission of harmful substances. During the bombing, large amounts of toxic and harmful substances were poured into the rivers and the land within the Pančevo South zone. Such pollution had seriously endangered the groundwater and the tap water that we drink is obtained by processing the groundwater.

Based on the facts presented we can clearly conclude that the problem of pollution of South Banat district should be taken seriously. Residents of South Banat should primarily be informed that there is a way and the measures that can be used to reduce the level of all forms of pollution.

In order to protect the air in South Banat certain measures can be applied, namely: technical-technological, biological and legal. Application of the above measures should be constant and simultaneous. Water can be protected by purification of wastewater. The land can be protected by applying legal measures in agriculture, as well as reducing the amount of solid waste, recycling waste and construction of sanitary landfills. Method of recycling achieves best results in protecting soil from waste both from the ecological and economical

aspects. Residents of South Banat should be informed through the media and through permanent educational programs so they could learn how to recognize environmental problems, how to act preventively and how to initiate civil and rural initiatives in order to protect the environment and their survival in such conditions. Education programs on environmental protection should be seriously and professionally planned and even more seriously implemented. The importance of education can best be observed in the programs that are implemented in the context of protecting the population from AIDS, and in the programs on behavior in traffic. Such training saved many lives.

2.1 METHODOLOGICAL FRAMEWORK OF RESEARCH

During the research, during the data collection, we used survey as the research instrument. The main purpose of the survey is to collect information about to what extent the inhabitants of South Banat are aware of environmental problems and environmental pollution, how seriously they compreehend environmental problems and how they are satisfied with the level of awareness by the media. The result of research is data obtained after the processing and analysis of data from the survey. The survey research was conducted in the period from 01 March 2016 until 20 March 2016. The survey included one hundred participants - residents of South Banat of different sex, age and educational qualifications; we feel that one hundred respondent is the appropriate number. When testing, a questionnaire that contained ten questions and was administered through a descriptive method was used.

The aim of this survey is to find out to what extent the residents of South Banat are informed about environmental problems and pollution, how seriously they compreehend environmental problems and how they are satisfied with the level of awareness by the media.

3. RESEARCH OF AWARENESS OF THE POPULATION OF SOUTH BANAT ON AIR POLLUTION, WATER, LAND AND FOOD POLLUTION AND THE LEVEL OF MEDIA AWARENESS

3.1 SUBJECT OF RESEARCH

Subject of this research is to establish the level of education on environmental pollution in South Banat, i.e. the level of education about pollution of air, water, soil and food and the level of notification by the media.

3.2 METHODOLOGICAL BASIS OF RESEARCH

The aim of this research is to determine the level of education of the pollution of the environment in South Banat i.e. the phenomena of pollution of air, water, soil and food.

The objective of this research is to determine whether there are same quanta of knowledge of the pollution of air, water, soil and food in the surveyed population of South Banat.

Hypothetical framework of this research is that, by using the survey conducted in the framework of this research we set out the following hypothesis:

1. The first hypothesis - The surveyed population of South Banat is best informed about air pollution compared to the contamination of water and soil.

2. The second hypothesis - Surveyed South Banat residents think that food they consume is healthy.

3. The third hypothesis - Most of the surveyed population of South Banat knows what additives are.

4. The fourth hypothesis - There is dissatisfaction of the surveyed residents of South Banat regarding the lack of information on pollution and environmental problems by the media.

3.3 DESCRIPTION OF THE METHOD AND THE APPLICATION

During the research, during the data collection, we used survey as the research instrument. The survey was anonymous.

The survey research was conducted in the period from 01 March 2016 until 20 March 2016. . The venue of survey – the cities of Pančevo and Vršac and Municipality of Kovin, Bela Crkva, Alibunar, Plandište, Opovo and Kovačica.

Map 1. South Banat as administrative area

The survey covered a hundred participants. The survey polled residents of South Banat of different sex, age and educational qualifications.

When testing we used a questionnaire that contained ten questions and was administered through descriptive method. In formulating and determining questions we tried to make questions short and clear.

The survey contained ten questions, and they are:

1. Are you aware of the environmental situation in the South Banat?

2. Do you know how polluted the air is in South Banat?

3. Do you know how polluted the water is in South Banat?

4. Do you know how harmful UV radiation is to human health?

5. Is the land land in southern Banat contaminated?

6. Is the food we eat healthy?

7. Do you know what additives are?

8. Do you know what genetically modified food is?

9. Do you have some health problems due to the environment in which you live?

10. Are you satisfied with the level of informing by the media about the level of pollution of our environment?

4.ANALYSIS OF RESEARCH

4.1 RESULTA OF THE RESEARCH – REVIEW AND ANALYSIS

After the survey the questionnaires were collected after which the groups were formed based on the response category, and then a table review of results of respondents was made regarding the surveyed population of South Banat.

Based on the tabulation, it can be concluded that 65% of respondents have knowledge about the environmental situation in the South Banat. This is not good because it raises the question: How to implement environmental initiatives with the percentage of residents who have knowledge about the environmental situation in the South Banat? It can be assumed that these inhabitants of South Banat possess a certain environmental awareness in terms of initiatives and commitment to resolve certain environmental problems.

Table 1. Question - Are you familiar with the environmental situation in South Banat?

RESPONSE CATEGORIES		TOTAL %
YES	65	65 %
NO	10	10 %
PARTIAL	25	25 %
TOTAL:	100	100 %

Analyzing the percentage of 10% of respondents who say they are not aware of the environmental situation, it can be concluded that the stated percentage of the ignorant population of South Banat is not negligible but devastating and it is a good reminder that in this district ecology should be given much more space.

Analyzing the percentage of 25% of the respondents, who have expressed the view that they are partially familiar with the environmental situation, this could open a controversy regarding the quality of their knowledge and to what this answer "partial" actually refers. If we proceed from the assumption that these respondents have only some basic knowledge, it is necessary to introduce environmental protection into education program.

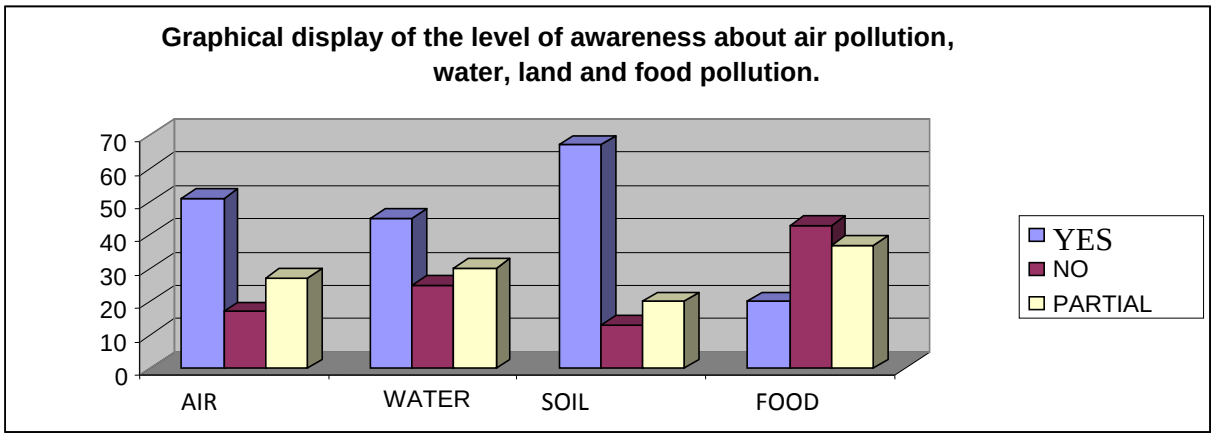

Figure 1. Graphical display of the level of awareness about the pollution of air, water, soil and food

Table 2. Question 2 - Do you know how polluted the air in South Banat is?

RESPONSE CATEGORIS		TOTAL %
YES	51	51%
NO	17	17%
PARTIAL	27	27%
TOTAL:	95	95%

Five respondents gave no answer.

Based on the above table, it can be concluded that 51% of respondents have knowledge about air pollution in South Banat. This is not good because it raises the question: How to implement environmental initiatives with the percentage of residents who have knowledge about air pollution in South Banat?

Analyzing the percentage of 17% of respondents who say they are not aware of the air pollution in South Banat, it can be concluded that the stated percentage of the ignorant population of South Banat is not negligible and it is a good reminder that in this district ecology should be given more space.

Analyzing the percentage of 27% of the respondents, who have expressed the view that they are partially familiar with the air pollution in South Banat, it can open up the controversy regarding the quality of their knowledge and to what this answer "partial" actually refers. If we proceed from the assumption that these respondents have only some basic knowledge, it is necessary to introduce environmental protection into education program.

Interpretation of the response category makes it clear that the majority of respondents have basic knowledge (summary responses of those surveyed who said "yes" and "partially" -

79%) on the problem of air pollution. If we analyze the detailed tabular overview of responses, it can be concluded that the percentage of 79% is indeed not optimal. We can observe that only 51% of respondents claim to have knowledge about air pollution, which is worrying and incomprehensible.

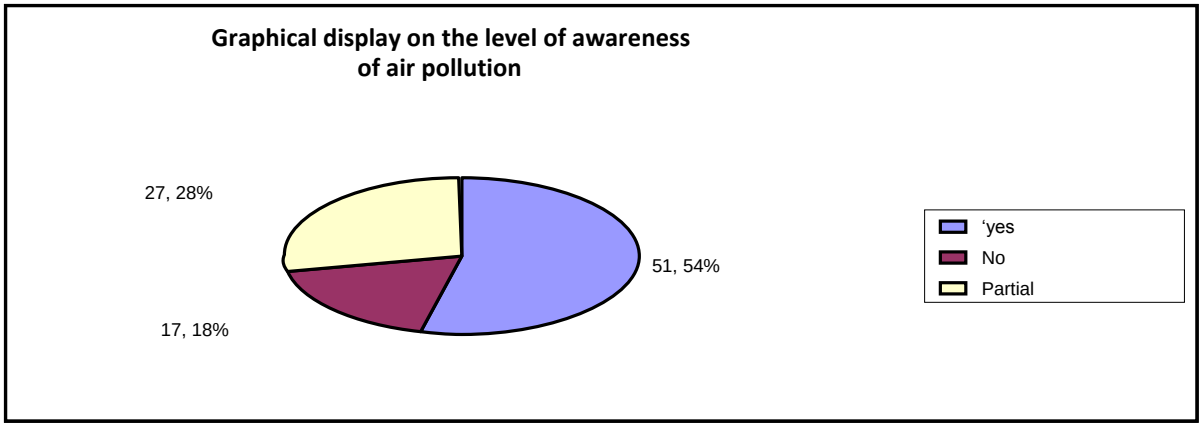

Figure 2. Graphical display of the level of awareness of air pollution

Five respondents did not answer, which can be interpreted differently, namely: either they have had enough; or they no longer wish to participate in the stories; or they are angry that nothing is undertaken; or among them there may be those who are responsible for the enormous air pollution.

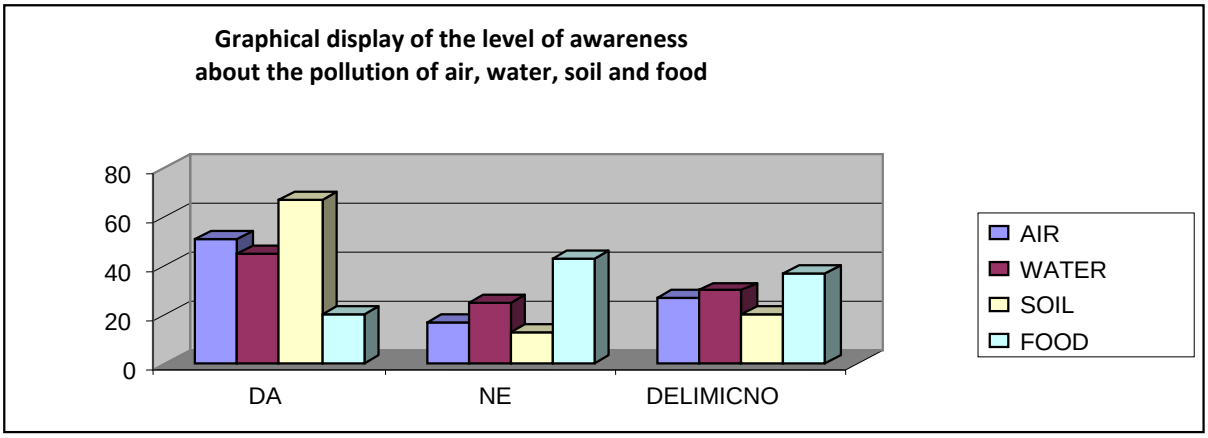

Figure 3. Graphical display of the level of awareness on pollution of air, water, soil and food

The first hypothesis - The surveyed population of South Banat is the best informed of about air pollution compared to the contamination of water and soil.

The analysis of the results of the survey enables us to conclude that the first hypothesis has not been proven.

Respondents have the most knowledge about the pollution of soild 67%, then the air pollution 51%, followed by the pollution of water by 45%.

By analyzing the above data on the level of knowledge of pollution of soild, air and water it can be concluded that the respondents - residents of South Banat have the most knowledge about the pollution of soil, because their interest is the motive of knowledge, since they live in Vojvodina, which is categorized as an agricultural area.

Table 3. Question 3 - Do you know how polluted the water in South Banat is?

RESPONSE CATEGORIES		TOTAL %
YES	45	45%
NO	25	25%
PARTIAL	30	30%
TOTAL:	100	100%

Based on the tabulation, it can be concluded that 45% of respondents have knowledge about water pollution in southern Banat. This is not good because it raises the question: How to implement environmental initiatives with the percentage of citizens who have information about water pollution?

Analyzing the percentage of 25% of respondents who say they are not aware of the pollution of water in South Banat, it can be concluded that the stated percentage of the ignorant population of South Banat is not negligible but it is devastating and it is a good reminder that in this district ecology should be paid much more more space.

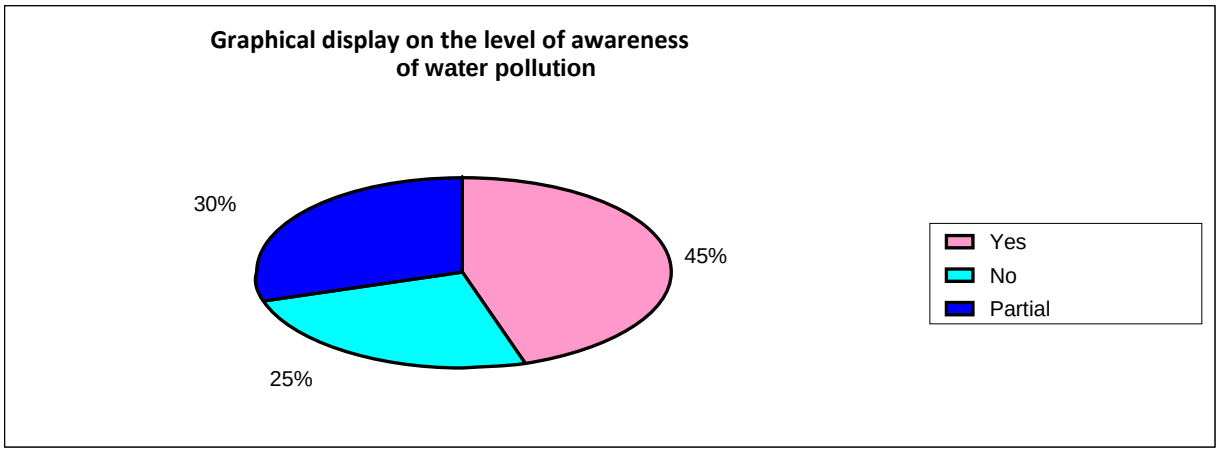

Figure 4. Graphical level of the awareness of water pollution

Analyzing the percentage of 30% of the respondents, who have expressed the view that the partially familiar with the pollution of water in South Banat, it can open up the controversy regarding the quality of their knowledge and to what this answer "partial" actually refers. If we proceed from the assumption that these respondents have only some basic knowledge, it is necessary to introduce environmental protection into education program.

Interpretation of the response category makes it clear that three quarters of respondents have basic knowledge (summary responses of those surveyed who said "yes" and

"partially" - 75%) on the problem of water pollution. If we analyze in more details the tabular overview of responses, it can be concluded that the percentage of 75% is not optimal. It is observed that only 45% of respondents claim to have knowledge about water pollution, which is disturbing and devastating. If to this number we add up those 30% of respondents who are partially familiar with this problem, then 75% of the citizens have basic knowledge of this phenomenon. The quality and scope of knowledge is certainly different in these two categories of respondents.

The analysis of the results of the survey enables us to conclude that the respondents have the least knowledge about water pollution 45%, then the air pollution of 51% and a maximum of 67% of land pollution.

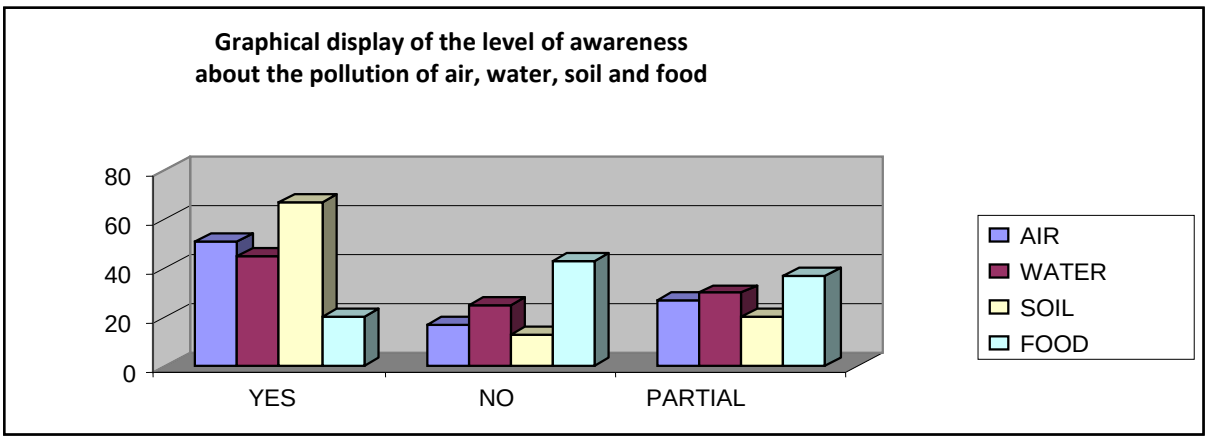

Figure 5. Graphical display of the level of awareness on pollution of air, water, soil and food

Table 4. Question 4 - Do you know how harmful UV radiation to human health is?

RESPONSE CATEGORIES		TOTAL %
YES	75	75%
NO	10	10%
PARTIAL	15	15%
TOTAL:	100	100%

Based on the tabulation, it can be concluded that 75% of respondents have knowledge about the harmful effects of UV radiation on health. The analysis of the data is very encouraging because it shows that a high percentage of respondents are informed about the harmful effects of UV radiation. It is observed that 75% of respondents claim to have knowledge about the harmful effects of UV radiation, which has achieved good informing through the media, which has lasted for several years now, especially in the summer months. This is a real confirmation of environmental commitment and increased level of environmental awareness.

Analyzing the percentage of 10% of respondents who say that they are not familiar with the knowledge of the harmful effects of UV radiation on health, it can be concluded that the stated percentage of the ignorant population of South Banat is not high, but it shows that it would be desirable to introduce the ignorant people of the program education on the harmful effects of UV radiation on health.

Analyzing the percentage of 15% of the respondents, who have expressed the view that they are partially familiar with knowledge of the harmful effects of UV radiation on health, this can open a controversy regarding the quality of their and to what this answer "partial" actually refers. If we proceed from the assumption that these respondents have only some basic knowledge, it is necessary to introduce the program of education on the harmfulness of UV radiation on health.

Interpretation of the response category makes it clear that the majority of respondents have basic knowledge (summary responses of those surveyed who said "yes" and "partially"-90%) of the damaging effects of UV radiation on health. If we analyze in more details tabular overview of responses, it can be concluded that the percentage of 90% of respondents is satisfactory. It is observed that 75% of respondents claim to have knowledge about the harmful effects of UV radiation, which is good. If to this number we add up the 15% of respondents who are partially familiar with this problem, then 90% of the population possess a basic knowledge of this phenomenon.

Table 5. Question 5 - Is soil contaminated in South Banat?

RESPONSE CATEGORIES		TOTAL %
YES	67	67%
NO	13	13%
PARTIAL	20	20%
TOTAL:	100	100%

Based on the tabulation, it can be concluded that 67% of respondents have knowledge of the pollution of land in southern Banat. This data is satisfactory in terms of awareness of citizens because of their interest in learning motivation, since they live in Vojvodina, which is categorized as agricultural area where all of the future production of healthy food depends on a healthy environment.

Analyzing the percentage of 13% of respondents who say they are not aware of the pollution of land, it can be concluded that the stated percentage of the ignorant population of South Banat is not negligible and it is a good reminder that in this district ecology should be given more space.

Analyzing the percentage of 20% of the respondents, who have expressed the view that they are partially familiar with the pollution of land in South Banat, it can open up a controversy regarding the quality of their knowledge and to what this answer "partial" actually refers. If we proceed from the assumption that these respondents have only some basic knowledge, it is necessary to introduce environmental protection into education program.

Interpretation of the response category makes it clear that the majority of respondents have basic knowledge (summary responses of those surveyed who said "yes" and "partially" - 87%) on the problem of pollution of soil. If we analyze in more details the tabular overview of the responses, it can be concluded that the percentage of 87% is not optimal, but it is satisfying. It is observed that 67% of respondents claim to have knowledge of the pollution of land, which is relatively satisfactory in terms of awareness of inhabitants. If to this number we add up 20% of respondents who are partially familiar with this problem, then 87% of the population possess a basic knowledge of the pollution of land. The quality and scope of knowledge are certainly different in these two categories of respondents.

The analysis of the results of the survey enables us to conclude that the respondents have the most knowledge about the pollution of land 67%, then the air pollution 51%, followed by the pollution of water 45% .

By analyzing the above data on the level of knowledge of pollution of soil, air and water it can be concluded that the respondents - residents of South Banat have the most knowledge about the pollution of soil, because their interest is the motive of knowledge, since they live in Vojvodina, which is categorized as an agricultural area.

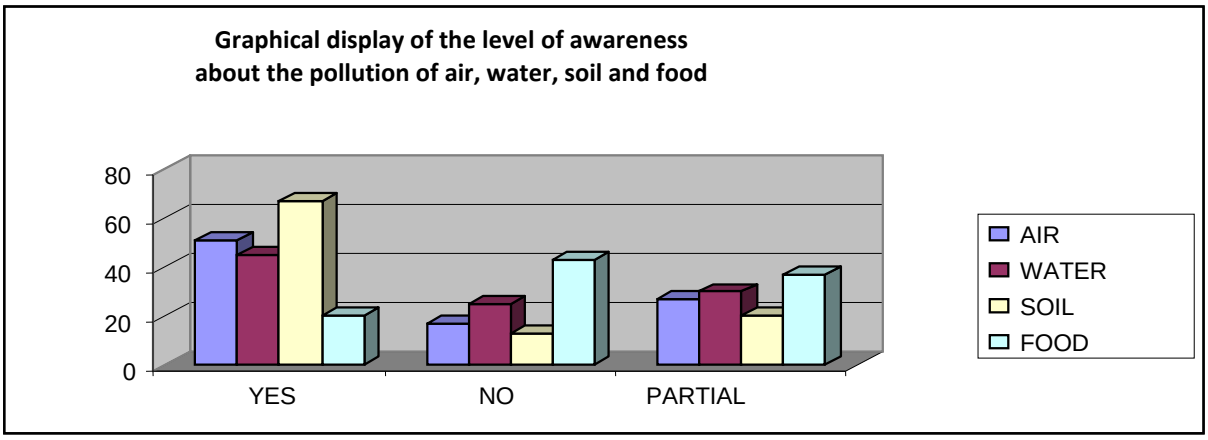

Figure 6. Graphical display of the level of awareness on pollution of air, water, *soil* and food

Table 6. Question 6 - Is the food that we eat healthy?

RESPONSE CATEGORIES		TOTAL %
DAY	20	20%
NO	43	43%
PARTIAL	37	37%
TOTAL:	100	100%

Based on the tabulation, it can be concluded that 20% of respondents believe that the food they eat is healthy. This is worrying in terms of awareness of citizens because their health depends on their knowledge of the production of healthy food and the food we ingest. This

brings the question: How to implement environmental initiatives with the percentage of the population who feel that the food they ingest is healthy?

Analyzing the percentage of 43% of respondents who say that the food we eat is not healthy, it can be concluded that the percentages of informed residents of South Banat is not insignificant but is inadequate.

Analyzing the percentage of 37% of the respondents, who have expressed the view that they partially know that the food they eat is healthy, it can open a controversy regarding the quality of their knowledge and to what this answer "partial" actually refers. If we proceed from the assumption that these respondents have only some basic knowledge, it is necessary to introduce environmental protection in the training program and production of healthy food because partial knowledge on this subject can be very harmful.

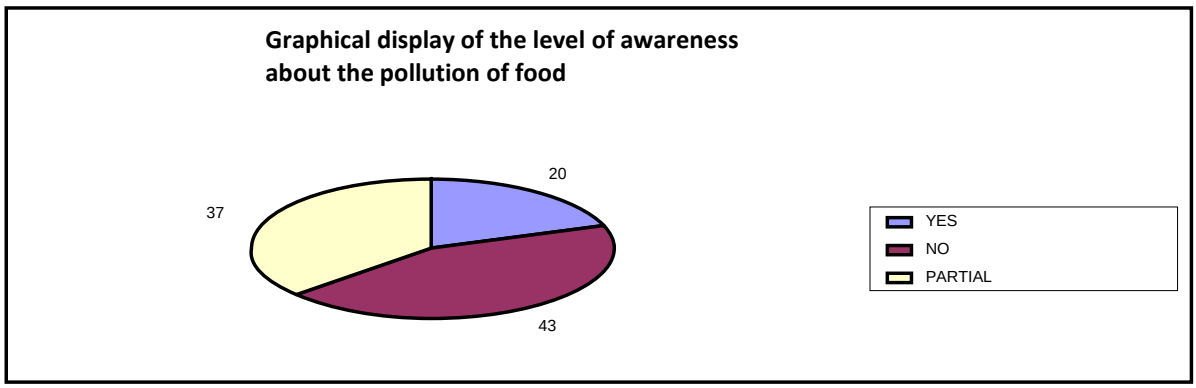

Figure 7. Graphical display of the level of knowledge on pollution of food

THE SECOND hypothesis - Surveyed South Banat residents think they eat healthy food.

The analysis of the results of the survey enables us to conclude that the second hypothesis has not been proven.

The analysis of the obtained results enable us to conclude that 20% of respondents believe that the food they ingest is healthy, then that 37% of respondents are partially familiar with the information and that 43% of respondents had information that the food they ingest is not healthy.

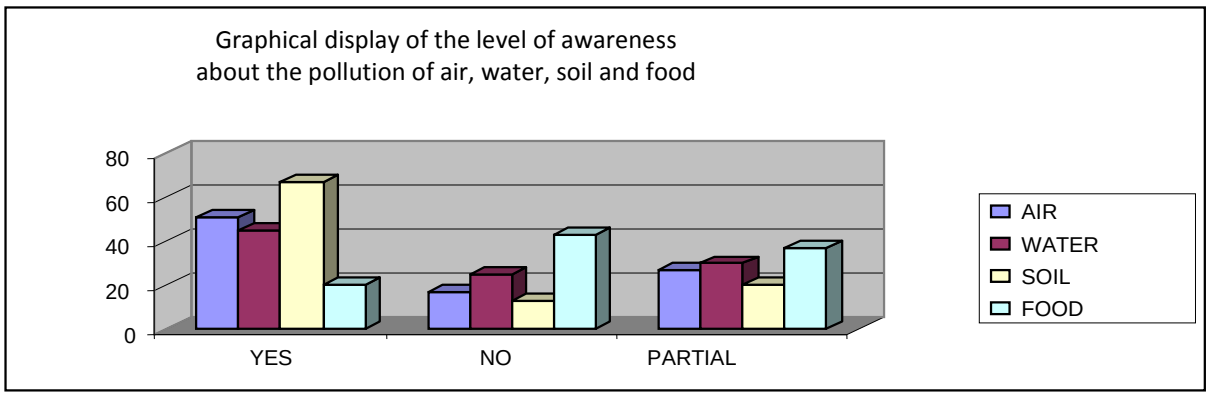

Figure 8. Graphical display of the level of awareness on pollution of air, water, soil and *food*

The analysis of the results of the survey enables us to conclude that the respondents have the most knowledge about the pollution of land 67%, then about 51% of air pollution, and pollution of water 45%, followed by the pollution of food by 43%.

Table 7. Question 7 - Do you know what additives are?

RESPONSE CATEGORIES		TOTAL %
YES	68	68%
NO	32	32%
TOTAL:	100	100%

Based on the tabulation, it can be concluded that 68% of respondents have knowledge of what additives are. This data is satisfactory in terms of awareness about what additives are.

Analyzing the percentage of 32% of respondents who declared that they have no knowledge of what additives are, it can be concluded that the stated percentage of the ignorant population of South Banat is not negligible with respect to the harmfulness of additives to human health because it is proven that certain carcinogenic additives.

The third hypothesis - Most of the surveyed population of South Banat knows what additives are.

The analysis of the results of the survey it can be concluded that the third hypothesis has been proven.

The analysis of the obtained results enables us to conclude that 68% of respondents have knowledge of what additives are and that 32% of respondents have no knowledge of what additives are.

Table 8. Question 8 - Do you know what genetically modified food is?

RESPONSE CATEGORIES		TOTAL %
YES	64	64%
NO	36	36%
TOTAL:	100	100%

Based on the tabulation, it can be concluded that 64% of respondents have knowledge of what genetically modified food is. This data is satisfactory in terms of awareness of citizens about what genetically modified food is due to the fact that this concept has run for several years.

Analyzing the percentage of 36% of respondents who declared that they have no knowledge of what is genetically modified food, it can be concluded that the stated

percentage of the ignorant population of South Banat is not negligible with respect to the harmful effects of genetically modified foods on human health.

Table 9. Question 9 - Do you have health problems due to the environment in which you live?

RESPONSE CATEGORIES		TOTAL %
YES	38	38%
NO	62	62%
TOTAL:	100	100%

Based on the tabulation, it can be concluded that 38% of respondents believe that they have health problems due to the environment in which they live.

Based on the tabulation, it can be concluded that 62% of respondents believe that they have no health problems due to the environment in which they live.

Table 10. Question 10 - Are you satisfied with the level of information from the media about the level of pollution of our environment?

RESPONSE CATEGORIES		TOTAL %
YES	14	14%
NO	86	86%
TOTAL:	100	100%

Based on the tabulation, it can be concluded that 14% of respondents are satisfied with the level of informing by the media about the level of pollution of the environment.

Based on the tabulation, it can be concluded that 86% of respondents are not satisfied with the level of informing by the media about the level of pollution of the environment.

THE FOURTH HYPOTHESIS - There is dissatisfaction of the surveyed population of South Banat regarding lack of information on pollution and environmental problems by the media.

The analysis of the results of the survey enables us to conclude that the fourth hypothesis has been proved.

The analysis of the obtained results enables us to conclude that 14% of respondents are satisfied with the level of informing by the media about the level of pollution of the environment and that 86% of respondents are not satisfied with the level of informing by the media about the level of pollution of the environment.

5. ANALYSIS OF THE RESULTS AND CONCLUSION

THE FIRST HYPOTHESIS - The surveyed population of South Banat is best informed about air pollution compared to the contamination of water and soil.

The analysis of the results of the survey makes us conclude that the first hypothesis has not been proven.

Respondents have the most knowledge about the pollution of land 67%, then the air pollution 51%, followed by the pollution of water by 45%.

By analyzing the above data on the level of knowledge of pollution of land, air and water it can be concluded that the respondents - residents of South Banat have the most knowledge about the pollution of soil, because their interest is the motive of knowledge, since they live in Vojvodina, which is categorized as an agricultural area.

THE SECOND HYPOTHESIS - Surveyed South Banat residents think they eat healthy food.

The analysis of the results of the survey enables us to conclude that the second hypothesis has not been proven.

The analysis of the obtained results enables us to conclude that 20% of respondents believe that the food they ingest is healthy, then that 37% of respondents are partially familiar with the information and that 43% of respondents had information that the food they ingest is not healthy.

The third hypothesis - Most of the surveyed population of South Banat know what additives are.

The analysis of the results of the survey enables us to conclude that the third hypothesis has been proven.

The analysis of the obtained results enables us to conclude that 68% of respondents have knowledge of what additives are and that 32% of respondents have no knowledge of what additives are.

FOURTH HYPOTHESIS - There is dissatisfaction of the surveyed population of South Banat regarding the lack of information on pollution and environmental problems by the media.

The analysis of the results of the survey enables us to conclude that the fourth hypothesis has been proven.

The analysis of the obtained results enables us to conclude that 14% of respondents are satisfied with the level of informing by the media about the level of pollution of the environment and that 86% of respondents are not satisfied with the level of informing by the media about the level of pollution of the environment.

Based on the facts presented it is clear that the problem of pollution of South Banat should be taken seriously. Residents of South Banat should be informed through the media and through permanent educational programs to learn to recognize environmental problems, how to act preventively and how to initiate civil and rural initiatives in order to protect the environment and their survival in such conditions. Education programs on environmental protection should be seriously and professionally planned and implemented even more seriously.

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IMPACT ON THE ENVIRONMENT ON SELECTION OF ADEQUATE TECHNOLOGY FOR THE COPPER SMELTING

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Abstract

Copper is one of the most important metals of the 21st century. Today, many different smelting technologies are being used for its production. This article provides a brief overview of the most important technologies for copper smelting, as well as their impact on environment. Different copper smelting technologies have different impact on environment, where there is a constant tendency in the production of copper to the processes that have also found a negative effect on the environment and consume little water and energy. When selecting technology for copper smelting is necessary to take the ecological aspect of technology. The technologies that considered in this paper are follows: Outokumpu flash smelting (present Outotec flash smelting), Ausmelt/Isasmelt lance, Inco Flash, Mitsubishi, El Teniente, Vanyukov, Reverberatory, and the environmental parameters of relevance discussed: SO_2 capture efficiency, smelting dust, amount offgases, SO_2 in offgases and other environmentally significant parameters.

Keywords: *Environment, Copper smelting, Technology*

1. INTRODUCTION

The environmental impact of copper usage (pollutant emissions, mechanical intervention in the natural environment) must not be allowed to result in the degradation of higher regional or even global life-preserving functions.

Smelting process is a form of extractive metallurgy, which is the physical process of changes the physical state of a material from solid to liquid. It can be achieved by heating or increasing the pressure which the temperature of the material to raise to the melting point. Its main use is to produce a base metal from its ore. This includes production of silver, iron, lead, zinc, copper and other base metals from their ores. Copper as primary metal has a very wide application and demand for them steadily increasing especially in industry and industrial countries.[1] Copper has been an important commodity since 2000 BC and it is still viable as we begin the next millennium.[2] Ore reserves and mine production are concentrated in a few countries (six nations have 65% of the reserve base and 12 approximately 85% of mine production).[1] Leading producer countries like Chile and Peru are investing permanetnly in new mines and expansion of present facilities. The ore grade is typically 0.5–1.0%, which makes copper production highly energy-intensive,

ranking third in specific energy consumption among production of five primary metals (aluminum, copper, iron, lead, zinc). According to Djordjevic and associates, copper production is, in many cases, also an important source of air pollutants.[3, 4] In an actual flash copper smelter plant with production capacity of 100 000 tons/year, only 25% of energy consumption is used for the production, while the residual is used for environmental control.[1] In accordance to selection of technology for smelting of copper concentrates have to consider both the aspects, energy consumption and air pollution that occurs as a result of the operation of the smelter. Both aspects have a negative impact on the environment as a result of the emission of gases, that cause the greenhouse effect as global warming and climate change.[1]

Copper is clasified in the group of heavy metals. Environmental problems related to heavy metals have a long history. Heavy metals have toxic properties, leading to adverse effects on human health and ecosystem even in small doses. By way of precaution, the relevant safety margins must be observed and the environmental impact minimised.

Another problem which occur are related with the heavy metals property and their nondegradability, once they enter the environment, there is no getting rid of them, because the metals tend to accumulate in soils and sediments.[5] Also the effects of copper production on the flora and flauna around the mine and smelter are very negative and difficult, however, none of these effects has not been extensively researched and recorded.[6] The aim of this paper is to present the main technologies for copper production and the parameters with negative impact on the environment, such as the utilization of sulfur, dust production, the amount offgases, SO2 in offgases and energy consumption.

2. HISTORY OF COPPER SMELTING

Metals have played an increasingly important role in human history. Copper has been an important commodity since 2000 BC and it is still have big imprtance in modern society. [2] Copper has been in use at least 10.000 years, but more than 97% of all copper ever mined and smelted has been extracted since 1900 (*McHenry, Charles, ed. (1992). The New Encyclopedia Britannica* ***3*** *(15 ed.). Chicago: Encyclopedia Britannica, Inc. p. 612. ISBN 085-229553-7.*)

The copper extraction had origined from Asia Minor region, and knowhow about that arrived later in Europe via the Aegean. Our knowledge of the first copper mines in Europe is slight (Table 1 and Figure 1).

Table 1. The origins of copper mines in Europe [5]

Rudna Glava	Serbia	Oxide ore	4500 - 4000BC
Ai Bunar	Bulgaria	Oxide ore	4500 - 4000BC
Chinflon	Spain	Oxide ore	3000 - 2500 BC
Mitterberg	Austria	Sulphide ore	1700 - 1000 BC
Mount Gabriel	Ireland	Oxide ore	1600 - 1500 BC

Figure 1. European copper deposits in the Bronze Age [5]

It is assumed that there were other locations, but only of those locations presented in the table 1. has written evidence. The oldest copper mines were founded upon copper-oxides that were copper reduced with charcoal. Miners from that period were easy recognized the deposits due to the green and blue coloured copper mineral. In the comparation with other locations, the conditions of Mitterberg deposit were different. Sulphides constitute the primary minerals – chalcopyrite and pyrite. Both minerals have a golden lustre and could have led the miners of that time to believe that it was gold. But it was not possible to produce metal by reduction smelting. [5]

Pure copper is a soft metal, not useable as a tool. Metals as nickel (Ni), arsenic (As) and antimony (Sb) contained in some copper deposits did stabilise and harden the copper, but thay were not so easy to extract from the copper. Table 2 contains a series of these natural copper alloys. Bronze and brass is also listed in table 2, which can only be produced by the joint smelting of copper and tin ore / zinc ore.

Tabela 2. Copper alloy of the Bronze Age. [5]

Natural alloys					
	BC	**Cu**	**% As**	**% Sl**	**% Ni**
Pure copper	2500	> 99.0	< 0.5	<< 0.1	-
Arsenic bronze	2000	95	< 5	< 0.1	< 0.5
AsSl bronze	1500	85	< 5	< 10	< 0.5
NiAs bronze	1500	> 88	< 5	< 1	< 0.5
Specifically manufactured alloys					
	BC	**Cu**	**% Sn**	**% Sb**	**% Zn**
Sn bronze	2000	> 85	< 15	< 1	-
Sn bronze	500	> 70	< 10	< 20	-
Brass	From 800	> 70	< 10	< 10	< 20

In metallurgy had occurred change in time and space dimensions, what was resulting with emissions and the hazards arising from emissions. In this way, they relied on a shift from acute and local hazards to long-term global effects. The objective of this was defined following: firstly, any type of emissions also signified a commercial loss, which had to be minimised; secondly, the expenses incurred for compensation were to be externalised.[5] The reason for this is growing needs for this metal and increase of production and production capacity. In this paper will be presented most important modern technologies for the copper production and copper concentrate smelting, as the effects of these technologies on the environment. These effects were significantly increased and more influential than at the beginning of the production of copper. Beginning of the process copper production required extraction and processing of very large amounts of ore. Typically, in order to produce 1 ton of refined copper has necessary to move several hundred tons of ore. For instance, according to US copper mining statistics [7] for a national average 0.57% grade ore, it was necessary to move 573 tons of material per ton of copper produced.

3. IMPACT OF COPPER PRODUCTION ON ENVIRONMENT

Important environmental issue is the use of water, which is of special concern for the many mines that are located in arid zones. Mining operations that include the production of refined copper by hydrometallurgical processes, where is the most used technology leaching– solvent extraction–electrowinning, L-S-E. This process requires significant amounts of water, typically 2.5– 3.0 m^3/s per ton of refined Cu. Important energy-related

environmental impacts can be performed emissions of GHGs and SO_2. Generation of these gases is of concern in productions that include pyrometallurgical processes, i.e. those used mainly for sulfur-type ores that generate and release large amounts of SO_2. Dust emissions coming from stacks are much less than fugitive dust originating elsewhere (e.g., crushers).[1]

An environmental issue of great local importance (i.e. at the copper smelter and vicinity) is the emission of SO2. This gas is released in significant quantities during the pyrometallurgical
process for sulfur ores. In the smelting–converting process of $CuFeS_2$ concentrate, approximately 2 tons of SO_2 are produced per ton of copper, including both energy and process-generated emissions. [7] Due to their high energy intensity, copper production also has high demands for electricity. Copper production, from mine to refinery, requires large power inputs. Hydrometallurgical processes also required the substantial amounts of sulfuric acid, which should be of the potential impacts. The specific acid consumption is approximately 2.2 mt/ton of Cu cathode. Chile is the world leader in copper production and now requires 2 Mt/year, a part of which is being imported. [8]

Acid plants are being used increasingly where SO_2 is a serious environmental concern. They consume both electricity, which is used mainly for powering blowers, electrostatic precipitators and pumps, whereas thermal energy is primarily required for pre-heating the incoming gas stream when the SO_2 content is low. However, an acid plant can have zero energy consumption or even be a net energy producer, depending on the type of plant, its thermal efficiency and the ingress SO_2 concentration . [9]

4. IMPACT OF DIFERENT COPPER SMELTING TECHNOLOGIES ON ENVIROMENT

All processes for the copper production can be classified into two basic groups. The first group is pyrometallurgical and the second group is hydrometallurgical. The pyrometallurgical processes for the copper production can be standard (the smelting furnace in the flame, electric furnace, furnace...) and autogenous (smelting in a floating state and smelting in the melt). These processes have produced more than 80% of world copper production. [10]

That characterizes "standard" presses for the processing of sulfide copper concentrate is that this process involves the roasting phase in which it is released and irrevocably lost a large amount of heat, while the next phase melting is requires the consumption of large amounts of expensive additional heat (oil, fuel oil, coal or natural gas). Therefore, the these processes for the production of copper become uneconomic. Also, additional unfavorable conditions such as the sudden increase energy prices in the world and a rigorous laws on environmental protection, the middle of the last century have resulted to develop and implement modern and rational technological solutions based on the principles of autogenous smelting, namely, the use of chemical energy of sulfur from copper sulfide concentrate.

The autogenous of pyrometalurgical copper production has known for more than a century and code sulfide concentrate roasting, smelting of pyrite ores and matte converting. For autogenous smelting of copper concentrates the largest part of the heat is obtained of the exothermic reaction of iron and copper sulfides: pyrite (FeS_2) and chalcopyrite ($CuFeS_2$).

This means that the content of sulfide componenties in the copper concentrations defined the parameters of oxidizing agents, such as: the degree of enrichment of air oxygen, enriched the air temperature and the amount of supplemental fuel. Sulfides are quite a high chemical energy that can be maximally utilized in the process of smelting copper concentrates. In this way, it provides a reduction of operating costs of additional energy in the form of coal or gas and improves the economics in the all of technological process, as well as reducing negative environmental impact.

Many leading companies in the field of copper production have developed their own processes of autogenous smelting of copper concentrates, which are technologically and operationally differen, therefore it is their impact on the environment is different. These impacts will be shown through the following text. However, in these technological procedures are found differences in and mode of combustion and melting sulfide.

4.1. OUTOKUMPU FLASH SMELTING

Outokumpu Technology was developed in 1949 and implemented in Harjavalta smelter in Finland. This technology was first implemented by the smelting process of copper concentrate in a floating state. This technology is now called Outotec. Outokumpu/Outotec flash smelting technology has a leading position in the production of copper on the basis of their cost-effectiveness, flexibility, low power consumption, and higher efficiency of sulfur. Sulfur capture efficiency of this technology is in the ranges 94% - 99%. In addition to sulfur capture efficiency as an essential parameter of this technology it can state, smelting dust that is in the range 80-250 t / day, the amount offgas 45000 Nm^3 / h, and the content of SO_2 in offgas is 24%. [10]

This technology was been developing over time, as elaborated and applied new solutions to improve processes, ecology, economics, technology and reducing energy consumption. Outokumpu Technology copper production is , in accordance to that it provides treatment of industrial water that meets all environmental requirements and reduced water consumption in the production process.

4.2. AUSMELT/ISASMELT LANCE

In 1971, researchers at the Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) began investigating the use of top-lancing technology for injecting coal into tin slags to improve reduction kinetics.[10]

ISASMELT is a simple, highly efficient bath-smelting process for the production of non-ferrous metals. It is recognised as the most innovative, efficient and cost effective smelting process available in the world and since going into commercial production in the 1990s it has been installed in major brownfield and greenfield plants around the world.[11]

As environmental indicators of this technology we can mention: SO_2 capture efficiency 97%-98%, smelting dust 1-3 % per tonne batches, amount off gases 70000 Nm^3/h, SO_2 in offgases is 22-25%.

The ISASMELT process is a top submerged lance (TSL) bath smelting technology which has been developed and optimized over the last 25 years. This technology is based on a furnace design which is readily enclosed to eliminate emissions to the surrounding

environment. It uses submerged lance injection technology to provide highly efficient mixing and reaction of feed materials in a molten slag bath.[12] This technology occupies a leading position in the world due to low production costs and satisfy stringent environmental standards.

4.3. INCO FLASH

INCO is a Group with a long and rich history. It first started as a design consulting company in 1952 and evolved to become one of the leading contracting companies in the field of construction and erection of Industrial process plants and petrochemical plants.[13] With the beginning of operating INCO smelter it eliminated the deficiencies of dominant reverberator furnace in order to improve energy efficiency of sulphide minerals from the concentrate. In this way, reduce energy consumption, improve environmental conditions, and therefore increases the utilization efficiency of copper. The introduction of this process in industrial applications realized the integration of roasting phase and smelting. Also, using of technical oxygen instead of air, reduces the amount of gases generated in the process up to 40 times than the reverberator furnace. On that way it is improving the economics of its work and the full protection of the atmosphere.

Beside expensive and complex preparation of batches, the main disadvantage of this technology is a big power consumption that accompanies oxygen production with a share of 50% of total costs. Other imporatnt environmental parameters are: utilization of sulfur, which is an average of 93.6%, generating dust that ranges from 95 - 230 tons per day, the amount offgas of 35000 Nm^3/ h, while the SO_2 in the offgases is 70%.

4.4. MITSUBISHI

The Mitsubishi process consists of three interconnected furnaces. In this process, smelting is distinctly separated from converting, thus single stage converting is employed in a separate furnace in the presence of molten copper phase. However, the three-furnace concept maximizes heat losses. Further, the movement of molten materials from furnace to furnace leads to fugitive emission of SO_2 gas.[14] This technological process is characterized by high utilization of SO_2 that stands out from the smelting process and converting section. Utilization of SO_2 average is about 99.5% and through electrostatic still directed into the production process of sulfuric acid or liquid SO_2. Mitsubishi process of continuous smelting of copper concentrates is permanently modernized and improved thus environmental protection is increased. This technology is applied the smelter in Naoshima, Japan with capacity of 240000 t per year of copper and Kidd Creek in Canada with capacity of 120000-150000 tons per year. Besides halved electricity consumption of processes other parameters that have impact on the environment are: dust production ranging in range 60-67 t / day, the amount offgas 500 Nm^3 / h, and SO_2 in offgases is 25-30%.[10]

4.5. NORANDA

Noranda Inc. was a mining and metallurgy company originally from Rouyn Noranda, Quebec, Canada. This company merged with that company Falconbridge in 2005., which is named Falconbridge Limited. Noranda process was under continuously improvement. As

the essential parameters of the technological process that has an impact on the ecosystem, it can extracted specific consumption of fuel heat which is 2321 MJ / t-2954 MJ / t of concentrate. Utilization of sulfur in range of 94%, production dust 70-100 tons per day, the amount offgases from 55000 Nm^3 / h, and SO_2 offgases in ranges of 16-20%.

4.6. EL TENIENTE

TC technology was developed in Chile, at the National Copper Corp. (CODELCO) Division
El Teniente (hence, the name) in the early 1970s. Since then, many TCs have been operating in Chile and abroad. [1] Teniente technology is an important technology for smelting and processing of copper concentrates. The continuous matte converting and the autogenous smelting of concentrate constitute the basic foundations of this technology. The TC can be considered an intermediate alternative between conventional and autogenous fusion, since it uses the heat given up by matte conversion to melt concentrate in a converter. The converter is fed periodically with matte and CONTINUOUSLY with dry (less than 1% moisture) concentrate and flux. Oxygen-enriched (30%) air is blown through tuyeres. [15] Control of the work process is a lot more complex than other control technologies. This complexity arises from the characteristics of the technological process. [16] The products of the process of smelting in this technology that have a significant impact on the environment are: utilization of sulfur ranges from 90% to 98%, the dust production 50 t / day, the amount offgas of 60,000 Nm^3 / h, SO_2 in the exhaust gases moving from 12% to 25%.

Today, Teniente converter used in 11 copper smelters in the world. Bearing in mind all the effects of modernization Kaletones smelter in Chile, this technology belongs the pyrometallurgical process with the lowest energy consumption, that the Teniente converter clasifies of the modern technology for the smelting of copper concentrates and classifies it into the group of cleaner technologies for smelting copper. For a realization of this technological process provides for the power consumption of 2816 MJ per tonne of concentrate, which makes it energy efficient technology.

4.7. VANYUKO

The Vanjukov smelting process, belongs to the "bath smelting" family of copper smelting processes. This process has generally been applied to low grade concentrates (10-15% Cu); it seems to be well suited for high slag forming, copper smelting operations. Matte grade is 45-74% Cu, and slag Cu content is 0.7-2%. It was predicted that the Vanyukov's attributes of high productivity coupled with efficiency and flexibility eventually may compete with the Outokumpu system in the next decade to process in excess of 5000 ton per day. [2] The Gintsvetmet Institute developed technology for processing solid municipal and industrial waste based on the Vanyukov principles. "Romet" is the ferrous off-shoot of the Vanyukov process for smelting of base metal). The offgas strength is 25-40 vol.-% SO_2, depending upon blast oxygen enrichment and hydrocarbon combustion rate, utilization of sulfur is 90%, dust production in range 0.5-0.9% per ton batches, the amount offgeses in range of 35000-55000 Nm^3 / h.

4.8. REVERBERATORY

This traditional means of smelting sulphide concentrates in a molten bath is still employed worldwide. Daily throughput in these units, which may include hearth areas up to 380 m^2, approaches 1000 tonnes per day [17]. Reverbatory smelting is still used, despite its high energy consumption. In Balkhashmed, the reverbatory smelters supplied 70 % of copper in matte. lt is a conventional design without major improvement. Two identical furnaces are used in this section. Utilization of sulfur in range of 50%, production dust 470-700 tons per day, the amount offgases in range of 21000-23000 Nm^3 / h, and SO_2 offgases in ranges of 1.5-2.5%.

5. CONCLUSION

The tendency in copper extraction is toward the processes that do not harm the environment and which consume little energy and water. This has led to energy- and pollution-efficient oxygen-enriched smelting; solvent extraction/electrowinning; increased re-circulation of water, increased recycle of end-of-use scrap. SO_2 is harmful to fauna and flora and is detrimental to the human respiratory system. It must be prevented from reaching the environment.

There are regulations for ground level SO_2 concentrations around copper smelters. Other regulations such as maximum total SO_2 emission (tonnes per year), percent SO_2 capture, and SO_2-ingas concentration at point-of-emission, also apply in certain locations.

New technology to mitigate the environmental impact of copper ore mining and processing.

Each of the previous technology has a different impact on the environment. In the way to better perceive their impact, it's necessary to analyze all parameters of previous technologies, shown in Table 3.

Table 1. Review of the most environmental parameters of technologies for copper smelting

Name of technology	Utilization of sulfur %	Dust production	The amount offgeses	SO_2 offgases
Outokumpu flash	94-99	80-250 t/dan	45000 Nm3/h	24% directly to the sulfuric acid
Ausmelt/Isasmelt lance	97-98	1-3 % per ton batches	70000 Nm3/h	22-25%
Inco Flash	93,6	95-230t/dan	35000 Nm3/h	70%
Mitsubishi	99,5	60-67t/dan	500 Nm3/h	25-30% SO2
Noranda	94	70-100t/dan	55000 Nm3/h	16-20%
El Teniente	90-98	50 t/dan	60000 Nm3/h	25%

Vanyukov	90	0,5-0,9% per ton batches	35000-55000 Nm3/h	25-40% SO_2
Reverberatory	50	470-700	21000-23000	1,5-2,5

Future research will be focused on the application of multi-criteria decision analysis with the ranking and selection of technological processes, which the aim of analysis will be finding the most optimal technology of copper smelting.

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MATHEMATICA AS A DECISION SUPPORT SYSTEM IN THE PROBLEM OF BLENDING FOR ECOLOGICAL COPPER PRODUCTION

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Abstract

Well-known mathematical models related to the problem of blending are extended and adapted to the specific problem of blending in the process of copper production. Certain constraints are deduced from the process of making copper as well as the constraints deduced from the ecological aspects of the production process. The models are applied to the production experience at the copper smelting plant RTB Bor. The implementation of introduced models was made in the programming package MATHEMATICA. Derived numerical results are compared to the results derived by means of classic mathematical models which are known in the literature.

Keywords: *Decision support system, MATHEMATICA, Blending problem, Ecological production, Charge optimization.*

1. INTRODUCTION

One of the most frequent applications of linear programming (LP) is the so-called problem of blending in which various ingredients (inputs) are mixed into one or more blends (outputs) to satisfy certain constraints and optimize desired objectives [1]. The problem to solve is how to do the blending of the desired products in order to maximize profit or minimize cost while still maintaining an adequate level of products quality and market supply. Furthermore, a very important question arises pertaining to whether it is possible to set such production to satisfy all the more rigid demands for human and environmental protection.

The general overview of the literature which studies the problem of blending is provided in [2]. The blending composition problems are typical in metallurgy, food, oil and chemical industries, as well as in some other industries. Thus, the problem of coal blending was researched in the papers by different authors [3-5]; as for steel production, papers by the

following authors [6] are significant; in the area of chemical fertilizers production, an important study by [2] stands out; the batch optimization problem in the production of copper was investigated in the papers by authors [7-9]; extended and adapted mathematical models for the problem of blending at the optimization of charge for ecological production of copper are investigated in the paper [10], and for the ecological production of zinc in the paper [11].

The basic idea in this paper is to develop and apply the optimization model for the specific problem of batch composition in the copper making process. There are different elements (components) in raw materials which, by their presence, determine the quality of the final product. Dry copper concentrates of various prices and quality are available on the market. Useful components in the concentrates are copper, silver and gold. Sulphur can be observed as both useful and harmful component in the concentrate. As far as harmful components are concerned, the most dangerous ones for people and the environment are: bismuth, arsenic, lead, zinc, cadmium, selenium, mercury, antimony, nickel. The problem sums up to determining the quantities of the raw materials which will be used for the production of the final product of adequate quality, but in such a way that the expenses of the raw material purchase are minimal, or that the production profit is maximum. In the process of smelting copper it is important, apart from production profitability, to satisfy all the standards of a high-quality product, but it is also very important to satisfy all the world ecological standards.

The technological progress within the area of the production of non-ferrous metals has irrevocably led to excessive emissions of harmful gases into the atmosphere. Strict abiding the standards imposes the application of new technological procedures and new methods whose goal is the production according to ecological norms.

The starting assumption is that, by means of selecting and mixing different copper concentrates, one can make such a batch that contains a smaller quantity of harmful components than the specified values. This way, the usual process of copper production influences, to a great extent, the reduction of harmful fumes emission into the atmosphere.

Based on the motivation and assumption, the main goal of this paper is established, to, using a mathematical algorithm set in software program MATHEMATICA, work out the decision support system (DSS) by use of which company managers could more easily make right business decisions, in order to maximally ecologically protect people and environment.

2. MATHEMATICA AS A DECISION SUPPORT SYSTEM

More important than modeling is providing the users with a software that will be easy to learn and easy to use, and will also enable them to effectively play with the coefficients and optimal solution, i.e. via graphical tools, for what–if analysis and better comprehension of the results. Solution to this problem lies in the design of an effective computer interface. When mathematical programming tools are properly integrated with user-friendly interfaces, they turn into effective Decision Support (DS) tools requiring almost no programming knowledge; also visual aids and options, for instance, for scenario analysis, largely enhance the interpretation process [12]. Desirable features that a DSS should have are suggested in [13].

Languages for mathematical modeling such as *Lindo/Lingo* [14], GAMS [15], AMPL [16], can be used for formulating and solving the linear programming model. A detailed overview of these languages can be found in the paper [17]. Spreadsheets, in this framework, provide the means for user-friendly interfaces for implementing mathematical models. In particular, Microsoft Excel spreadsheets have become one of the most popular software packages in the business world and have been used by millions of professionals [18].

But, entering data corresponding to models investigated in the current paper in modeling languages as well as in the Excel worksheet is a relatively complicated and time consuming job. Moreover, there are neither extended graphical capabilities, nor packages capable to solve the stated multi criteria optimization problems.

DSS which is developed in this paper was written by means of numerical, symbolical and graphical properties of the programming language MATHEMATICA. The basic advantages arising from the DSS which was developed in such programming environment can be described as in the following:

- DSS developed in this paper is easy to use. It is based on interactive calculations connected to the slider activation, which result from the functions `Manipulate` and `DynamicModule`. Computer algebra system of interpretative type is an attractive medium for interactive work. Extensive computational engine supported by symbolic capabilities can be activated by means of mouse or keyboard manipulation. The decision support system is designed so that a production manager with no knowledge of linear programming could easily use it. In this way, we overcome the important problem in implementing LP models, as well as many other mathematical programming tools in the industry, conditioned by the fact that neither the managers, nor the engineers have sufficient mathematical programming expertise to formulate or modify a model and interpret the optimal solutions (stated in [18]).
- The written software is based on numerical computations of high accuracy. The usage of numerical software of high accuracy enables overcoming of badly conditioned problems, which sometimes diverge in numerical processes. It is known that MATHEMATICA represents the primary software for numerical, symbolical and graphical calculations and visualization [19-22]. It represents a high rating programming language which is adaptable to various mathematical areas. MATHEMATICA includes arithmetic of arbitrary accuracy, as well as precise numerical calculations, symbolical calculations, graphics, sound - all together integrated into a package which is easy to use.
- Programs developed in the paper are concise and it is easy to examine the logic of the system. Written programs are applicable to arbitrary input data. The user can easily obtain important information by changing the prices, the number of raw materials, content of copper in the concentrate, as well as other data.
- DSS developed in this paper is accompanied by visualization and graphical illustrations thanks to the graphical possibilities of the package.
- As it is claimed in [23], mobile tools, mobile e-services, and wireless Internet protocols will mark the next major sets of development in DSS, thereby expanding the accessibility

of the tools to decision-makers wherever they may be. MATHEMATICA allows you (using the command File/Save As) to build up linked web page contents as symbolic expressions using the full power of the Mathematica system, then immediately export them as graphics, animation, sound or full active web documents [21]. Standard function `Export` has many options applying to HTML export that allow you to specify how notebooks should be converted into the format applicable in web browsers with different capabilities. Also, using the standard function `Import` it is possible to import a file from any accessible URL or from an FTP server [21].

3. MATHEMATICAL MODELS

The task dealt with in this paper assumes that more products are produced from more raw materials. A general mathematical model for multi-blend problem is observed in the first subsection. In the subsequent subsections, such general mathematical model is adapted to the specific case which originates from the pyrometallurgical process used in copper production. Multi criteria optimization methods are used taking various objective functions into account.

3.1. MATHEMATICAL MODEL FOR SOLVING BLENDING PROBLEM

Starting assumptions used in the investigations are:

(AS1) There are m different raw materials (concentrates) Con_i available for blending;

(AS2) n different products P_1,..., P_n are obtained by processing these raw materials;

(AS3) the indices of useful products are contained in the set I;

(AS4) there is waste of 8% during production, so the final product can be expressed as 92% in relation to the quantity of all concentrates used for its production.

The task sums up to determining the qualities of every raw material (concentrate) which will be used for the production of every product as well as making the biggest difference between the profit from selling useful products and expenses for the purchase of raw materials. To form an adequate mathematical model the following usual notations are used:

x_{ij} - the Con_i concentrate quantity which will be used for producing the product P_j;

a_i - the total amount of the concentrate Con_i which will be used for the production;

g_i - the disposable quantity of the concentrate Con_i;

ci_i - the purchase (input) unit price of the concentrate Con_i;

b_j - the quantity of product P_j according to the optimal solution;

t_j - the amount of the P_j product that can be sold on the market;

co_j - the selling unit price of the final-useful product P_j unit;

p_{ij} - the percentage of P_j product in one unit of the Con_i concentrate;

U_j - the upper approved value limited with the P_j element percentage contained in the batch;

L_j - the lower approved value limited with the P_j element percentage contained in the batch;

Y_i - yield coefficient for raw material Con_i.

Equations (1) and (2) provide correlations between x_{ij}, a_i and b_j, which are necessary for the model. Dependent variables a_i and b_j are formulated to simplify the formulas.

$$a_i = \sum_{j=1}^{n} x_{ij}, \quad i = 1,\ldots,m; \tag{1}$$

$$b_j = \sum_{i=1}^{m} (Y_i \cdot p_{ij} \cdot a_i), \quad j = 1,\ldots,n; \tag{2}$$

Now the mathematical model of the problem can be formulated as in the following:

$$\max F(x) = \sum_{j \in I} co_j \cdot b_j - \sum_{i=1}^{m} ci_i \cdot a_i \tag{3}$$

$$a_i \le g_i \Leftrightarrow \sum_{j=1}^{n} x_{ij} \le g_i, \quad i = 1,\ldots,m; \tag{4}$$

$$b_j \le t_j \Leftrightarrow \sum_{i=1}^{m} Y_i \cdot p_{ij} \cdot a_i = \sum_{i=1}^{m} Y_i \cdot x_{ij} \le t_j, \quad j = 1,\ldots,n; \tag{5}$$

$$p_{ij} = \frac{x_{ij}}{a_i} \Rightarrow x_{ij} = p_{ij} \cdot a_i \quad i = 1,\ldots,m. \tag{6}$$

$$x_{ij} \ge 0, \quad i = 1,\ldots,m, \; j = 1,\ldots,n. \tag{7}$$

Basic mathematical model for solving the mixtures problem represented by the formulas of (1) to (7). The task of the mathematical model sums up to determining the quantities x_{ij} of all products produced from each concentrate in order to make the biggest profit according to the objective function given by formula (3), and constraints of (4) to (7).

3.2. DESCRIPTION OF THE PROBLEM

For the last several decades, considerable development of pyrometallurgical technology process of copper production has been recorded. From the traditional process of oxidation roasting-melting in flame furnaces-converting by means of SO_2 for sulphuric acid production

great progress was made by introducing: Outokumpu flesh furnace, Mitsubishi smelting concept, Noranda reactor, Peirce-Smith converting, El Teniente converter and others [24]. The purposes of these improvements are: bigger technological exploitations, better environment protection, and reduction of anode copper production cost price [25]. These improved technological processes led to the enlargement of production plants capacities and increase of entire copper production in the world [26], which, at the same time, led to increasing problems due to environmental pollution [27-30].

Besides copper minerals (Cu), many ore layers of copper contain minerals of other metals, such as: Se, Bi, Cr, Cl, Sb, Cd, As, Zn, Pb, S, Ni, Fe, F, Hg, and so on, that during the process of enriching regardless of the attempts of selective separation [31] mostly get into the content of copper concentrate. Arsenic is especially characteristic and it is often found in the form of double sulfides with copper of enargite (Cu_3AsS_4) and tenatite ($Cu_{12}As_4S_{13}$) thus in the process of flotation concentration of copper minerals its concentration is done too [26]. Some of these metals are harmful but are easily eliminated from the organism, such as copper (Cu). When taken in larger quantities arsenic (As) is lethal, but in small quantities it is easily eliminated from organism in 3-5 days. The first category poisons include lead (Pb) and cadmium (Cd), which after entering the organism, stay and sediment there permanently; they are carcinogenic, too. When taken in larger quantities mercury (Hg) is poisonous, but in small quantities it is eliminated from the organism within a month and is not carcinogenic. Nickel (Ni) is also a carcinogenic metal.

Nowadays, 90% of entire copper production in the world is obtained by pyrometallurgi-cal process [25]. Present sulfides of heavy metals oxidize at increased temperature or sublimate in sulfide form [32-33], or in the particle form of PM_{10}. Due to incomplete treatment of waste fumes, these compounds and particles pollute the environment. Modern copper smelting plants have installed the latest technology devices for treating waste fumes from airborne particles and maximum degree of utilization of SO_2 gas. In spite of that, they still represent the biggest polluters in their regions [30]. Smelting plants with old technologies (oxidation roasting-smelting in flame furnaces-converting) emit PM_{10} and SO_2 far above the limited values which seriously damages people's health [34].

Heavy metals (Cu, Ni, Cd, Pb, Zn, Hg, As, Sb, Bi,...) in airborne dust of PM_{10} represent a hazard to human health within the area of copper smelting plant. Because of this, the World Health Organization (WHO) [35] has prescribed limited values of SO_2, PM_{10} content and heavy metals content in the air in order to protect the health of people living in these areas. Moreover, EU by their regulations limits the values of the contents of these polluters in the air [36-37], and this obliges companies to respect these regulations.

Even besides the mentioned rules and regulations, in the world market there are copper concentrates which, along with the useful components, contain harmful heavy metals in larger quantities than the prescribed ones. The presence of useful and harmful elements in copper concentrate influences its price, which is formed on the basis of market offers and demands. When forming the price of copper concentrate, some "bonuses" are assigned for the presence of useful components, as well as "penalties" for the heavy metals content.

3.3. MATHEMATICAL MODEL CORRESPONDING TO THE CASE STUDY

In the case study we investigate the blend composition problem for pyrometallurgical process of copper production in the copper smelting plant in RTB (Copper Smelting Complex) Bor, Serbia. Actually, we consider five different concentrates which gravitate towards this smelting plant, whose properties are shown in Table 1. From this table the percentages p_{ij} are generated.

While processing copper, silver (Ag) and gold (Au) are produced in small quantities. Financial benefit from selling silver and gold is inappreciable in comparison to the gained profit from selling copper, but it is not negligible. Therefore, besides copper, production and sale of silver and gold is also included in the mathematical model. These three metals (Cu, Au, Ag) are seen as useful components of the concentrate needed by the market that could be produced and it is desirable to have them as much as possible. Heavy metals (Bi, As, Pb, Zn, Cd, Se, Hg, Sb, Ni), which are the most harmful from the aspect of man's health and protection of the environment, and which are inevitable elements of the concentrate, are monitored in the model. The tendency is to provide the lowest percentage of harmful metals concentrate. Sulphur (S) can be observed as both harmful and useful component of the concentrate. In this mathematical model, sulphur is observed as a useful component due to its role of fuel in the process of roasting and smelting.

Table 1. Chemical analysis of copper concentrates (share percentage of P_j in Con_i)

Products	**P_1**	**P_2**	**P_3**	**P_4**	**P_5**	**P_6**	**P_7**	**P_8**	**P_9**	**P_{10}**	**P_{11}**	**P_{12}**	**P_{13}**	**P_{14}**
Chemical symbol	**Cu**	**Bi**	**As**	**S**	**Pb**	**Zn**	**Cd**	**Se**	**Hg**	**Sb**	**Ni**	**Ag**	**Au**	**Miscellaneous**
Unit	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Con 1	12.62	0.018	0.0340	10.71	0.19	0.52	0.0025	0.0086	0.00003	0.004990	0.008	0.002192	0.000308	75.88
Con 2	16.21	0.021	0.0029	37.73	0.01	0.10	0.0025	0.0140	0.00001	0.004991	0.012	0.001234	0.000132	45.89
Con 3	14.59	0.024	0.0057	28.72	0.14	0.40	0.0025	0.0110	0.00002	0.004990	0.010	0.003300	0.000460	56.09
Con 4	25.87	0.018	0.0070	33.86	0.13	0.21	0.0025	0.0200	0.00002	0.004990	0.002	0.003350	0.000572	39.87
Con 5	21.45	0.021	0.0180	26.16	0.32	0.42	0.0050	0.0190	0.00003	0.004991	0.003	0.006350	0.000420	51.57
Standard	21-25	0.05	0.2	32	2	3	0.01	0.01	0.0005	0.3	0.1	0.015	0.001	
Criterion	max	min	min	max	min	min	min	min	min	min	min	max	max	max

According to the technological requirements, copper should be within 21-25%, and arsenic below the value of 0.2%. Apart from arsenic, there is a large number of other elements and compounds in the concentrate which are extremely harmful for people's health and environment. As it can be seen in Table 1, our case study assumes 14 products, 4 of which are useful and 9 of which are harmful. In the last group ("miscellaneous") there are Cr, Cl, CO, Fe, F, H_2O, SiO_2, Al_2O_3, CaO, and so on. The prescribed upper (U_j) and lower (L_j) limited values of the products P_1-P_{13} in the mixture composition (charge) are shown in Table 1.

In comparison to the general mathematical model of blend composition problem, it can be concluded that m=5, n=14 is valid. Values a_i and b_j are calculated according to the formulae (1) and (2) from the general mathematical model. The set of indices corresponding to useful products is equal to I={1,12,13}. Selling prices of useful products for copper (product P_1), silver (product P_{12}) and gold (product P_{13}) are known. These selling prices are marked as co_1, co_{12} and co_{13}, respectively, based on the data taken from the London metals exchange (LME). Purchase prices of copper concentrates Con_1,...,Con_5 are marked as values ci_1,...,ci_5 and are calculated using the formula (8):

$$ci_k = co_1 \cdot 0.96 \cdot p_{k,1} - 400, \quad k = 1,\ldots,5 \tag{8}$$

where are:

co_1 – selling price of copper (according to LME),

$p_{k,1}$ – percentage copper in the concentrate,

0.96 – yield coefficient for raw material,

400$/t – production costs.

The first group of constraints represents disposable quantities of raw materials: these constraints refer to the concentrate quantities that can be purchased. In the specific case these quantities are unlimited, that is, $g_i \to \infty$. In the model, the quantity of 1T for each concentrate is arbitrary which is shown in the relation (9). The second group of constraints can be expressed in the form (10), where is $t_j = \infty$.

$$a_i = \sum_{j=1}^{n} x_{ij} \le 1, \quad i = 1,\ldots,m; \tag{9}$$

$$b_j = \sum_{i=1}^{m} Y_i \cdot x_{ij} \le \infty, \quad j = 1,\ldots,n. \tag{10}$$

The third group of constraints represents structural constraints (6), and the fourth group of constraints represents natural constraints for x_{ij}, shown in (7).

In the problem of blending there are typically specification constraints that limit the content of various properties of the blend that it acquires from the ingredients to certain maximum or minimum percentages of the total blend. Our motivation in the present paper is to impose limitations (lower and upper bounds) for desired raw materials in the final blend.

The fifth group of constraints is defined by copper limits, i.e. defined the lower bound L_1 and the upper bound U_1 for copper share in the charge composition. In the specific case the limits of copper presence in the charge are L_1=21% and U_1=25%, which is shown in the relation (11).

$$L_1 \sum_{j=1}^{n} b_j \le b_1 \le U_1 \sum_{j=1}^{n} b_j. \tag{11}$$

The sixth group of constraints is defined by sulphur limits, i.e. defined the lower limit of sulphur share in the blend composition. Since the sulphur is seen as a useful component the model includes only the lower limit of its presence in the charge. In the specific example it is L_4=0.32%, which is shown in the relation (12).

$$b_4 \geq L_4 \sum_{j=1}^{n} b_j . \tag{12}$$

The seventh group of constraints define the upper (standardized) limits for harmful elements present in the charge composition which is shown in the relation (13). The data are taken from the Table 1.

$$b_j \leq U_j \sum_{j=1}^{n} b_j , \quad j \notin I,\ j \neq 4,\ j \in \{1,\ldots,14\}. \tag{13}$$

4. IMPLEMENTATION OF ESTABLISHED MATHEMATICAL MODELS

Implementation of the presented model was done in the programming language MATHEMATICA, by means of its standard function `Maximize`. Standard MATHEMATICA function `Maximize[f, {cons}, {x,y,...}]` maximizes *f* subject to the constraints *cons* with respect to *x*, *y*, ... yields lists giving the value attained at the minimum or maximum, together with rules specifying where the minimum or maximum occurs.

List *P* defines the coefficients of share percentages of all 14 products (14th product is the group "miscellaneous") in 5 offered concentrates. The coefficients are divided by 100 in order to be expressed decimally.

```
P={
      {12.620000,0.018000,0.034000,10.710000,0.190000,0.520000,0.002500,0.008600,0.000030,0.0
04990,0.008000,0.002192,0.000308,75.881380},

      {16.210000,0.021000,0.002900,37.730000,0.009999,0.100000,0.002500,0.014000,0.000010,0.0
04991,0.012000,0.001234,0.000132,45.891234},

      {14.590000,0.024000,0.005700,28.720000,0.140000,0.400000,0.002500,0.011000,0.000020,0.0
04990,0.010000,0.003300,0.000460,56.088030},

      {25.870000,0.018000,0.007000,33.860000,0.130000,0.210000,0.002500,0.020000,0.000020,0.0
04990,0.001990,0.003350,0.000572,39.871578},

      {21.450000,0.021000,0.018000,26.160000,0.320000,0.420000,0.005000,0.019000,0.000030,0.0
04991,0.003000,0.006350,0.000420,51.572209}

      }/100
```

Dimensions of the problem (*m*=5, *n*=14) can be defined by assigning

```
{m, n} = Dimensions[P]
```

List *co* defines selling prices of the products. The first element of the list *co* defines the price of copper in the world market at that moment; the 12th place occupies the price of silver and the 13th corresponds to the price of gold, expressed as $/T (according to LME). The rest of the prices equal zero since these are harmful, nonprofit products.

```
co = {7070.004,0,0,0,0,0,0,0,0,0,0,596835.923,38279334.732,0}
```

The purchase price of the concentrates is calculated according to (8) using the function `CInput[i_]`, and the list $c_i=\{ci_1,\dots ,ci_m\}$ defines purchase prices of the concentrates Con_i, $i=1,\dots ,m$.

```
CInput[i_]:=co[[1]]*0.96*P[[i,1]]-400
ci=Table[CInput[i],{i,m}]
```

List *L* defines lower bounds of the useful products, while list *U* defines the upper bounds of the harmful products. Because of the technological procedure, there is the upper and lower limited value for copper. It can be noticed that silver and gold are useful elements which appear in the charge, and should not be constrained by a lower bound and the upper bound. The presence of these elements in the charge is desirable, no matter in which amount, because it would only increase the value of the goal function. Moreover, the constraint related to the upper limit of sulphur is not defined. The lower limit for sulphur is 32%, it must not be lower since it is used as the fuel in the process of roasting and smelting. List *Y* represents the exploitation level in the technological procedure.

```
L = N[{21,0,0,32,0,0,0,0,0,0,0,0,0}/100]
U = N[{25,0.05,0.2,100,2,3,0.01,0.01,0.0005,0.3,0.1,100,100,100}/100]
Y = 0.92*Table[1, {i, m}]
```

List *g* defines disposable concentrate quantities whereas list *t* means the quantities of products which can be sold in the market.

```
g = Table[1, {i, m}];                                          (*Upper bounds in (4)*)
t = Table[0, {i, n}];  t[[1]] = t[[12]] = t[[13]] = Infinity ;(*Upper bounds in (5)*)
```

List *vrb* defines all the variables necessary for the model and they are built in the two-dimensional list whose elements are array objects *x*[*i*, *j*]. List *var* is unidimensional and defines all the variables which occur in the mathematical model.

```
vrb = Table[x[i,j], {i, m}, {j, n}]
var=Flatten[vrb]
```

The value *a*[*i*_] defines the quantity of raw material Con_i which is necessary for the production. These values are stored in the list $a=\{a_1,\dots ,a_m\}$.

```
a[i_] := Sum[vrb[[i,j]],{j,n}];
a = Table[a[i],{i,m}]
```

Function *b*[*j*_] defines the produced quantity b_j of product P_j, whereas the list $b=\{b_1,\dots ,b_n\}$ contains these values.

```
b[j_]:=
 Module[{k=j},
        Return[Sum[Y[[i]]*vrb[[i,k]],{i,m}]]
  ];
b = Table[b[j],{j,n}]
```

Expression *F* is the objective function defined in (3).

```
F := Module[{k},
Return[Simplify[co[[1]]*b[[1]]+co[[12]]*b[[12]]+co[[13]]*b[[13]]-Sum[ci[[k]]*a[[k]]]
```

```
] ];
     ]
```

Variables *Suma* and *Sumb* define the total quantity of all disposable concentrates and the total quantity of final products, respectively.

```
Suma = Sum[a[[i]],{i,m}]; Sumb = Sum[b[[j]],{j,n}];
```

Function *Compai*[*k*_] generates value a_k, i.e. the quantity of the concentrate Con_k. In the function is used the global variable *vr*, which represents the optimal solution of the model. This value must be previously obtained by means of the function `Maximize`, and it is a list of the general form $\{f_{max},\{x\rightarrow x_{max}, y\rightarrow y_{max} ,...\}\}$ [21].

```
Compai[k_] :=
 Module[{j, s = 0},
  For[j = 1, j <= n, j++,
       s += vr[[(k - 1)*n + j, 2]]
     ];
  Return[s]
  ]
```

Function *Compbj*[*k*_] calculates the quantity b_k of the product P_k from the optimal solution *vr*.

```
Compbj[k_] :=
 Module[{i, s = 0},
  For[i = 1, i <= m, i++,
          s += Y[[i]]*vr[[k + n*(i - 1), 2]]
     ];
  Return[s]
  ]
```

In the following code the list of usual constraints is defined.

```
constr1 = {};
Do[AppendTo[constr1, a[[i]]<=g[[i]]], {i,m}]                        (*Constraints (4)*)
constr2 = {b[[1]]<=t[[1]], b[[12]]<=t[[12]], b[[13]]<=t[[13]]}   (*Constraints (5)*)
constr3 = {};
Do[AppendTo[constr3, a[[i]]*P[[i,j]]==x[[i,j]]], {i,m}, {j,n}]   (*Constraints (6)*)
constr4 = {};
Do[AppendTo[constr4, var[[i]] >= 0], {i, m*n}]                    (*Constraints (7)*)
```

Variable denoted as *constr*5 corresponds to inequalities (11) (imposed to the copper), variable denoted as *constr*6 corresponds to inequalities (12) (imposed to the sulphur), and variable denoted by *constr*7 is the list which contains constraints from (13).

```
constr5 := {Sumb*L[[1]] <= b[[1]], b[[1]] <= Sumb*U[[1]]}
constr6 := {b[[4]] >= Sumb*L[[4]]}
constr7 := {b[[2]] <= Sumb*U[[2]], b[[3]] <= Sumb*U[[3]], b[[5]] <= Sumb*U[[5]],
       b[[6]] <= Sumb*U[[6]], b[[7]] <= Sumb*U[[7]], b[[8]] <= Sumb*U[[8]],
       b[[9]] <= Sumb*U[[9]],b[[10]] <= Sumb*U[[10]], b[[11]] <= Sumb*U[[11]] }
```

Implementation of the mathematical model which contains only constraints which appear in the first four groups is defined by the following function:

```
Compute[x_] :=
 Module[{Sma, Smb, k, constr},
    Print["x = ", x]; L[[1]] = x/100;
    constr = Join[ constr1, constr2, constr3, constr4 ];
    R = Maximize[ Simplify[Expand[Simplify[F]]], constr, var];   vr = R[[2]];
    ai = Table[Compai[k], {k, m}]; bj = Table[Compbj[k], {k, n}];
    Smb = Sum[bj[[k]], {k, n}]; Print["Suma bj = ", Smb];
    Sma = Sum[ai[[k]], {k, m}]; Print["Suma ai = ", Sma];
    Print["Profit = ",co[[1]]*bj[[1]] + co[[12]]*bj[[12]] + co[[13]]*bj[[13]]];
    Print["Costs = ", Sum[ci[[k]]*ai[[k]], {k, m}]];
    Print["b /Suma = ", bj/Smb];
    Return[R];
  ]
```

Implementation of the model which contains not only the constraints which appear in the first four groups but also the constraints the fifth group is different from the previous function only in the command:

```
constr = Join[ constr1, constr2, constr3, constr4, constr5 ];
```

Implementation of the model which contains the constraints which appear in the first six groups has the following command:

```
constr =  Join[constr1, constr2, constr3, constr4, constr5, constr6 ];
```

Implementation of the model which imposes all types of constraints has the following command which defines the constraints:

```
constr =  Join[constr1, constr2, constr3, constr4, constr5, constr6, constr7 ];
```

Other functions that contain different combination of constraints can analogically be defined. For example, constraints related with copper, sulphur and arsenic are defined by the expression:

```
constr= Join[constr1, constr2, constr3, constr4, constr5, constr6, {b[[3]]<=Sumb*U[[3]]}];
```

The command `Compute[n]`, where as $n \in \{21,\ldots,25\}$ starts the calculating process. One of the desirable properties of DSS from [13] is the interactive processing, providing immediate response. MATHEMATICA as an interpretative programming language provides significant interactivity. Software interactivity can be increased by means of the function `Manipulate`. Expression of the form `Manipulate[expr,{u,umin,umax,du}]` generates a version of *expr* with controls added to allow interactive manipulation of the value of *u*, where the value of *u* varies between *umin* and *umax* in steps *du*.

By means of the command

```
Manipulate[Compute[x],
 Style[Row[{"L[1] = ", Dynamic[N[L[[1]]]]}], Black, "Label"],
```

```
 Row[{"a[1] = ", Dynamic[N[ai[[1]]]]}], Row[{"a[2] = ", Dynamic[N[ai[[2]]]]}],
 Row[{"a[3] = ", Dynamic[N[ai[[3]]]]}], Row[{"a[4] = ", Dynamic[N[ai[[4]]]]}],
 Row[{"a[5] = ", Dynamic[N[ai[[5]]]]}],
{x, 21, 25, 1}, {x, {21, 22, 23, 24, 25}}]
```

it is possible to obtain animation corresponding to lower bounds L_1=21,... ,25. The next snapshot (Figure 1) is derived as a situation from the complete animation, created in the case L_1=21 and imposing all types of constraints in the model.

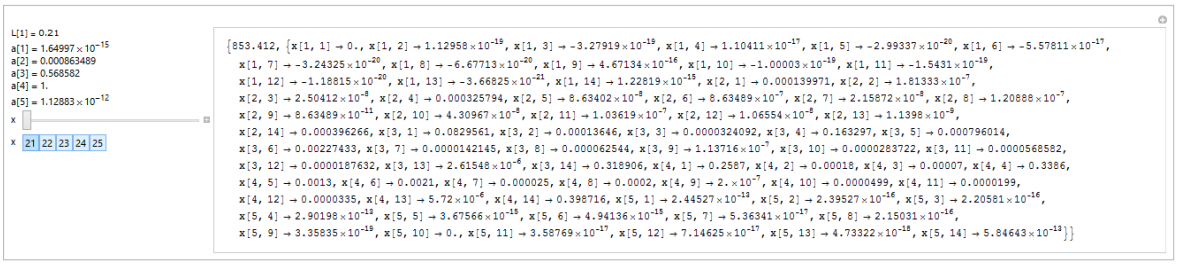

Figure 1. Snapshot of the result given by the function `Manipulate`

Also, we write the following function `Graphic` which creates lists *grafa*[[*k*]],*k*=1,... ,*m* and *grafb*[[*k*]],*k*=1,... ,*n*. The list *grafa* (resp. *grafb*) contains elements of the form {*x*,a_k[*x*]}, (resp. {*x*,b_k[*x*]}), *x*=21,...,25, where a_k[*x*] (resp. b_k[*x*]) denotes value of a_k (resp. b_k) in the case when the lower bound L_1 is equal to *x*.

```
Graphic := Module[{x, k},
  grafa = Table[{}, {k, 1, m}]; grafb = Table[{}, {k, 1, n}];
  For[x = 21, x <= 25, x++,
       Compute[x];
       For[k = 1, k <= m, k++,
             AppendTo[grafa[[k]], {x, ai[[k]]}]; AppendTo[grafb[[k]], {x, bj[[k]]}]
       ];
   ] ]
```

Now, it is possible to derive graphical illustration representing usage of concentrates as well. For example, graphical illustration corresponding to a_1 can be obtained by means of the next code

```
ListPlot[{grafaSVI[[1]]},PlotRange→{{20.8,25.2},{-0.1,1.1}},Axes→True,
  AxesOrigin→{20.8,-0.1},AxesStyle→Directive[Black,22],AspectRatio→12,Joined→True,
  PlotStyle→{Black,Thick},PlotMarkers→{Automatic,12},AxesLabel→{"%Cu","Grade"},
  PlotLabel→Style["Concentrate1", FontSize→20,Italic,Bold]]
```

5. EXPERIMENTAL RESULTS

Implementation was carried out in the programming language MATHEMATICA using the standard Maximize function from the package [21]. Numeric experiments for the Cu grade within the batch graded from 21 to 25% were carried out and presented in this paper. The values L_1 from 21 to 25% were taken as assumed and no specific batches having such a composition were considered in this paper.

Four numerical experiments were carried out for each fixed Cu grade value within the batch. The objective function, which is defined in (3), was used in all experiments. The constraints defined by relations (6), (7), (9) and (10) represent the constraints of the primary model for solving the problem of blending, and they are used in all numerical experiments.

In the first numerical experiment, along with fundamental constraints, the mathematical model of the constraints shown by relations (11), is defined. It is the experiment when only Cu content is observed.

Besides fundamental constraints, the second numerical experiment is defined by constraints shown by relations (11) and (12). Besides the contents of Cu this experiment controls the contents of S in the final charge.

The third numerical experiment is defined by fundamental constraints and constraints shown by relations (11), (12) and (13) for j=3. This experiment controls Cu, S and As in the final charge.

The fourth numerical experiment is defined by fundamental constraints and constraints shown by constraints from (11) to (13), and it is the experiment that optimizes all elements and compounds in the batch.

Copper production is frequently realized in practice only regarding the technological and economic aspects of the business. Such a state of affairs is defined by the model corresponding to the first and second numerical experiment where the only thing that matters is to produce more copper and thus make bigger profit. Environmental aspects are not considered in these experiments. In order to meet the basic ecological requirements of the production of copper, many manufacturers take the emissions of SO_2, PM_{10}, $PM_{2.5}$ particles in the air as well as the content of certain harmful metals (As only) into account. Such a business scenario is defined by the model that matches the third numerical experiment.

The authors of the present paper wanted to show that it was possible to produce copper while simultaneously respecting technological, economic and environmental aspects, which are contradictory by nature. This production scenario is defined by the model that corresponds to the fourth numerical experiment where, in obtaining the optimal solution all the elements and compounds present in batches, are taken into consideration.

During the implementation of numerical experiments for all four models just one value within the limits of 21-25% Cu in batches was taken for L_1. For each value L_1 in each model an optimal solution is obtained. The results of numerical experiments are presented in Table 2.

Table 2. Results of numerical experiments – optimal solutions

% Cu in batches	*Experiments*	Con_1	Con_2	Con_3	Con_4	Con_5
21	Cu	0	1	0.083	1	1
	Cu + S	0	1	0.083	1	1
	Cu + S+ As	0	1	0.083	1	1
	Zn + all elements	0	0.001	0.568	1	0
22	Cu	0	0	0.448	1	1
	Cu + S	0	0.584	0	1	0.891
	Cu + S+ As	0	0	0.522	1	0
	Zn + all elements	0	0	0	0	0
23	Cu	0	0	0.157	1	1
	Cu + S	0	0.286	0	1	0.599
	Cu + S+ As	0	0	0.341	1	0
	Zn + all elements	0	0	0	0	0
24	Cu	0	0	0	1	0.733
	Cu + S	0	0.103	0	1	0.419
	Cu + S+ As	0	0.103	0	1	0.419
	Zn + all elements	0	0	0	0	0
25	Cu	0	0	0	1	0.245
	Cu + S	0	0	0	1	0.245
	Cu + S+ As	0	0	0	0	0
	Zn + all elements	0	0	0	0	0

Graphical illustrations of the optimal results of the fourth numerical experiment are illustrated in Figure 2. Changing Cu values for L_1 within the interval from 21 to 25% in the optimal batch are presented on the *x*-axis in all graphs. *Y*-axis is marked with Grade values shown in the range of 0-1. These values present each a_i grade in the optimal batch.

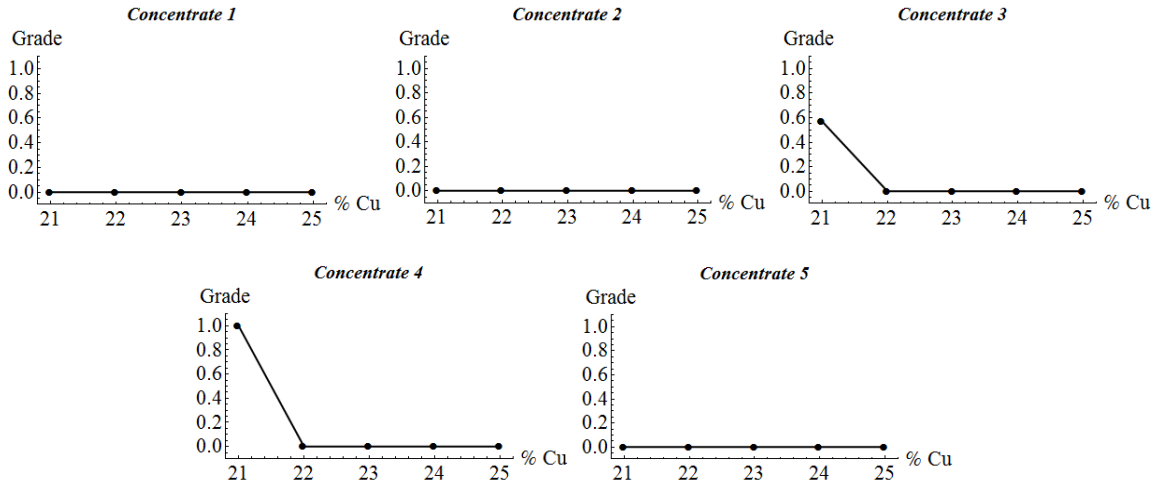

Figure 2. Amount of concentrates towards the optimal solution, fourth numerical experiment - from Con1 to Con5

In Figure 3 the comparative review of concentrates, for second, third and fourth numerical experiments towards the optimal solution is shown.

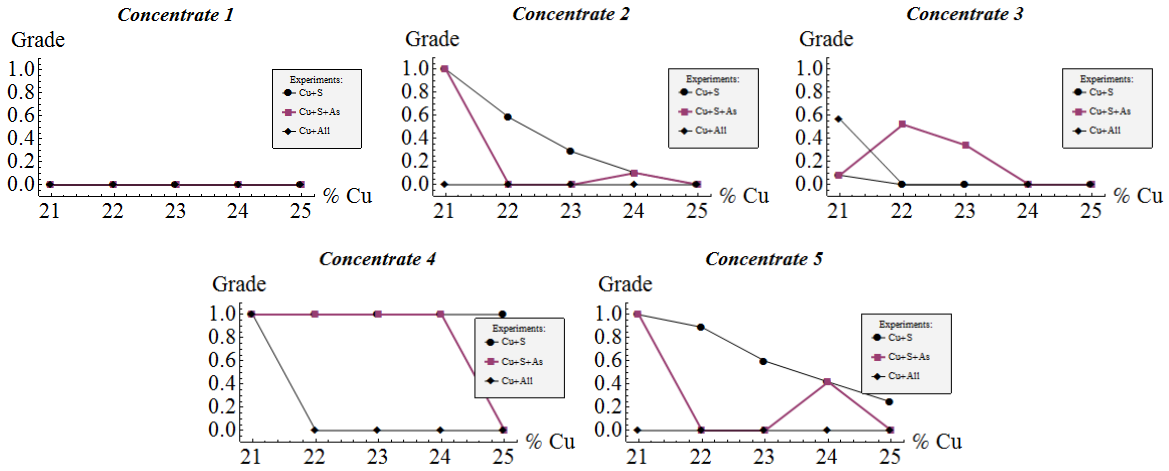

Figure 3. Comparative review concentrates for second, third and fourth numerical experiments - from Con1 to Con5

6. DISCUSSION

Comparing the results presented in Table 2, as well as Figure 2 and Figure 3, the following comments can be derived.

A) General comments

A1. Comparing the optimal results it may be concluded that it is possible to compile the optimum batch for all four numerical experiments.

A2. Concentrates Con_4 and Con_5, respectively, contain the highest percentage of Cu in their compositions. These concentrates have a maximum participation within the optimal batch composition for all four numerical experiments, for all values of L_1=21-25%.

A3. Interestingly, the concentrate of copper Con_1, for all four numerical experiments, is not included in the optimum batch for either value L_1=21-25%. These is also the concentrate which have the lowest percentage of Cu in their compositions.

B) Comments derived by applying the first numerical experiment (only Cu)

B1. In the first numerical experiment, optimum solutions can be found for all values L_1=21-25% Cu in the batch.

B2. For the optimal batch preparation of L_1=21% Cu, four concentrates participate: Con_2, Con_3, Con_4 and Con_5, in ratio of 1:0.083:1:1 to each other, i.e., the optimal batch should

contain 32.4% of concentrate Con_2, 2.8% of concentrate Con_3, 32.4% of concentrate Con_4, and 32.4% of concentrate Con_5. Assembling the optimal batch, within the limits L_1=22-25% Cu, requires concentrates which are found in certain relations, in accordance with the obtained optimal solution shown in Table 2.

C) Comments derived by applying the second numerical experiment (Cu+S)

C1. In the second numerical experiment optimum solutions can be found for all values L_1=21-25% Cu in the batch.

C2. For the optimal batch preparation of 21% Cu, the optimal solution is also as in the first numerical experiment. For others value of L1=22-25% Cu requires the concentrates which are found in certain relations, in accordance with the obtained optimal solution shown in Table 2. This optimal solution is different from the first numerical experiment.

D) Comments derived by applying the third numerical experiment (Cu+S+As)

D1. In the third numerical experiment optimum solutions can be found for values L_1=21-24% Cu in the batch.

D2. The optimal solution, for L_1= 21% Cu, is also as in the first and second numerical experiment. For others value of L_1=22-24% Cu requires the concentrates which are found in certain relations, in accordance with the obtained optimal solution shown in Table 2. This optimal solution is different from the first numerical experiment.

E) Comments derived by applying the fourth numerical experiment (all elements)

E1. In the fourth numerical experiment an optimum solution can be found for values L_1=21% Cu in the batch. For other values of L_1=22-24% Cu, with these concentrates, it is not possible to find the optimal solution.

E2. For the optimal batch preparation of L_1=21% Cu, four concentrates participate: Con_2, Con_3 and Con_4, in the ratio of 0,001:0.568:1 to each other, i.e., the optimal batch should contain 0.1% of concentrate Con_2, 36.2% of concentrate Con_3 and 63.7% of concentrate Con_4.

7. CONCLUSION

We emphasize two different aspects in the paper. The first aspect is specific mathematical models for blend composition goven for the case where raw materials are concentrates and the number of products is imposed by these raw materials. Our primary criterion is to determine the optimum blend composition in relation to the obtained maximal profit. In other, side criteria, our intention is to ensure that the blend should meet all the technological, economic and ecological requirements. The case study investigated fourteen concentrates for the copper smelting plant in RTB Bor.

The second aspect is the usage of the package MATHEMATICA that would be used as an environment for the support of decision making. The standard function `Manipulate` automatically creates an interface for manipulating the parameters and supports not only mouse and keyboard manipulation, but also gamepads and other devices.

The obtained numerical results explicitly lead to the conclusion that it is both possible and necessary, when making optimal charge composition, to take the presence of all harmful components into consideration, not only the certain ones, which has been the case in the working practice so far. Applying this mathematical model made it possible to make, out of disposable concentrates, the optimal blend ratio which represents the optimal charge composition both from the aspect of useful components content and from the aspect of minimal environment pollution caused by emission of smelting plants fumes which endanger the environment. The choice of optimal charge composition is the key element, for the copper smelting plant in RTB Bor, for environmental protection in this region. The analysis of the results showed that optimization of all the elements in the charge did not jeopardize basic business principles. On the contrary, the analysis gives an answer to the question which concentrates and which quantities of them should be purchased, for the discussed period, in order to make profit.

In the working practice so far, the decision which charge to use in processing copper concentrate used to be made by the company management on the basis of their own subjective experience and ad hoc. This paper shows that the problem of blend composition choice can be dealt with systematically, by defining a mathematical model which will help company management decide on the charge composition. The decision support system is a helpful tool to estimate the required raw materials in the future and it is also a good support for investment decisions.

The authors of the paper believe that by this systematic approach in the process of copper production, by means of decision support system (DSS) developed in MATHEMATICA environment, preconditions are created for solving a great number of problems related to human and environmental ecological protection according to ecological standards in Europe and the world. Moreover, this paper can serve as a good starting point for further research and development of new models in solving present ever increasing ecological problems in the field of non-ferrous metal production.

8. APPENDIX: Implementation in MATHEMATICA

This section describes the MATHEMATICA code for computing values max$F(x)$.

```
P={  {12.620000,0.018000,0.034000,10.710000,0.190000,0.520000,0.002500,0.008600,0.000030,0.0
04990,0.008000,0.002192,0.000308,75.881380},

      {16.210000,0.021000,0.002900,37.730000,0.009999,0.100000,0.002500,0.014000,0.000010,0.0
04991,0.012000,0.001234,0.000132,45.891234},

      {14.590000,0.024000,0.005700,28.720000,0.140000,0.400000,0.002500,0.011000,0.000020,0.0
04990,0.010000,0.003300,0.000460,56.088030},

      {25.870000,0.018000,0.007000,33.860000,0.130000,0.210000,0.002500,0.020000,0.000020,0.0
04990,0.001990,0.003350,0.000572,39.871578},

      {21.450000,0.021000,0.018000,26.160000,0.320000,0.420000,0.005000,0.019000,0.000030,0.0
04991,0.003000,0.006350,0.000420,51.572209}}/100

{m,n} = Dimensions[P]
```

```
co = {7070.004,0,0,0,0,0,0,0,0,0,0,596835.923,38279334.732,0}
CInput[i_]:=co[[1]]*0.96*P[[i,1]]-400
ci=Table[CInput[i],{i,m}]
L = N[{21,0,0,32,0,0,0,0,0,0,0,0,0}/100]
U = N[{25,0.05,0.2,100,2,3,0.01,0.01,0.0005,0.3,0.1,100,100,100}/100]
Y = 0.92*Table[1, {i,m}]
g = Table[1, {i,m}];
t = Table[0, {i,n}]; t[[1]] = t[[12]] = t[[13]] = Infinity ;
vrb = Table[x[i,j], {i,m}, {j,n}]
var=Flatten[vrb]
a[i_] := Sum[vrb[[i,j]],{j,n}];
a = Table[a[i],{i,m}]
b[j_]:=
 Module[{k=j},
       Return[Sum[Y[[i]]*vrb[[i,k]],{i,m}]] ];
b = Table[b[j],{j,n}]
F := Module[{k},
 Return[Simplify[co[[1]]*b[[1]]+co[[12]]*b[[12]]+co[[13]]*b[[13]]-Sum[ci[[k]]*a[[k]]]
     ] ];  ]
Suma = Sum[a[[i]],{i,m}]; Sumb = Sum[b[[j]],{j,n}];
Compai[k_] :=
 Module[{j, s = 0},
  For[j = 1, j <= n, j++,
       s += vr[[(k - 1)*n + j, 2]]  ];
       Return[s]  ]
Compbj[k_] :=
 Module[{i, s = 0},
  For[i = 1, i <= m, i++,
       s += Y[[i]]*vr[[k + n*(i - 1), 2]]  ];
       Return[s]  ]
constr1 = {};
Do[AppendTo[constr1, a[[i]]<=g[[i]]], {i,m}]
constr2 = {b[[1]]<=t[[1]], b[[12]]<=t[[12]], b[[13]]<=t[[13]]}
constr3 = {};
Do[AppendTo[constr3, a[[i]]*P[[i,j]]==x[[i,j]]], {i,m}, {j,n}]
constr4 = {};
Do[AppendTo[constr4, var[[i]] >= 0], {i, m*n}]
constr5 := {Sumb*L[[1]] <= b[[1]], b[[1]] <= Sumb*U[[1]]}
constr6 := {b[[4]] >= Sumb*L[[4]]}
constr7 := {b[[2]] <= Sumb*U[[2]], b[[3]] <= Sumb*U[[3]], b[[5]] <= Sumb*U[[5]],
  b[[6]] <= Sumb*U[[6]], b[[7]] <= Sumb*U[[7]], b[[8]] <= Sumb*U[[8]],
```

```
b[[9]] <= Sumb*U[[9]],b[[10]] <= Sumb*U[[10]], b[[11]] <= Sumb*U[[11]] }
```

To obtain an optimal solution for the first numerical experiment it is necessary to apply step A. For the second numerical experiment step B is applied. For the third numerical experiment step C is applied, and step D for the fourth.

Step A. Calculation for the first numerical experiment (*only* Cu):

```
Compute[x_] :=
 Module[{Sma, Smb, k, constr},
      Print["x = ", x]; L[[1]] = x/100;
      constr = Join[ constr1, constr2, constr3, constr4, constr5 ];
      R = Maximize[ Simplify[Expand[Simplify[F]]], constr, var]; vr = R[[2]];
      Return[R];  ]
```

Step B. Calculation for the second numerical experiment (Cu+S):

```
Compute[x_] :=
 Module[{Sma, Smb, k, constr},
      Print["x = ", x]; L[[1]] = x/100;
      constr =  Join[constr1, constr2, constr3, constr4, constr5, constr6 ];
      R = Maximize[ Simplify[Expand[Simplify[F]]], constr, var]; vr = R[[2]];
      Return[R];  ]
```

Step C. Calculation for the third numerical experiment (Cu+S+As):

```
Compute[x_] :=
 Module[{Sma, Smb, k, constr},
      Print["x = ", x]; L[[1]] = x/100;
      constr= Join[constr1, constr2, constr3, constr4, constr5, constr6,
      {b[[3]]<=Sumb*U[[3]]}];
      R = Maximize[ Simplify[Expand[Simplify[F]]], constr, var]; vr = R[[2]];
      Return[R];  ]
```

Step D. Calculation for the fourth numerical experiment (*all elements*):

```
Compute[x_] :=
 Module[{Sma, Smb, k, constr},
      Print["x = ", x]; L[[1]] = x/100;
      constr =  Join[constr1, constr2, constr3, constr4, constr5, constr6, constr7 ];
      R = Maximize[ Simplify[Expand[Simplify[F]]], constr, var]; vr = R[[2]];
      Return[R];   ]
```

To obtain animations use the following command:

```
Manipulate[Compute[x],
 Style[Row[{"L[1] = ", Dynamic[N[L[[1]]]]}], Black, "Label"],
 Row[{"a[1] = ", Dynamic[N[ai[[1]]]]}], Row[{"a[2] = ", Dynamic[N[ai[[2]]]]}],
 Row[{"a[3] = ", Dynamic[N[ai[[3]]]]}], Row[{"a[4] = ", Dynamic[N[ai[[4]]]]}],
 Row[{"a[5] = ", Dynamic[N[ai[[5]]]]}],
```

```
{x, 21, 25, 1}, {x, {21, 22, 23, 24, 25}}
          ]
```

To create graphics use the following command:

```
Graphic := Module[{x, k},
  grafa = Table[{}, {k, 1, m}]; grafb = Table[{}, {k, 1, n}];
  For[x = 21, x <= 25, x++,
       Compute[x];
       For[k = 1, k <= m, k++,
           AppendTo[grafa[[k]], {x, ai[[k]]}]; AppendTo[grafb[[k]], {x, bj[[k]]}]   ];
   ] ]
```

For a graphic illustration to use the following command:

```
ListPlot[{grafa[[1]]},PlotRange→{{20.8,25.2},{-0.1,1.1}},Axes→True,
   AxesOrigin→{20.8,-0.1},AxesStyle→Directive[Black,22],AspectRatio→12,Joined→True,
   PlotStyle→{Black,Thick},PlotMarkers→{Automatic,12},AxesLabel→{"%Cu","Grade"},
   PlotLabel→Style["Concentrate1", FontSize→20,Italic,Bold]]
```

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IMPLEMETATION OF CONTROL CHARTS IN ENVIRONMENTAL MONITORING OF WATER QUALITY

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Abstract

There are many different methods of analysing data obtained from environmental monitoring. Application of statistical process control tools has a huge potential in control and management of environmental monitoring processes. Among these tools control charts, originally developed for industrial applications, present one of the most sophisticated methods. Control charts are more informative than most traditionally employed methods of environmental monitoring and can be constructed for many different types of indicators. This paper describes the application of univariate or multivariate types of control charts in order to evaluate the water quality in the South Morava River, during the monitored period of eight years. The non-random shifts in the variability of the two chosen indicators of the water quality were detected during particular months using multivariate Hotelling T^2 control charts, thus accomplishing one of the main goals of the monitoring, which is the detection of particular occurrences of impact of anthropogenic pollution sources in the investigated locations.

Keywords: *River water quality, SWQI, control charts, anthropogenic pollution sources, Hotelling T^2*

1. INTRODUCTION

Preserving water ecosystems is one of the most important missions nowadays. In order to ensure humans survival and development, it is necessary to deal with water quality problems. Reliable and efficient monitoring system and quality control is essential for successful water quality management. Most acceptable ecological and water related decisions are difficult to make without careful modeling, prediction and analysis of river water quality for typical development scenarios [1]. Control of the values of pollution indicators should be used to recognize the need for promptly activities. If measures are beyond regulatory limits, that is an alert to prevent further deterioration of resource.

There are numerous water quality parameters that indicate the impact of anthropogenic pollution sources, among which a special emphasis is put on Orthophosphates (PO_4) and

Biochemical Oxygen Demand (BOD_5). Excess nutrients in water cause rapid growth of plants that disturbs the balance of aquatic ecosystems. After death, plants sink to the bottom of river system, where the bacteria decompose them. In this process much more oxygen is used than it is produced by photosynthesis. Due to the lack of oxygen in the water, the survival of plant and animal species is becoming increasingly uncertain. Phosphorous is a nutrient found in all living things. It is also a mineral in nature. There are different forms of phosphorus that enter the water due to the flushing of agricultural land, discharges of waste water from industry and households (especially those containing detergents) or decomposition of phosphates rocks. Measuring and monitoring the concentration of phosphorus (orthophosphate) in water is very important, especially because its' presence in surface water is mainly from organic sources. Biochemical Oxygen Demand determinates the extent of oxygen consumed by microorganisms in the process of decomposing organic matter in stream water [2]. Although there is no direct impact on human health, this parameter is an important indicator of the overall quality of water. BOD_5 indicates waste water contamination and efficiency of the wastewater treatment plant. Increased value of this parameter indicates the presence of more organic matters in the river flow. Above indicates that parameters PO_4 and BOD_5 are directly correlated.

The surface waters are complex multi-component system. The specificity and complexity of the surface water chemical composition and the quality indicators as the consequence of the of the mineral and organic matter dissolved within, and gases, colloids, suspended particles and microorganisms that came by natural or manmade processes, emphasize the importance of the application of index methods for their evaluation by finding the common factors applicable to the overall quality [3]. One of the indicators of water quality is index method. The Environmental Protection Agency of the Ministry for Environment and spatial planning of the Republic of Serbia has developed an environmental index for watercourses designated for the public and experts reports – Serbian Water Quality Index (SWQI). Ten physicochemical and microbiological quality parameters (oxygen saturation, biological oxygen demand, ammonium ion, pH, total nitrogen oxides, orthophosphates, suspended solids, temperature, conductivity and coliform bacteria) are embedded in the composite indicator of the quality of surface water. The importance of each parameter in water quality determination is relative. Based on the different proportions of the total water quality parameters, each of them got the appropriate weighting coefficient (w_i) and the number of points to share (q_i). Then, calculated value products of q_i and w_i, for each parameter individually, are summed up and index number is obtained. According to the SWQI, it is possible to classify water quality (Table 1).

Table 1. Water quality classification according to the SWQI

Serbian Water Quality Index (SWQI)	
Numerical indicator	Descriptive indicator
100 – 90	Excellent
84 – 89	Very good
72 – 83	Good
39 – 71	Bad
0 - 38	Very bad

The aim of this article is to investigate the possibility of applying control chart technique to detect non-random patterns and shifts in variability of the water quality indicators in order to identify potential harmful impact and to be able to timely react and prevent further pollution.

2. MONITORING DATA

The South Morava River is located in southern Serbia. It belongs to the Black Sea drainage basin, while its own drainage area amounts to 15,469 km^2. It flows the south to north direction, from the Macedonian border to the central Serbia. The South Morava springs in the mountain of Skopska Crna Gora in the Republic of Macedonia. It has been formed by the confluence of the Binacka Morava and Presevska Moravica rivers in Bujanovac. Having the lenght of 295 km, this river represents a shorter headwater of the Great Morava. The South Morava River has got 157 tributaries. The most important are: the Jablanica, the Veternica, the Pusta Reka and the Toplica on the left, and the Vrla, the Vlasina, the Nisava, and the Sokobanjska Moravica on the right side. On the banks of the South Morava basin there are located many settlments: Vladicin Han, Vranje, Surdulica, Vlasotince, Grdelica, Leskovac, Pecenjevce, Toplica, Aleksinac, Dimitrovgrad, Pirot, Bela Palanka and Nis. The South Morava River has a great potential for the production of electrical energy, but it has not been exploited yet [3]. There are five hydrology monitoring stations located on the main flow of South Morava River: 1. Ristovac; 2. Vladicin Han; 3. Grdelica; 4. Aleksinac and 5. Mojsinje (Figure 1).

Figure 1. Monitoring stations located on South Morava River

In this study, values of BOD_5 and PO_4 measured on five monitoring stations located along the main course of South Morava during January 2005 – December 2012 were used. Also, SWQI values for all considered year and locations were calculated based on the following parameters: Oxygen saturation, Biochemical Oxygen Demand, Ammonium Ion (NH_4), pH, Total nitrogen, Orthophosphates (PO_4), Suspended Solids, Water Temperature, Electrical Conductivity and Escherichia Coli. Analyzed parameters are part of the database kept by the Republic Hydrometeorological Service of Serbia.

3. RESULTS AND DISCUSSION

In order to define spatial and temporal changes of South Morava water quality it have been analyzed variations of SWQI mean values, in function of monitoring location and year (Figure 2). These trends are displayed by the three dimensional graphs, that provide a better visual insight. On horizontal *x* and *y* axis are shown time (years of monitoring 2005 – 2012.) and space (monitoring stations located along the river flow), respectively. Vertical z axis presents SWQI mean values.

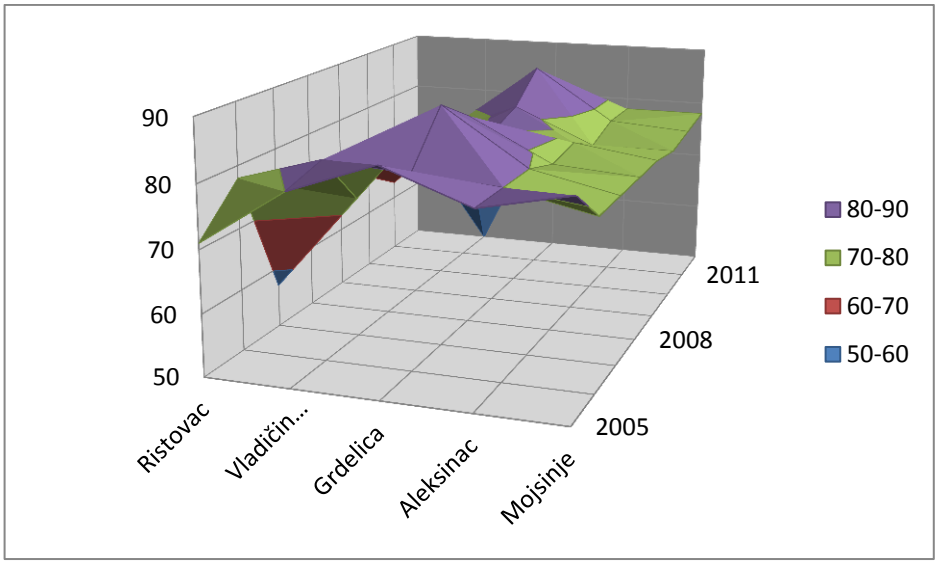


Figure 2. Changes of SWQI values according to the year of monitoring and the location

Table 2. Mean values of SWQI in the analyzed period for the locations on South Morava

	Ristovac	**V. Han**	**Grdelica**	**Aleksinac**	**Mojsinje**
2005	71	80	85	80	83
2006	78	82	81	80	77
2007	57	73	89	80	77
2008	70	78	85	78	77
2009	69	75	80	79	77
2010	67	76	82	76	76
2011	63	76	87	78	77
2012	69		79	78	78
2005 - 2012	68	77	84	79	78

In Table 2 are presented mean values of SWQI for every station during the analyzed period. Based on the results mean values of SWQI, it could be recognized that the lowest water quality level was on Ristovac location. In this case, SWQI mean value for the analyzed period amounted 68, which indicates on water with "bad" quality. The lowest SWQI on this sampling site was in year of 2007 and amounted 57. Mean value of water quality index for monitored period on location Vladicin Han, was 77. According to this, water is classified as the third class of quality ("good"). There were no significant changes in quality of water samples from this site. On adjacent site (Grdelica), the water quality was improved. The mean value of the

quality index for this location, in the analyzed period, amounted 84, so water belonged to the category II ("very good"). Locations Aleksinac and Mojsinje, characterized approximate values of SWQI - 79 and 78, respectively. This indicates the III class of water quality.

3.1. SPC and control charts

During the last two decades numerous authors have shown that application of statistical process control (SPC) tools has a huge potential in control and management of environmental processes [4-6]. A broad range of quality control methods, including univariate and multivariate control charts can be applied to environmental management [7-9]. One of the fundamental assumptions of traditional SPC is that the monitored process variable, while in a state of control, has a statistical distribution with constant parameters. In recent years, SPC has extended to observing relationships between a monitored response variable and related covariates [6]. The monitored response may be "in control" even when its statistical distribution varies over time, provided the response variation is systematic and inherent to the observed process and may be captured by a model that reflects regular process dynamics, namely, how the response varies with relevant covariates (with time as a possible covariate).

In many countries, the special emphasis is put on the pollution control and prevention due to the fact that the costs of pollution have risen dramatically during the past decades. This is especially true for developed industrial countries where relatively small emissions in excess of local regulations can be very costly to firms through taxes and penalties. Even lesser environmental accidents especially if they occur frequently, which is often a case in underdeveloped countries, can have a serious detrimental effect on the local community in the long run [10], and in some cases even on the whole region. Exceeding the permitted amount of emissions of pollutants in the air and in the local rivers can lead to substantial fines, civil and criminal lawsuits, and usually partial or full shutdown of the offending company for a period of time, which further increases their expenses. Finding the right balance between tight control of these processes and its cost-effectiveness, while still maintaining efficiency, is precisely the purpose of utilizing SPC. The SPC relies on a set of tools which are utilized in order to achieve and maintain stability of the processes through the control and reduction of the variability.

Among these tools, control charts are one of the most sophisticated ones. Since its inception [11] this SPC technique has played a major role in controlling product quality by applying statistical concepts in the manufacturing process. In a short period of time it was recognized as a quintessential statistical tool for managing quality in both production and service processes, which enabled the application of this technique in a huge range of business sectors. The main goal of a control chart is to monitor the variance of the quality characteristics in the process, plotted along the y-axis, and to detect and analyse non-random patterns and shifts in the variance of quality characteristics among samples, during the observed time period, which is plotted against the x-axis. The chart contains a center line that represents the average value of the quality characteristic corresponding to the in-control state. It also contains upper control limit (UCL) and the lower control limit (LCL) which specify thresholds beyond which occurrence of the data points indicate that the process is "out of control". These control limits

do not relate to specification limits, they are rather calculated according to the statistical criteria.The goal of statistical process control is to reduce the variability in the process, while the control charts are very efficient tools to monitor and reduce this variability as much as possible. This tool is used first to verify the assumption that the process is in-control, which enables consequential analysis of the process capability and estimation of other crucial process parameters.

Shewhart univariate control charts can only be used to monitor a single characteristic of a stationary process. They are extensively used today due to the fact that they are relatively simple to construct by using the modern software. The pattern analysis of the Shewhart charts is well documented, and especially taking into account the relatively low cost of implementation of this type of charts in everyday practice, their usage exceeds other types of control charts. On the other hand, advancements in technology have raised the need to simultaneously monitor two or more correlated quality characteristics. Using separate univariate charts is not always the best method for monitoring correlated characteristics, because the correlations between variables has a serious impact on the reliability of the charts and degrade their statistical performance, thus having a serious impact on the reliability of these charts. When quality characteristics of interest are mutually correlated, multivariate control charts are employed to avoid poor operating performance. The majority of the multivariate control schemes discussed in the literature [12] assume that the joint probability distribution of the monitored quality characteristics is, or approximates a multivariate normal distribution, while measurements are serially uncorrelated.

3.2. Ecological application of control charts

Application of control charts in industrial processes is very different compared with natural resources monitoring. In industry, an engineer usually determines the centerline for the quality characteristic, where relatively little variability exists around it and the machinery is designed and adjusted accordingly. In practice, because relatively little variability exists around this centreline any non-random patterns and shifts in the variability can be relatively easily identified. In environmental monitoring, we are dealing with parameters that are often unknown (before the commencement of monitoring) and are always changing, at least over some time scale. Relatively large variability frequently characterizes environmental data [13], where issues of seasonality and phenology may also complicate the analysis. Monitoring usually involves sampling from several sites of a similar habitat, at regular (or irregular) intervals through time and its purpose is to determine where and when an impact may have occurred or, once detected, may still be occurring [14].

As previously mentioned SWQI parameter can be used as a reliable indicator of the overall quality of the water courses. Therefore this parameter can be used as a quality characteristic of the quality of water and as such can be presented in the univariate control chart. There are two general categories of the Shewhart control charts depending on the nature of quality characteristic. If the quality characteristic can be measured and expressed as a number on

some continuous scale of measurement, it is called a variable control chart. If quality characteristics are not measured on a continuous scale or even a quantitative scale, we may count the number of nonconformities (defects) in the process based on whether or not they possess certain attributes. Control charts for such quality characteristics are called attributes control charts. Due to the nature of SWQI as the observed quality characteristic and the sample size, which represents the number of SWQI values taken from each measuring station per year, the $\bar{X}$ - σ control chart was chosen. An example of Shewhart variable control chart used to present the variation on the SWQI, taken as a parameter of the overall water quality, is shown in the Figure 3.

One of the advantages of using control charts is very accessible visual representation of the fundamental statistical parameters of central tendency and variation of the process, which is graphically presented as a function of an observed time period. Accordingly, Figure 3 clearly shows the decline in water quality through years of monitoring.

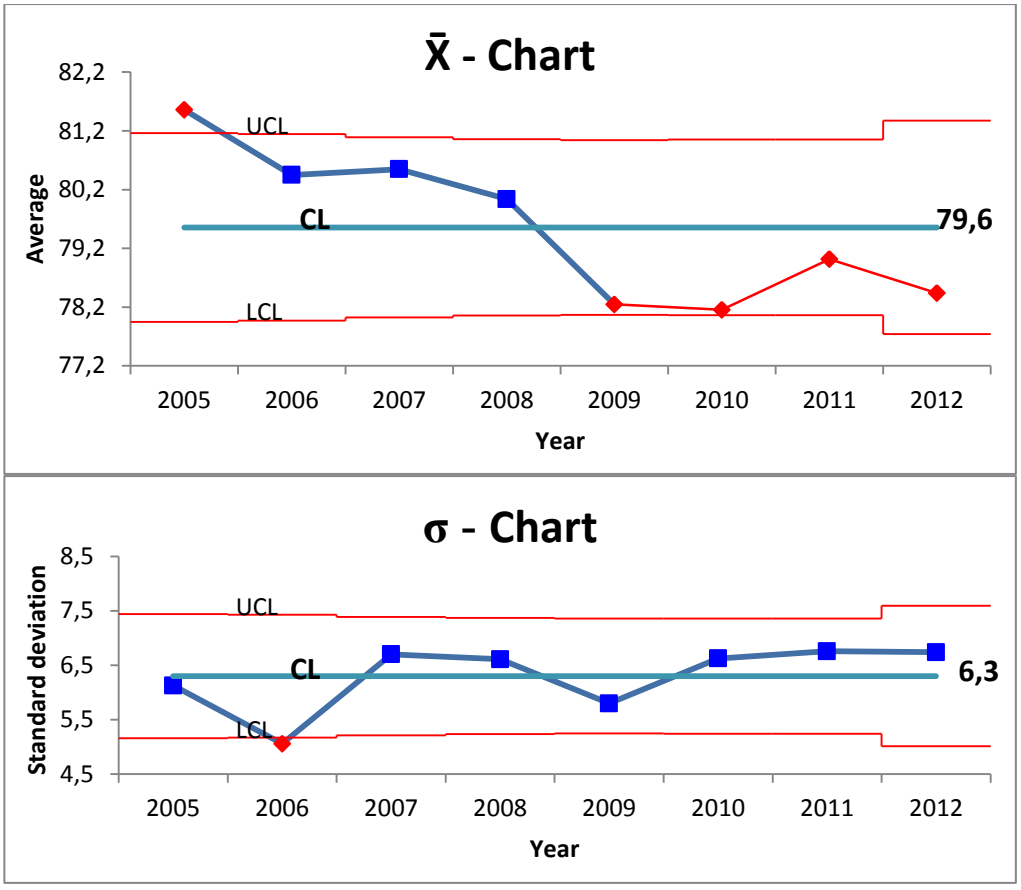


Figure 3. $\bar{X}$ - σ control chart representing the variation of overall quality of the Morava river system as a function of the SWQI and the year of monitoring

Based on the $\bar{X}$ - σ control chart the water quality of the Morava river system, as a function of SWQI, reached its highest level in period of 2005-2008. After 2008 the quality rapidly declined and in the period from 2009 onwards it was constantly below the average value, for the entire period of observation, which was approximately 80.

Unfortunately any further analysis is impeded by the two limiting factors. First issue is represented in the fact that any thorough analysis of patterns is limited by the number of samples which in this case represents the year of monitoring [15]. The second limitation is imposed by the lack of normal distribution in the data sampled from some measuring stations, which is induced by the sample size in conjunction with the nature of the SWQI parameter. This limitation can be eliminated by increasing the sample size, together with some data transformation techniques such as natural log, square root transformations or other methods which can be conducted prior to developing the control charts if the size of the sample is adequate. Therefore based on this univariate control chart alone we cannot draw a reliable conclusion about the statistical stability of this environmental monitoring process.

3.3. Hotelling T^2 control charts

In order to monitor the mean vector of multiple quality characteristics of a process Hotelling [16] developed the multivariate T^2 control chart as a direct analog of the Shewhart $\bar{X}$ chart. The T^2 control chart combines several quality characteristics for each sample into a single quality measurement of the overall performance of the process. Therefore, the goal was to construct a control chart based on a scalar statistic that summarises the necessary information from all the quality characteristics. The main challenge was to find such a statistic that has the power to detect changes in the parameter in the joint characteristic distribution which also enables the possibility of computing the adequate control limits. Consequently, Hotelling formulated T^2 on the basis of a generalized Student Ratio (t) and it may be thought of as the multivariate counterpart of the Student's-t statistic. The Hotelling T^2 distance is a measure that accounts for the covariance structure of a multivariate normal distribution.

The advantage of the T^2 control chart is that multiple quality characteristics and the process performance can be monitored over time by observing one metric. There are two versions of this type of control chart: one for subgrouped data and another for individual observations. In many industrial applications, it is either difficult or too expensive to obtain a subgroup size of several units, especially since there are usually multiple quality characteristics that must be monitored. This is also often the case in environmental monitoring processes, such is the case in this research, therefore, the T^2 control chart where sample size is one will be utilized [17].

For this type of control charts, the probability distribution of the process characteristics is assumed to be multivariate normal with a mean vector μ and a covariance matrix S. Multiple measurements of each process are assumed to be drawn from a population with standard values denoted as μ_0 and S_0. When changes in the process cause parameters of μ or S to shift from the standard values, it is necessary to detect and correct the sources of these assignable causes to ensure a stable process. This is a directionally invariant control chart, that is, its ability to detect a shift in the mean vector only depends on the magnitude of the shift, and not

on its direction [17]. If there are (p) process characteristics that are jointly distributed according to the p-variate normal distribution, a random sample of size (n) is available from the process and when T^2 is generalized to (p) variables [18], then it becomes:

$$T^2 = n(\bar{X} - \mu_0)'S^{-1}(\bar{X} - \mu_0) \quad (1)$$

where,

μ_0 is a vector of population mean
$\bar{X}$ is a vector of sample mean
S is a variance-covariance matrix

The (p x p) sample variance covariance matrix S is formed as the:

$$S = \begin{bmatrix} S_1^2 & S_{12} & \dots & S_{1P} \\ S_{12} & S_2^2 & \dots & S_{2P} \\ \vdots & \vdots & \dots & \vdots \\ S_{1P} & & \dots & S_p^2 \end{bmatrix} \quad (2)$$

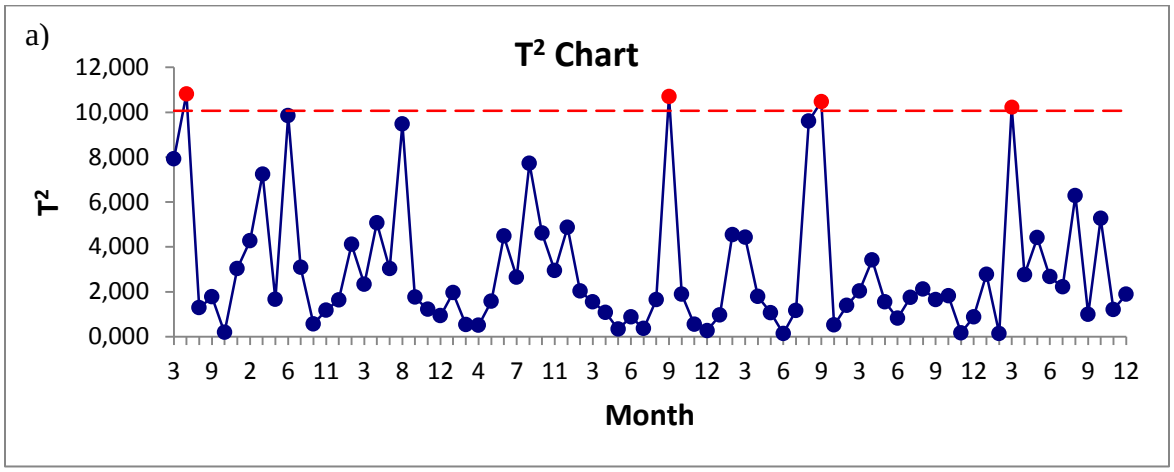
The control limits of the T^2 chart can be calculated as:

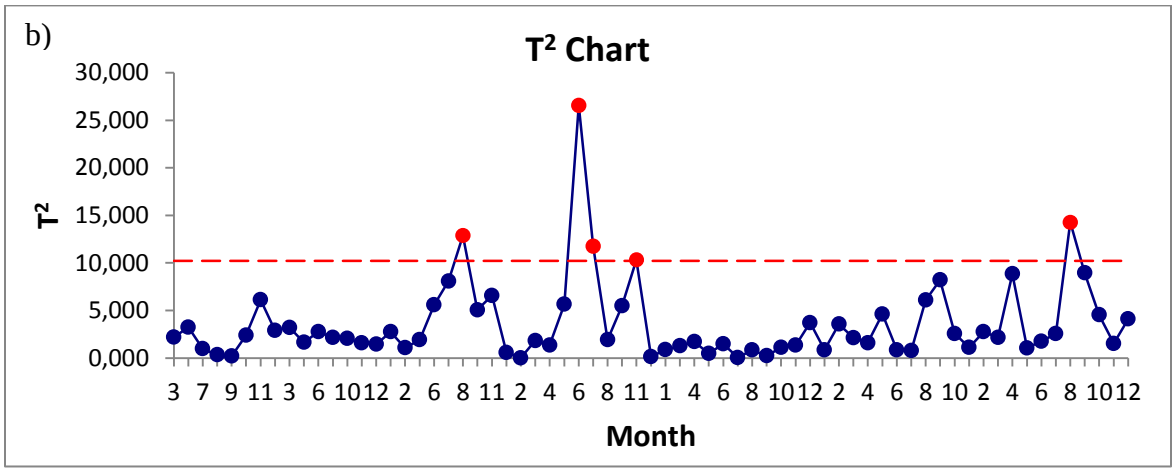
$$UCL = \frac{p(n-1)}{n-p} F_{\alpha(p,n-p)}$$

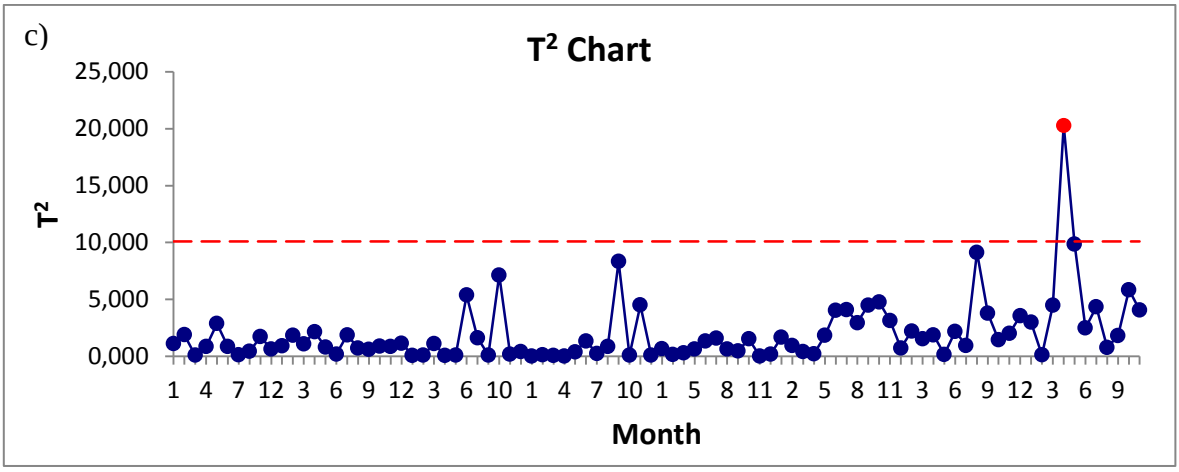
$$LCL = 0 \quad (3)$$

$F_{\alpha(p,n-p)}$ refers to the F-distribution with (p) and (n – p) degrees of freedom and a probability of Type 1 error of α (concluding the process is out of control when it is really in control). In the scientific literature there are propositions of using control charts in natural resource monitoring [13, 14]. The biggest obstacle in utilization of this technique in environmental monitoring processes is that monitored variables need to exhibit multivariate normal distribution. In industrial applications, for which control charts are initially developed, this requirement is not difficult to meet due to the fact the central tendency of the process is predetermined, usually according to the nominal value of the specification, and there is a small amount of excepted variation from this value. Parameters of the environmental stochastic systems are rarely normally distributed and because traditional multivariate statistical procedures are not robust to violations of this assumption these very useful SPC techniques are usually overlooked. Morrison [13] proposed the use of somewhat different terminology regarding the application of control charts in natural resource monitoring than the one which is traditionally used in industry. The term “indicator” is used in place of quality characteristic, to represent the observed natural parameter. The term “control limit” is used more broadly, and represents any threshold at which management should be alarmed and should consider action, regardless of the statistical basis used to obtain this threshold.

In order to study the water quality in the South Morava River we analyzed two indicators which had been collected from the 5 measuring stations located along the main flow of river (Figure 1). The samples had been taken during the period from 2005-2012 on the monthly bases. Selection of appropriate indicators among 21 monitored parameters was carefully conducted, in order to satisfy the requirement of multivariate normal distribution. For this purpose PO_4 and BOD_5 were chosen, where Orthophosphates represent mainly anthropogenic source of pollution, while Biochemical Oxygen Demand is an indicator of the overall quality of water. The Hotelling T^2 control charts indicating the quality of water for all five measuring stations are shown in the Figure 4.







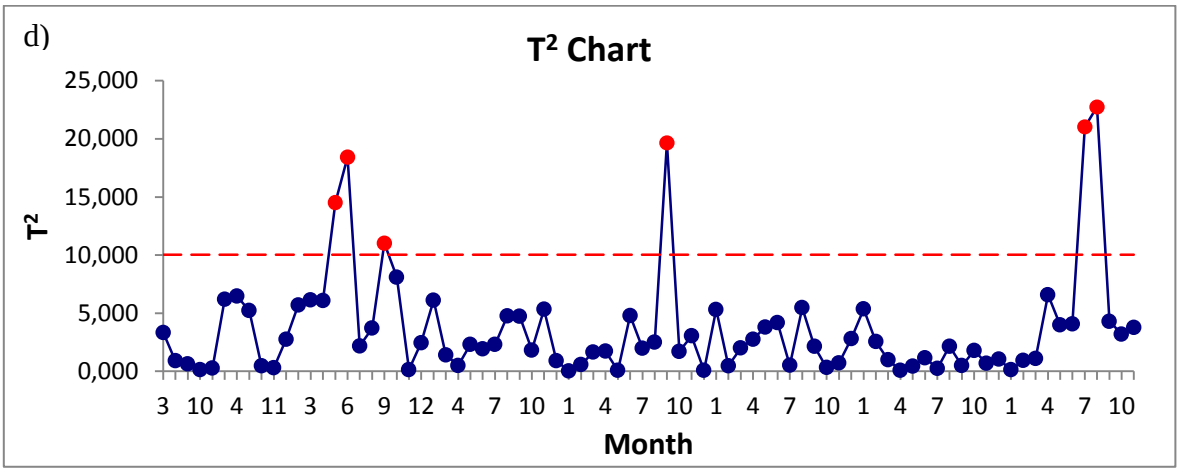


Figure 4 continued

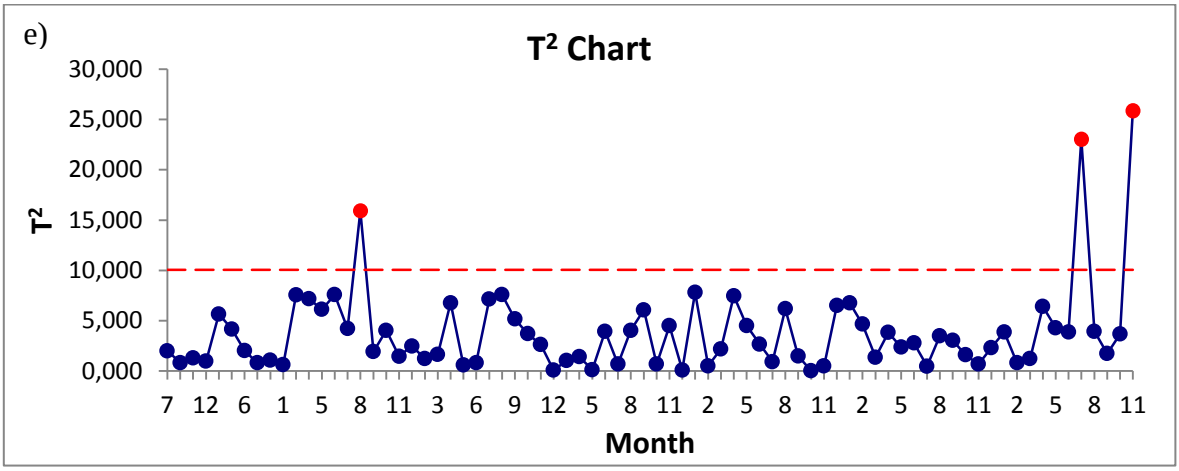


Figure 4. Hotelling T^2 control charts for the following measuring stations: a) Ristovac; b) Vladičin Han; c) Grdelica; d) Aleksinac; e) Mojsinje

The calculated T^2 values for each measuring station are plotted against the y-axis, while the corresponding month of the monitored time period from 2005-2012 was shown on the y-axis. The confidence level was chosen to be $\alpha = 0.01$. Due to the fact that some of the data for particular months were not available, those cases were omitted from the chart. This is especially evident in the first months of the monitoring, although measurements after this period were rather consistently available until the end of the observed period.

Based on the constructed multivariate control charts it can be concluded that the observed environmental monitoring process can be considered to be out of control in all observed measuring stations. Location Ristovac exhibits the largest variation, while location Grdelica emerged as having the most consistent water quality, according to the observed indicators of PO_4 and BOD_5. In large number of cases shifts can be observed during the months in which temperatures of water reach the highest annual levels, which is expected due to evaporation of water and subsequent rise in concentration of pollutants. These foundlings are consistent with the results of other analysis presented in this paper, as well as in other published research papers [19].

The main objective of a multivariate control chart is to detect the presence of special causes of variation. On the other hand, the complexity of multivariate control charts and cross-correlation among variables makes it difficult to analyse assignable causes leading to the out-of-control signals, especially in the context of environmental systems. These charts can be used not only in achieving a state of statistical control (Phase I) but also in maintaining control over the process (Phase II). For a retrospective Phase I analysis of a historical data set (HDS), which was covered in this particular phase of our research, the objective is twofold [20]: (1) to identify shifts in the mean vector which might distort the estimation of the in-control mean vector and variance-covariance matrix, and (2) to identify and eliminate multivariate outliers. The goal is to find an in-control subset of the HDS with which we may estimate in-control parameters for use in a Phase II analysis, which will be the next phase of our research. If the process is found to be out-of-control it is essential to be able to track the assignable source of an out of-control signal in order to maintain acceptable levels of quality and prevent further degradation of the water quality.

4. CONCLUSION

In this paper a SPC technique of control charts was used to assess the quality of water in the South Morava River over a period of eight years. Although univariate Shewhart control charts are the most commonly used in the industrial processes, their application in the environmental monitoring is limited due to the complexity of the stochastic environmental systems and the fact that it is usually necessary to simultaneously observe multiple parameters. Therefore, multivariate Hotelling T^2 control charts were used to monitor the mean vector of quality characteristics of a process via two indicators PO_4 and BOD_5. The non-random shifts in the variability were detected, thus accomplishing the main goal of the monitoring, which is to provide a “signal” or “alarm bell” to the presence of an impact [14], if, where, and when it does occur, because more often than not, unless the potential impact is

planned or conspicuous (for instance the opening of a sewage outfall or an oil spill) it is usually not known where or when an impact may have occurred or may still be occurring.

For the next phase of the research the application of other more sensitive multivariate charts such as Multivariate Cumulative Sum (MCUSUM) and Multivariate Exponentially Weighted Moving Average (MEWMA) control charts will be investigated and comparative analysis will be conducted in order to define the most efficient set of SPC tools which can be of great help in the process of environmental monitoring of water quality.

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ASPECTS OF URBAN AND ECOLOGICAL DEVELOPMENT AS A TOOL OF SUPPORTING ACTIVITY OF PERSONS WITH DISABILITIES IN CZESTOCHOWA

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Abstract

Paper presents a definition of persons with disabilities according to Polish legislation and the selected international definitions WHO ICIDH, ICIDH-2, IFC as well as statistics from the World Report on Disability and the World Health Survey and the documents of the Central Statistical Office in Poland. Article specifies the concept of exclusion (as well as social exclusion) and its influence on the formation of barriers to persons with disabilities. Article presents definitions of barriers and types of barriers, particularly functional, personality, development, and financial regulatory, and determines their problems in terms of the urban construction in the context of the ecological awareness. Ensuring accessibility of buildings for persons with disabilities requires the elimination of obstacles already at the stage of planning of a building plot, as well as individual elements buildings. There are presented results of the survey "Blue questionnaire" carried out in 2010 by Czestochowa City in cooperation with the Municipal Social Welfare Centre. The objective of the study is to define existing barriers that restrict the functioning of persons with disabilities, barriers encountered in everyday life and the assessment of the availability of services: transport, medical care, utilities and others. It pointed out the need for identification and elimination of barriers to urban as well as architectural and transport in urban areas in the ecological development context.

Keywords: *barriers, persons with disability, urban construction, ecological awareness*

1. INTRODUCTION

1. 1. DISABILITY IN THE POLISH LEGAL SYSTEM

According to Act on vocational and social rehabilitation and employment of persons with disabilities (Journal of Laws 2011 No. 127, item. 721, as amended), the definition of a persons with disabilities states , that the disabled persons are persons whose physical, psychological or mental permanently or temporarily hinders, restricts or prevents the fulfilment of social roles, and in particular restricts the ability to do work [1].

Resolution of the Polish Parliament on 1 August 1997 - The Charter of Rights of Persons with Disabilities defines "that persons with disabilities, are persons in their physical, psychological or mental permanently or temporarily hinders, restricts or prevents daily life, education, work and performing social roles in compliance with legal and customary, persons with disabilities have the right to an independent, autonomous and active life, and not be subject to discrimination [2]. The Act regulates the attitude in terms of access to goods and services, enabling full participation in social life, access to treatment and medical care, access to rehabilitation, education in schools, together with their non-disabled peers, special education or individual education, psychological, pedagogical and other specialist support for development, gaining or raising the general and vocational qualifications, employment in the open labour market and in conditions tailored to the needs of the disabled, social security live in an environment devoid of functional barriers, in particular, access to offices, polling stations and public facilities, freedom of movement and the general use of public transport, access to information, the possibility of interpersonal communication, have a self-governing representation of their environment and full participation in public life, social, cultural, artistic, sports and recreation and tourism, according to their interests and needs [2].

1. 2. SELECTED INTERNATIONAL DEFINITIONS ON THE DISABILITY AND ECOLOGICAL STANDARDS

In 1980, The World Health Organization launched the International Classification of Impairments, Disabilities and Handicaps (ICIDH). This classification is a tool useful for statistical research, clinical, social and educational purposes. International Classification of Impairments, Disabilities and Handicaps emphasizes the medical aspect of disability and the need for adaptation of persons with disabilities to the situation. The disadvantage of the definition is the lack of the need to adapt the environment to social and physical needs of persons affected by disability. Reaching for the definition of the World Health Organization (WHO) adopted in 1980. There are three dimensions of the phenomenon of disability: impairment, disability, handicap [3]. In 1993, the WHO agreed to begin a revision process of the ICIDH in 1980, across all three dimensions - Impairment, Disability and Handicap. The revised classification defines components of health and some health-related components of well-being (such as education and labour). The ICIDH-2 domains can, therefore, be seen as health domains and health-related domains. These domains are described from body, individual and societal perspectives by two basic lists: (1) Body Functions and Structures; (2) Activities and Participation [4].

The World Programme of Action for Disabled Persons and The Standard Rules on the Equalization of Opportunities for Persons with Disabilities emphasize that disability is a social problem and not limited to a specific person. Speaking about the disability we should be keep in mind the relationship between human health (taking into account age, gender and education), and the society and the environment that surrounds it [5] [6]. The social context of disability was discussed in the International Classification of Functioning, Disability and Health (International Classification of Functioning, Disability and Health - ICF), adopted at the World Assembly for Health (World Health Assembly) in 2001. This document emphasizes

that disability concerns the whole mankind, cannot be burdened with problems of disability social minorities - each person may experience a worsening of health status and become a person with a disability.

1. 3. PERSONS WITH DISABILITIES IN THE WORLD

According to the World Report on Disability there are more than one billion persons with disabilities in the world, of which 110-190 million facing serious difficulties in functioning. According to WHO estimates from the seventies of the twentieth century, 10% of people in the world were persons with disabilities. Thanks to the analysis made by the World Health Survey, the Global Burden of Disease Study, and the national institutions, we know that the true number is closer to 15% and the number is constantly growing. This change is caused in part by an increase in life expectancy and a higher incidence of chronic diseases such as diabetes and heart disease. The effect of increasing the number of persons with disabilities have other environmental or random factors or, e.g. road accidents or natural disasters.

The document outlines the problem of inequality. The disability frequently affects the poor, the women and the elderly. The report lists a number of common environmental barriers. The report lists a number of common environmental barriers, for example: stigma and discrimination; lack of access to adequate health care and rehabilitation services; inadequate level of service (incompetent handling equipment, refusing to help, ill-treatment); lack of access to transport, buildings and information and communication technologies; lack of opportunities to participate in decisions having a direct impact on their lives [7].

1. 4. PERSONS WITH DISABILITIES IN POLAND

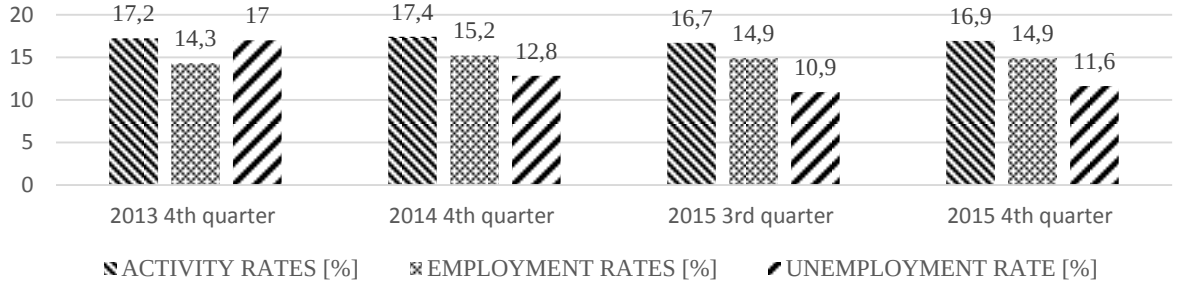
The *European Health Interview Survey* (EHIS) collects data on collects data on biologically persons with disabilities in the European Union, based on a unified definition of biological disability. [8] Representative surveys the state of health of the Polish population as carried out twice - in 1996. and 2004 by Central Statistical Office. They were prepared using the recommendations of international organizations dealing with health statistics. The *European Health Interview Survey* (EHIS) was completed in 2009 for the first time in Poland. The results are available in a publication called Central Statistical Office. "The state of health of the Polish population in 2009" [9]. The study was also conducted in 2014. - Detailed results of the study will be published in a report entitled "The state of health of the Polish population in 2014" that Central Statistical Office plans to publish in 2016. The data on persons with disabilities (both legally and biologically). Data on persons with disabilities legally and biologically are collected as part of national population and housing censuses (in Poland, every 10 years) and sample surveys (questionnaire): health condition of the population questionnaire (in Poland, every 5 years since 2004) and The European Statistics on Income and Living Conditions (EU SILC – every year since 2005) [10]. In Poland, as part of the National Census of May 2002 data was collected on the number of persons with disabilities (legally and biologically). The study was general, because it was carried out for the entire

Polish population and was obligatory [11]. In 2013, the data from National Census of Population and Housing 2011 was publised. According to the results of the National Census of Population and Housing from 2011, the number of persons with disabilities in general was at the end of March 2011. approximately 4.7 million (exactly 4 697 thousand.). Thus, the number of persons with disabilities in Poland accounted for 12.2% of the population compared with 14.3% in 2002. (Nearly 5.5 million persons with disabilities in 2002). The share of men among of persons with disabilities was 46.1% compared to 53.9% for women. In 2011 more than 3.1 million people (exactly 3 133.5 thousand) had The legal confirmation of the disability. The legal confirmation of the disability had in 2011 more than 3.1 million people (exactly 3 133.5 thousand.). The size of the community of persons with disabilities legally and biologically (simultaneously) amounted to 2 652.0 thousand. Only legally - 479.5 thousands, only biologically - 1 565,6 thousands, biologically - 4 217.6 thousand. Compared with the results of the National Census of 2002, the total number of persons with disabilities decreased by 759.7 thousands, e.g. 13.9%, while the number of persons with disabilities legally decreased by 1 316.6 thousand, e.g. 29 6%. The number of persons with disabilities only biologically increased by 559.0 thousands, e.g. 55.5%. The most common cause of disability constitute the cardiovascular, locomotor system and neurological disorders. The relatively lower percentage of persons with impaired eyesight and hearing, mental illness and mental retardation in the community of persons with disabilities, however, concerns thousands of people with reduced efficiency in everyday functioning, and therefore require a specific approach in education, the labour market and in everyday life [9] [11] [12].

According to the survey of the European Health Study at the end of 2009. Legal disability certificate or equivalent had nearly 4.2 million Poles, including nearly 184 thousand. children under 16 years of current disability certificate, e.g. about 600 thousand. more people compared to estimates from the LFS for the same period [10].

Data on persons with disabilities legally in Poland are available on the a regular basis, with quarterly frequency, based on the results of the Labour Force Survey (LFS) [13]. The most recent data on persons with disabilities is the data for the fourth quarter in 2015 years [14] shown in Figure 1.

Figure 1. Number of persons with disabilities in the fourth quarter in 2015 [14]



- **Activity rates** – according to the CSO LFS 16.9% of persons with disabilities was economically active, 18.8% were male and 15% female. The activity rate was 0.5% lower compared to the 4th quarter 2014 and 0.2% higher compared to the 3rd quarter 2015.
- **Employment rates** – according to the CSO LFS 14.3% of persons with disabilities was employed, 16.3% were male and 12.2% female. The employment rate was 0.3% lower compared to the 4th quarter 2014 and the same compared to the 3rd quarter 2015.
- **Unemployment rate** – according to the CSO LFS 17% of persons with disabilities was unemployed, 16.5% were male and 17.4% female. The unemployment rate was 1.2% lower compared to the 4th quarter 2014 and 0.7% compared to the 3rd quarter 2015.

1. 5. PERSONS WITH DISABILITIES IN CZĘSTOCHOWA

According to the National Census of 2002 a total of 31,764 people (13%) were persons with disabilities among the total population of Czestochowa. According to the National Census of Population and Housing 2011 the number of persons with disabilities in the city of Czestochowa was 35,603 people, of which 15 263 were men and 20,340 were women. In comparison with the results of the National Census of 2002, the overall number of persons with disabilities has increased by 3.839 of a total number of 234,472 inhabitants of Czestochowa. Currently 15,18% of Czestochowa inhabitants include persons with disabilities [15].

2. THE BARRIERS OF PERSONS WITH DISABILITIES

One of the major problems that persons with disabilities have to face of everyday basis is the lack of social and professional integration. The evolution of social attitudes allowed perceive the needs and limitations of persons with disabilities in modern society. Participation in social and professional life allows a person with a disability partial or full integration and thus the development and self-fulfilment. Social exclusion pushes the person with a disability on the margin, so it is necessary to take preventive measures and proactive approach to the problem of exclusion. Process of exclusion is dynamic and multidimensional. It manifests a lack of or insufficient level of participation in social life, weakens social and family ties [16]. It can be presumed that social exclusion is the basis of all barriers to persons with disabilities.

2. 1. THE DEFINITION OF BARRIER

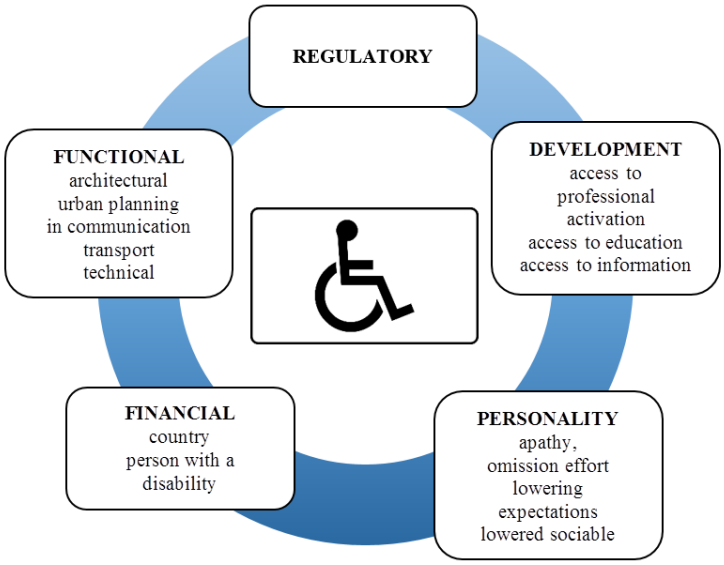
According to the Merriam-Webster dictionary a barrier is „something (such as a fence or natural obstacle) that prevents or blocks movement from one place to another; a law, rule, problem, etc., that makes something difficult or impossible; something that makes it difficult for people to understand each other" [17], and according to Cambridge Dictionaries Online a barriers is „anything used or acting to block someone from going somewhere or from doing something, or to block something from happening" [18]. The use of the definition of the barriers to the problems of faced by persons with disabilities will address the obstacles hindering or preventing the movement in the environment and difficulties in the development

of the phenomenon or situation. There is a direct correlation between the difficulties in movement (moving both individual as well as by means of transport vehicles) and the activity of persons with disabilities. Both social and professional activities are largely dependable on the ability to move and the ability to overcome the barriers.

2. 2. TYPES OF BARRIERS OF PERSONS WITH DISABILITIES

In everyday life persons with disabilities face barriers (Figure 2), that hinder or prevent them from performing social and professional roles, meeting the needs and development. Barriers may exist on a global scale, national, local and individual level of persons with disabilities. Barriers may exist on a global scale, domestic, local and individual level of persons with disabilities (Figure 2).

Figure 2. Types of barriers [19]



Functional barriers arise from a lack of availability or hindered possibility of using human living space. functional barriers are: architectural barriers (restrict physical access to buildings and their environment, e.g. staircases, elevators, curbs, doors and door handles); **urban barriers** (to prevent or limit its movement in urban areas, e.g. the unevenness sidewalk, proper labelling and colour-billable paving, landscaping elements and the edges of buildings); **barriers to communicate** (difficulty or inability to communicate with the environment); **transport barriers** (restrictions on the use of public transport, that makes the participation in social life, occupational life, etc. difficult and sometimes even impossible). **technical barriers** (difficulty or inability to improve the quality of life, mainly from a lack of proper technical equipment adapted to the needs and limitations of persons with disabilities). **Barriers of personality** are derived from the individual characteristics of persons with disabilities. Although persons with disabilities may be affected by the same stigmata of disability, but due to innate personal characteristics, each of them is an independent

individual. The negative effects of the barriers of personality among other things are **apathy**, **omission effort**, **lowered expectations**, and **reduced ability to establish interpersonal contacts**. Overcoming the barriers of this nature involves building awareness that disability does not necessarily mean the degradation of person with disability to worse sorts of man. It is necessary to improve the self-esteem of that person. **Barriers in the development** have impact on predispositions, qualifications and skills of persons with disabilities. Barriers consequence of the development restrictions in access to professional activation, access to education, access to information and psychosocial development. **Barriers in regulatory system** are related to the existing legislation. Regulatory barriers condescending attitude towards the persons with disabilities can limit their development. It is necessary to formulate regulations treating persons with disabilities on an equal footing with non-disabled persons, and vice-versa. The rules are intended to prevent discrimination against persons with disabilities. **Financial barriers** are limitation in the public finances and the finances of persons with disabilities. Financial resources are used to meet the needs of persons with disabilities, and their absence contributes to the further development and deepening of barriers. Financial resources are spent on financing the process overcoming barriers [19].

4. BARRIERS OF PERSONS WITH DISABILITIES IN POLISH LEGISLATION

Persons with disabilities come into contact with public buildings in two situations: being its customers or employees. Due to a growing awareness of the size of the population of persons with disabilities in Polish society Persons with disabilities come into contact with public buildings in two situations: being its customers or employees. Due to a growing awareness of the size of the population of persons with disabilities in society Polish (approx. 15% of Polish citizens) it is well known that public buildings must be designed, built and maintained to ensure the necessary conditions for use by persons with reduced mobility. However, despite a number of actions taken, aimed to respect the principle of non-discrimination of persons with disabilities in public life, as well as the guarantee implementation of the right related to their full participation in social and professional life, including the right to a life free from functional barriers, in the general opinion many offices and of public buildings are still not adapted to the needs of persons with disabilities [20]. "Equality of all citizens before the law is guaranteed in both the Polish Constitution and the Charter of the Rights of Persons with Disabilities. Both legal acts that no one, by any cause and therefore also because of physical or mental disability or old age can't be discriminated against" [21]. Ensuring accessibility of buildings for persons with disabilities requires overcoming the barriers already at the stage of development of a building plot, as well as individual elements of buildings.

Persons with mobility disabilities encounter the difficulties associated with physical access to facilities. Overcoming the barriers requires providing hardened sidewalk (Car access) to the building, wide gates and doors, lowering curbs and removal of stairs. The entrance to the buildings requires a wide doors and non-slip surface, removal of the thresholds and installation of adapted elevators, lifts, ramps, platform starlit and the handrail. Similar solutions should be used inside buildings. **Persons with dysfunction of eyesight** (from weakened vision, debris eye, complete blindness) the role of the sense of sight take the sense

of touch and the sense of hearing. The best help is a personal support of employees especially in moving in the building environment and at the entrance to its area. is recommended the lack of staircase, it is recommended to install the signalling paging systems and varied structured surface at the entrance to the building. In addition, staircases should be marked with contrasting colours and modified texture staircase also with installed handrails at the stairs. Information boards of contrasting colours and large print should be place inside the building in the reception area. Corridors inside the building should be well lit. The use of Braille is becoming more common, same as acoustic signalling and a speech synthesizer. **Persons with hearing impairment**, who are deaf, hard of hearing or persons that are mute compensate their impairment with the sense of sight and the sense of touch. communicating with the officer or other employee of a public building can be difficult for them. A common problem turns out to be finding the right way or Obtaining any information. It is important to ensure that all types of written messages were clear, legible, simple and obvious. The assistance provided by placing easily readable information boards in public buildings is far more widespread than communication using sign language. **Persons with intellectual disabilities** must be supported by an alternative form of communication, e.g. through the pictograms or graphic signs. Pictograms are the most primitive form of picture writing, which shows the characters of fixed content, thing, event, or signals. The main advantage of using them is the possibility of replacing the information, warnings, and teachings through logos, by memorizing and later restore the messages on the basis of association with this sign. Persons with mental disabilities should rely primarily on additional, personal support worker, both at the entrance to the building, as well as the movement in the building environment.

Detailed information regarding the availability of public buildings for persons with disabilities can be found in the Ordinance of the Minister of Infrastructure of 12 April 2002. concerning the technical conditions to be met by buildings and their location (Dz. U. of 2002., No. 75, item. 690, as amended). The Regulation applies to the following elements: Reaching and access roads (§16), Parking spaces for cars (§18, §20, §21), Green and recreational facilities (§40), Fencing (§42, §43), Buildings and facilities (§54, §55, §56), Buildings Entrances (§61), Stairs and ramps (§62, §70, §71), Rooms to accommodate people (§74, §75), Hygienic-sanitary facilities (§81, §86, §87), apartments in multifamily buildings (§95) Pitches for cars (§104, §105, §107), Buildings technical equipment (§129), Ventilation and air conditioning systems (§155), Electrical installation (§191), Lifting equipment (for the blind) (§193, §194), Safety (§293, §297, §298, §302).
Construction for the people with disabilities should meet different kinds of standards that ensure the appropriate environment for the human leaving. One of the standard that include problems of disabilities and ecological problems is DGNB standard confirmed by DGNB certificate. German Sustainable Building Certificate was developed by the German Association for Sustainable Building (DGNB) together with the Federal Ministry of Transport, Building and Urban Development (BMVBS), to be used as a tool for planning and evaluation of buildings. In accordance to DGNB standard, buildings must have facilities for the disabled in all public spaces. It should be noted, that this is the only system that emphasis the disabled facilities. None of the other systems doesn't clearly define issues of this type of accessibility. This is due, among other things from a different than in other distribution

systems rated categories. In this case, these are specific aspects of different fields. DGNB certification distinguishes the following aspects: ecological aspect, economic aspect, socio – cultural, technological aspect, the quality aspect of the process, aspect location .

5. CITY ACCESSIBLE TO PERSONS WITH DISABILITIES

Overcoming the barriers of persons with disabilities requires taking action by local authorities broad action plan of urbanization, architectural and adapt ensure the transportation options. In 2010. Czestochowa City Hall in cooperation with the Municipal Centre for Social Welfare conducted a survey aimed at defining the existing barriers to persons with disabilities to function in everyday life as well as an assessment of the availability of services: transport, medical care, of public buildings and others. The study involved 316 people, persons with disabilities and their caregivers participated in the research. A survey paper (51.6%) and mail (48.4%) were used as a research tool. "Blue survey" helped to identify barriers hindering the functioning of persons with disabilities. Everyday life barriers were identified especially in the field of access to communication and access to public buildings in Czestochowa (results in Table 1 and Table 2).

Table 1. Barriers in communication in Czestochowa [22]

Barriers in communication	bad		rather bad		average		rather good		good		no answer	
	n	%	n	%	n	%	n	%	n	%	n	%
access and seating at the bus sto	89	28,2	75	23,7	100	31,6	26	8,2	10	3,2	16	5,1
condition of the sidewalk	175	55,4	81	25,6	41	13	5	1,6	2	0,6	12	5,1
curbs	173	54,8	72	22,8	36	11,4	12	3,8	2	0,6	21	3,8
condition of th street	177	56	78	24,7	40	12,7	9	2,8	2	0,6	10	6,6
lighting	45	14,2	41	13	137	43,5	64	20,2	9	2,8	20	3,2
acoustic signaling	41	13	46	14,6	112	35,4	65	20,6	32	10,1	20	6,3
adapted transport	62	19,6	80	25,3	99	31,3	28	8,9	10	3,2	37	11,7

The survey revealed that the biggest barrier in communication is the condition of streets, sidewalks and curbs. Lighting, acoustic signalling and access and seating at the bus stop respondents assessed as the an average burdensome to functioning in everyday life. The results presented in the table above indicate that the communication capabilities of persons with disabilities are evaluated as bad.

Table 2. Access to public buildings in Czestochowa [22]

Access to public buildings	bad		rather bad		average		rather good		good		no answer	
	n	%	n	%	n	%	n	%	n	%	n	%
authorities	41	13	46	14,6	148	46,7	46	14,6	22	7	13	4,1
post offices	55	17,4	80	25,3	114	36	41	13	16	5,1	10	3,2
banks	41	13	60	19	109	34,5	68	21,5	25	7,9	13	4,1
cinemas	57	18	61	19,3	89	28,2	61	19,3	24	7,6	24	7,6
medical clinics, hospital, pharmacies	39	12,3	52	16,5	115	36,4	64	20,2	34	10,8	12	3,8
churches,cementarier	59	18,7	73	23,1	86	27,2	54	17,1	24	7,6	20	6,3
retailers	23	7,3	63	19,9	105	33,2	76	24,1	31	9,8	18	5,7
services: barber, tailor,catering etc.	55	17,4	70	22,1	117	37,1	32	10,1	16	5,1	26	8,2
services: access to the residential station	132	41,8	79	25	62	19,6	18	5,7	8	2,5	17	5,4
train station (PKP)	51	16,1	59	18,7	105	33,2	54	17,1	35	11,1	12	3,8
bus station (PKS)	51	16,1	64	20,3	106	33,5	51	16,1	28	8,9	16	5,1

The study shows that respondents evaluated accessibility of public buildings as an average. Only access to dwellings (66.8%) was negatively rated. Retailers, banks, medical clinics, hospitals and pharmacies received quite good rates [22].

6. CONCLUSION

Supporting the activity of persons with disabilities is inextricably linked to the development of construction adapted to the needs and limitations of persons with disabilities.
The problem relates mainly to overcoming urban, architectural and transportation barriers. Creating urban structures without barriers is a challenge for both new and existing parts of the city. Freedom of movement in the urban space applies to persons with disabilities and non-disabled.
It is an essential tool fight against exclusion. It is one of the major determinants of the development of the city. Overcoming barriers allows participation in the enjoyment of broad culture and education, allows personal and professional development.

Identification of barriers preventing persons with disabilities from function in everyday life on the example of "Blue survey" conducted in Czestochowa in 2010 have shown that there are many offices and institutions that are not or only partially adapted to the needs of persons with disabilities.
The most frequent inconveniences are the lack of accessible toilets, too narrow doors, the lack of handles in toilets and corridors, lack of ramps and elevators to facilitate transport to the upper floors of buildings. Adaptation of public facilities to meet the needs and limitations of persons with disabilities, as well as the condition of Czestochowa streets and sidewalks leaves much to be desired.

The plausible solution to the problem of accessibility of public building is the modern concept of Disability, Accessibility and Sustainable Urban Development. The United Nations' Third Global Conference on Housing and Sustainable Development (Habitat III) will take place in 2016. A "New Urban Agenda" will be considered by the international community at the Conference. The New Urban Agenda needs to ensure that future cities, towns and basic urban

infrastructures and services are more environmentally accessible, user-friendly and inclusive of all people's needs, including those with disabilities. Urban environments, infrastructures, facilities and services can impede or enable, perpetuating exclusion or fostering participation and inclusion of all members of society. Persons with disabilities face widespread lack of accessibility to build environments, from roads and housing, to public buildings and spaces. Lack of accessibility contributes greatly to the disadvantaged and vulnerable situations faced by persons with disabilities. As the world is now designing a psot-015 development agenda,, the global community is presented with an opportunity to promote systematically accessibility and inclusion of persons with disabilities [23].

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DESIGN ASSUMPTIONS DEVELOPMENT FOR THE ENVIRONMENTAL MANAGEMENT SYSTEM IMPLEMENTATION

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Abstract

The reform of the organization's management system requires not only the anticipation on the employees, but above all, their deep involvement in the creation of a new system for managing the organization and to determine their place in the new reality. Chapter presents the design assumptions that were used to implement an environmental management system in selected company.

Keywords: *system, process, environmental management system, design assumptions*

1. INTRODUCTION

One of the subsystems of the integrated management system is an environmental management system. In companies that declare and want to demonstrate that the approach to environmental protection seriously and that they are ready to reduce their impact on the environment implementing an environmental management system is obvious action.
Standard PN-EN ISO 14001:2004 does not establish absolute requirements for environmental performance. However, it requires that the organization primarily fulfil the applicable legal requirements, and it has also made voluntary commitments to prevention of pollution and other harmful effects on the environment.

The revised standards encourage to a process approach during its elaboration, implementing and improving the effectiveness of the quality management system in order to enhance customer and stakeholders satisfaction by fulfilling their requirements. For the effective and efficient operation the organization should identify all interrelated activities (processes) and manage them. In practice, the output from one process to the process of the next input.
The use of a system of processes within the organization implementing the system with its inter-linkages between processes and management can be defined as the "process approach". The advantage of this approach is to ensure regular supervision of the linkages between various processes in the process chain, as well as of their interactions. If the quality

management system will be applied to the process approach it is therefore stresses the importance of the following issues [2]:

- understanding and compliance,
- need to examine the processes (activities) in terms of added value - increasing degree of achievement of complete external and internal customer satisfaction,
- receiving results relating to the functioning and effectiveness of processes,
- continuous improvement of processes based on monitoring (measurement) and objective analysis.

Each process should be described in order to allow people using the different activities identified in the process of filling. The description may be in any form of verbal, through a graphic to tabular. The most comprehensive form of description of the process seems to be a form of tabular endearing all the elements necessary to properly define the process, and in particular [5]:

- input,
- output;
- owner (leader) of the process,
- goal of the process,
- steps (steps / stages) assigning responsibilities and the necessary documentation,
- measures of the process with the success indicator - to monitor the process and evaluate the effectiveness.

There is an important role of the customer in determining input requirements of the process. Monitoring customer satisfaction requires the evaluation of information relating to the perception of customers as to whether the organization has met their requirements. Models presented in the standards, however, do not reflect the process in detail. It is on the side of each organization is calling its processes, grouping them in the appropriate categories, e.g. management processes, basic and support management processes, so as to form the structure of these processes. The very first step in the implementation of the quality system in the organization using the process is to identify the processes, preferably divided into two groups: basic processes, the auxiliary processes (sub-processes).

According to terms contained in ISO 9001:2000 process is a logical sequence of activities whose purpose is to provide both the external and internal customers a specific product in accordance with their requirements. This definition is focused on a very important aspect that the customer is not only the customer who is external for the organization, but it is also a recipient of the service within the organization. Going further, there should be realized fact that every member of the organization is both a customer and a supplier, who creates a string connecting the supplier with the end client. As a result, there is created a logical sequence of supplier-customer also known as the chain of customers and suppliers [7].

The presentation of the processes and their links with the drawings and diagrams are treated by majority of companies as a duty and a standard requirement. However, the compounds and the relationship between the processes can be presented not necessarily using complex drawings, especially in the book of quality. When creating the appropriate descriptions of the processes covered by the system in the quality manual should indicate what kind of

information (documents), or other factors are the entry process, indicating the where (for what processes) come. Likewise, it should be described output process, e.g. by identifying the records of the process and an indication of other processes in which the information will be used. This approach is fully consistent with the requirements of the standard, while transparent to the use of this type of description [3].

The aim of this study is to present a process for the project assumptions elaboration for the implementation of an environmental management system for a selected company and directions of its improvement.

2. THE INTEGRATED MANAGEMENT SYSTEM

The integrated management system is a management system to lead and supervise the organization, in which special emphasis was placed on at least two of these areas: a quality, an environment and a safety. There is PDCA principle that can be applied to all systems that create integrated management system called also Deming cycle (Fig. 1):

- plan (P - Plan),
- do (D - To),
- check (C - check),
- improve (A - Act).

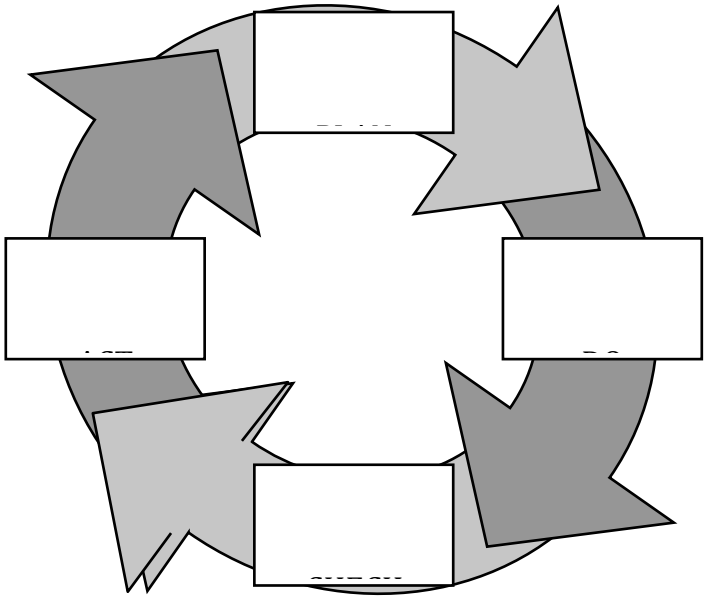

Figure 1. Deming cycle [6].

It is also the primary mechanism that is basic for the structure of standards: ISO 9001, ISO 14001, PN-N 18001. This mechanism has been elaborated to ensure the management systems continuous improvement.

1. PLAN – establish objectives and processes necessary for their implementation and ensure adequate resources. It is a work of company managers.
2. EXECUTE - execute processes. It is operation of all process participants.
3. CHECK - monitor and measure processes in relation to the policies and objectives, and the products in relation to the requirements present results. It is work of auditors.
4. IMPROVE - continuously take actions to improve the processes functioning. It is work of company managers.

The integrated management system includes three, cooperating and complementary systems, based on the requirements of the following standards [4]:

- PN-EN ISO 9001 – the quality management system. The quality management means creating a system of projects seeking to produce goods and services that meet customer expectations, while profitable.
- PN-EN ISO 14001 – the environment management system. The environmental management means creating a system of projects that seek to minimize the environmental impact resulting from its activities by the organization.
- PN-N 18001 – safety and occupational health management system. Management of occupational health and safety means creating system of projects to improve the safety.

The family of ISO standards contains also PN-EN ISO 19011 including guidelines for auditing management systems. The family is best illustrated by Fig. 2.

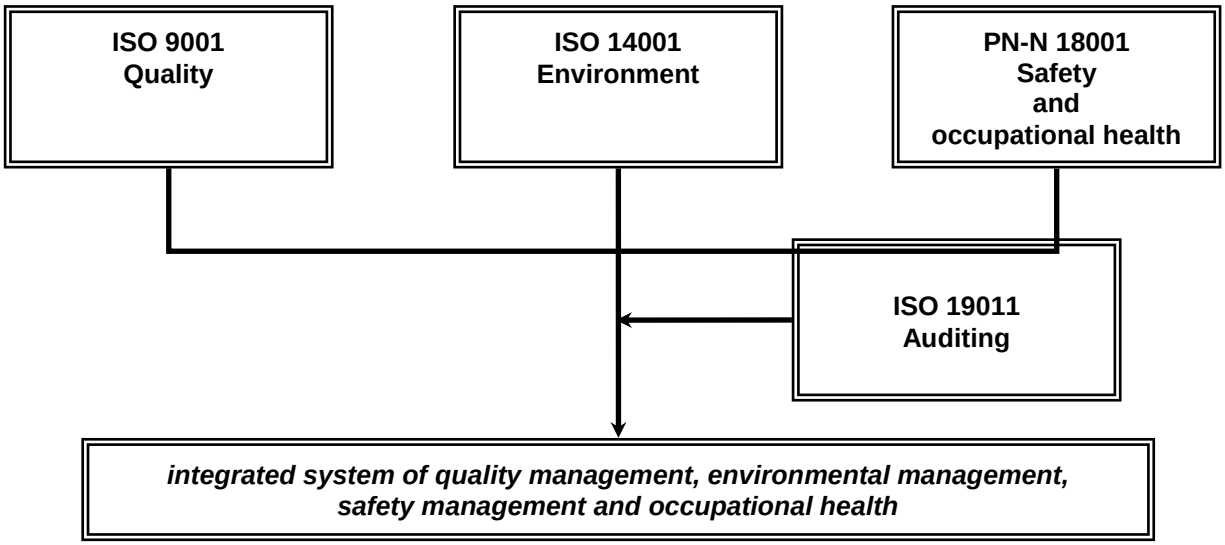

Figure 2. Family of ISO standards [8].

Requirements of standards in the system of integrated management can be grouped as common elements, whose implementation comes to elaboration and implementation of the same patterns of actions and items that require separate treatment, i.e. characteristic for each standard.

3. THE ENVIRONMENTAL PROTECTION IN THE ASPECT OF QUALITY MANAGEMENT

The primary objective of ISO 14001 standard is to support activities related to environmental protection and the pollution reduction and prevention and creating that creates a model of the system oscillating in the direction of continuous improvement. The ISO 14001 standard adopts the management system principles shared with the quality systems according to ISO 9001. Another objective of environmental management is to improve the relationship between the effects of human activity and the environment. The behaviour of the balance requires uniform management of access to environmental resources, eliminate the negative effects of economic activity and rational use of natural resources. Environmental management strategy is based on the most important elements as [1]:

- prevention of waste,
- waste reduction at source,
- reduce pollution,
- waste management.

Environmental management is a response to the state ecological policy in order to effectively and efficiently solve environmental problems at local, regional and national levels. An important element of environmental policy and the socio-economic state is the realization of the sustainable development principles. The sustainable development strategy is a socio-economic policy implemented while maintaining a balance between economic development and environmental resources. In practice, it means adjusting the economic development of the "strength of the environment", in order to preserve environmental resources for present and future generations.

Targeting the principle of sustainable development means:

- maintenance of possibilities of the environmental resources reproducing,
- rational management of non-renewable resources and replace them with substitutes,
- minimize inconvenience to the environment and not to exceed the limits set its "strength",
- ensuring environmental safety of residents.

Realization of this principle is:

- establishing legal measures to ensure the use of the environment in accordance with the interests of the population,
- determine the responsibilities of the state, local government entities, as well as social and professional organizations,
- protection of the environment by every inhabitant and developing its environmental awareness.

Environmental management is a part of the whole organization's management system. Management of the organization is the realization of four basic elements aimed at continuous improvement (Deming cycle). System approach involves setting goals and tasks of the organization, then putting them into practice, monitoring and evaluation of the effectiveness of operations and removal of identified irregularities during the monitoring which contributes

to continuous improvement of the implemented actions. Environmental management includes: planning, control, monitoring and improvement of all organization's activities in the field of the environmental protection. Environmental management system according to PN-EN ISO 14001 is based on the essential elements of the concept of Total Quality Management (TQM). This standard establishes management methods and not the result. It is not the norm for the environment and emissions. This is a standard in the field of management [1].

3.1. PN-EN ISO 14001: 2004 against the previous version EN ISO 14001: 1998

Section 4.1. (General Requirements) in the new version of the standard expands the responsibilities of an organization that not only has (so far) to establish and maintain an environmental management system, but also to define it and documented, which means the need to create a new document.

Section 4.2. (Environmental policy) requires the Environmental Policy contains a commitment to compliance with legal and other requirements that apply to its environmental aspects, while so far, as required (by section 4.2.c), environmental policy should include a commitment to compliance with the relevant requirements of the legislation and environmental legislation and other requirements that apply to the organization, "and therefore it will be possible, while maintaining the existing levels of system, referring e.g. to the safety requirements, if they relate to environmental aspects.

Section 4.3.1. (Environmental aspects) requires that environmental aspects are documented and included activities, products and services (previous version of the standard uses the term "activities, products or services," that is “or” instead of “i”).

Section 4.3.2. (Legal and other requirements) requires that the organization has determined how these requirements are related to its environmental aspects, which means that "not enough" so far practiced a simple statement of "legal and other requirements."

Section 4.3.3. former "Aims and objectives" is awarded the title "Objectives, targets and programs", as the objectives and tasks have been combined with the Environment Programme at one point.

Thus, section 4.3.4. "The program (s) environmental management" ceases to exist. Changing the seemingly irrelevant, because only affecting the system documentation, but even for that reason it should be considered valid. Based on practical experience it shows that in a way meant to combine the requirements, there can be created a more functional system documents.

Section 4.4.3 requires that the organization decided whether to give out information about its significant environmental aspects. It is necessary to document adopted decision.

Section 4.5.2 entitled "Evaluation of Compliance", whose last paragraph of section 4.5.1 of existing standard, states that "the organization shall establish and maintain a documented procedure for periodically evaluating compliance with relevant legislation and regulations relating to environmental protection." The new section provides the assessment of conformity not only with the legal requirements, but also with "others". It was erected as the requirement to keep records of the results of conformity assessment. Formulated requirement may result in the need for additional activities related to the implementation of the "other requirements".

Section 4.5.3. (previously 4.5.2) entitled "Non-conformity, corrective and prevention actions" is adapted to the requirements of quality standard ISO 9001: 2000 providing clear, presented a step-by-step requirements. Introduced requirements for the identification and investigation of the causes of non-compliance. It also included the requirement conduct effective corrective and preventive actions.

In the new version of the environmental standard there are required less documented procedures, only those which are related to operational control. The new standard requires establishing of new documents: "Scope System", "Environmental Aspects", "Decision on External Communication", "Documentation of information on the environmental impacts monitoring", "Applied operational control" and "Compliance environmental objectives and targets organizations." Documentation still require "Politics", "Aims and objectives", "Responsibility", "External Communications".

Activities aimed at introducing an environmental management system based on the assumption that leads to the improvement of the organization functioning and consequently, to minimize its negative impact on the environment. The organization must also meet applicable legal provisions for the protection of the environment [9].

4. THE ANALYSIS OF THE OBJECT IN TERMS OF ITS IMPACT ON THE ENVIRONMENT

As a result of the current activities of the analysed company, which is a brown coal mining, in the course of exploitation, transformation of the land and the environment, occurred expressing above all:

- excluding large areas of agricultural and forestry use,
- change hydrographic network, settlement, communications, energy,
- the destruction of soil cover within the excavation, the external dump and auxiliary facilities,
- creation of new forms of relief in the form of artificial cavities (pits) and elevations (dumping ground external and internal),
- change the relationship of groundwater caused by dehydration deposits resulting in the large cone of depression with an area of about 450 km².

Considering environmental nuisance caused by opencast coal exploitation, there are implemented almost all environmental issues in the analysed coal mining in advance, eliminating or limiting the size of the effects of the operation.

4.1. Design assumptions for the implementation of the environmental system

The rapid industry development result in the growing importance of natural environment and activities focused on practices encouraging changes of industry attitudes with regard to natural surroundings care. Initially, the companies took action after the

completion of the manufacturing process, however, among other things, the experience with the implementation of quality systems have suggested the desirability of introducing measures still at production stages. Hence there was lately established the environmental management, which involves reducing the amount of pollution and waste at the source of their creation. In these activities there is underlined already well known principle "think globally - act locally". The paper presents one of the ways to adapt company to the current environmental requirements according to the above principle, which concerns the adaptation of existing documentation to the needs of the analysed coal mining. During the project designing for the implementation of the environment management system in the analysed coal mining the most appropriate way for existing conditions seems to be a third way, namely to adapt the existing state of things to the requirements of the standard.

The procedure of the successful implementation of an environmental management system is as follows:

I. The initial environmental review should be conducted which is aimed at:

- identification of environmental aspects (effects of the impact of the organization on the environment),
- determination of these aspects that are significant and that may appear in emergency situations,
- identification of environmental legislation and their fulfilment in the organization.

Requirement of the standard is to define the organization's environmental aspects of its activities, which may have a significant impact on the environment. The standard requires the establishment and implementation of procedures specifying how the organization identifies environmental aspects and determines the ones that have a significant impact on the environment.

Identification must be subject to those environmental aspects that the organization can supervise and those which may have an impact. Appointment of environmental aspects is the first step to formulating environmental objectives and targets. The identification of environmental aspects is an ongoing process that allows defying past, present and potential impact, both positive and negative impacts of the organization on the environment.

Methodology of the initial environmental review depends on the initial size and the complexity of the organizational unit and on whether it will be carried out by employees of the organization, and also by independent external consultants. Employment consultant gives the benefit of an impartial "fresh look" at the existing management system, as well as environmental impacts. It should be noted that the important issue is to make an initial environmental review was conducted in an objective way. The review should be carried out using techniques such as, for example surveys, interviews with staff at all levels, random inspection, direct inspection and measurement, checklists, etc.

II. The top management and middle management staff should be trained in terms of:

- interpretation of the requirements of ISO 14001: 2004,
- environmental management,

- foundations of the system of environmental management,
- documenting the environmental management system,
- methodology of implementation activities,
- maintenance and improvement of the system.

III. Plenipotentiary for the management of environmental management system should be appointed. Plenipotentiary will ensure that requirements of the environmental management system will be established, implemented and maintained.

The management of the organization should be in a formal way (e.g. ordinance) appoint plenipotentiary for the environmental management system. It should also define the responsibilities and powers of the Plenipotentiary. It is important that the attorney characterized the relevant competence and authority among the workers. This will allow him to effectively supervise the system. In larger organizations, such as the analysed coal mining, there can be considered appointment of a team implementing a system composed of should include specialist for the environmental protection. A team is involved in the environmental review and the identification of environmental aspects, and it helps in the development of system documentation.

The standard requires that the duties and powers of the environmental management system should be documented. Practically, it is accomplished through the introduction of obligations related to the environmental management system for specific procedures, instructions and "Ranges of official duties" or "Cards of the work positions" of those employees whose work is related to the environmental aspects of the organization.

IV. There should be established a policy environment. Requirements to be met by the environmental policy are as follows:

- appropriateness of the nature, scale and influence of the organization, its products or services on the environment,
- a need to commit organizations to continuous improvement,
- a need to commit organizations to meet the requirements under from legislation and regulations relating to environmental and other requirements that apply to the organization.

Moreover, the policy should be adjusted to the specific organization and provide a basis for determining the environmental objectives and targets. Politics is a declaration of commitment and organizations to take action to protect the environment, it should be publicly available.

The organization elaborating the environmental policy should take into account the following elements:

1. Brief information about what is an organization and how it affects the environment.
2. The reference of the policy to the identified significant environmental aspects and their relationship with environmental objectives and targets (e.g.".... actions of our company aimed at minimizing the negative environmental impacts will include: reduction of noise emissions, optimal energy management, optimal waste management. ").

3. A commitment to pollution prevention e.g. “.... the company undertakes activities related to the implementation of Cleaner Production Programme".
4. Reference to meet the legal requirements (e.g. "..... we are committed to comply with legal and other environmental").
5. A commitment to improve the environmental management system (e.g. "..... implemented, maintain and improve an environmental management system according to PN-EN ISO 14001: 2004").
6. Declaration of the Supreme Management to comply with the provisions under with policy (e.g. "... The management declares respect the commitments included in this policy").

The policy should be accepted by the president of the coal mining. The requirement of the standard is the public publishing the content of the policy by the organization. Some of the organizations use the policy for the marketing objectives by its including in the marketing materials or publishing on the website. Environmental policy must be reviewed from the point of view of its relevance and usefulness. Such a review may be conducted during the periodic review of top management, which is a requirement of this standard.

V. There should be established objectives and tasks that are measurable and consistent with the environmental policy objectives and targets.

The requirement of standard is to establish a documented environmental objectives and targets. Environmental objectives and targets can be determined using the diagram cause - effect Ishikawa diagram also called "fish diagram”, herringbone or fishbone. This diagram is used to illustrate the cause and effect of the problem, which is also a simple way to analyse the links between causes and their effects. When building the diagram should ensure the wide participation of people affected by the problem. Most often the preferred method for creating diagrams is called. "Brainstorming", which derives from the work of Japanese Quality Circles. So the environmental objectives and targets can be summarized as follows (Fig. 3) using the above-mentioned Ishikawa cause - effect diagram.

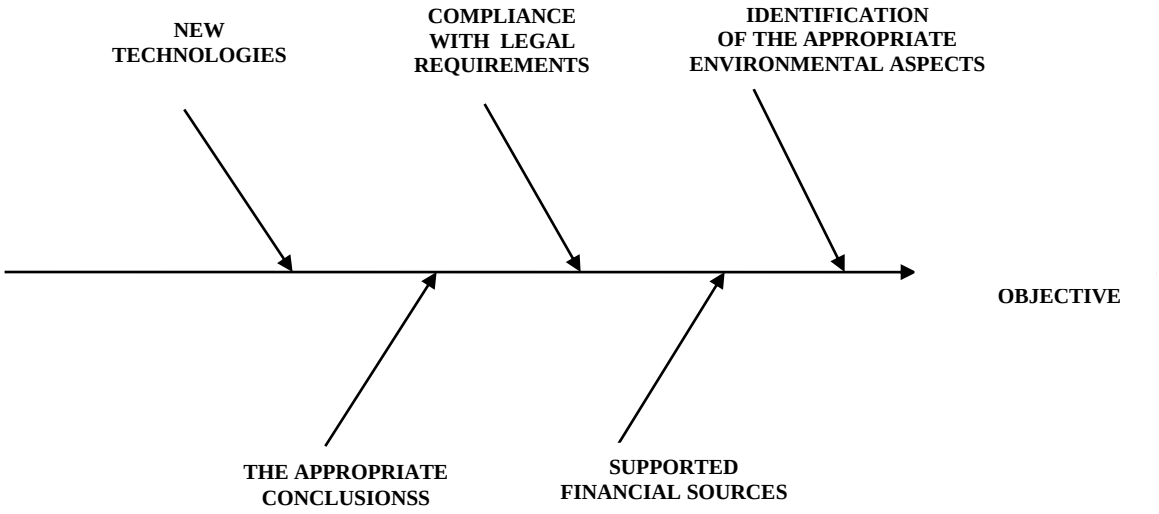

Figure 3. The graphical interpretation of the environmental objectives [own elaboration].

There should be determined environmental task for each objective, whose completion allows a goal achieving. Environmental tasks may relate to the different levels and organizational units. Where it is possible environmental goals should be measurable. There should be also paid an attention to coherence between the objectives of environmental policy, a commitment to pollution prevention and continuous improvement. Environmental objectives and targets in practice determined after identification of environmental aspects and identify significant aspects.

The standard requires that the objectives and tasks have been documented. In practice, this means compiling a register of environmental objectives and targets. Often, this register defines the objectives and short-term perspective. Although the standard does not require the procedure for the determination of environmental objectives and targets, due to the importance of the problem, it is advisable to develop such a procedure describing the rules for determining and approving environmental objectives and targets. This procedure should include provisions for the periodic review of the objectives and tasks and update them.

The ISO 14001: 2004 places special emphasis on the parameterization of the environmental objectives and targets. In practice, this requirement is complied with already many organizations that have implemented an environmental management system using the experiences of the certification of quality management systems.

VI. Documented environmental management programs should be elaborated.

Environmental management program defines the objectives, the tasks to be performed, the deadline for their implementation, the cost and the persons responsible for their

implementation. It is also important to define the objectives and priorities, which should be completed in the first place.

The standard recommends that a program has been developed by organizations in tabular form taking into account the environmental objective and corresponding tasks. For each goal and task it is recommended to determine the person responsible, the measures envisaged for its implementation and completion date. Such a program can be developed as a short-term, e.g. an annual and long-term-perspective.

VII. Book of the Environmental Management System should be elaborated.

The standard does not require elaborating of Management Book. However, it document is helpful in describing the system and highlight links with documents system, on the individual requirements of the standard. The book also provides assistance in conducting audits of the system. A size and a volume of the Management Book depend on the needs of the organization, and the decision in this case take proxy or team appointed to its drafting. A book of Environmental Management should be drafted concisely, and all the formulation of clear and unambiguously interpreted. Construction of the book is divided into chapters, layout pages and their numbering, should provide the ability to easily modify or replace the card. Elaboration of the book is identified in such a way as to be able to freely remove the individual cards. The book should describe all elements of the environmental management system. the statements contained in the book are valid throughout the organization. It does not include what is confidential and is the property of, and may be made available to customers.

VIII. Documented procedures established for the environmental management system should be elaborated in terms of:

- Identification and assessment of the significance of the environmental aspects and environmental impacts,
- operational control,
- control issues monitoring the effect of environmental measures and conduct in emergency conditions.

The procedure is a particular way of acting or conducting the process. A typical procedure includes: purpose and scope, range of the responsibility and authority, the complex procedures - algorithm, a description of what should be done and what materials, equipment and documents should be used and how it should be controlled and recorded.

Procedures should be agreed, available for staff and understood by all concerned. These procedures are often posted flowcharts (algorithms) allowing graphically present the sequence of activities performed or operations, decisions and documents produced.

The use of graphic schemes in procedures significantly improves readability. Structure of the documentation environmental management system (Fig. 4) in the most transparent illustrates

the general system documentation necessary to correct (and consistent with the requirements), the environmental management system.

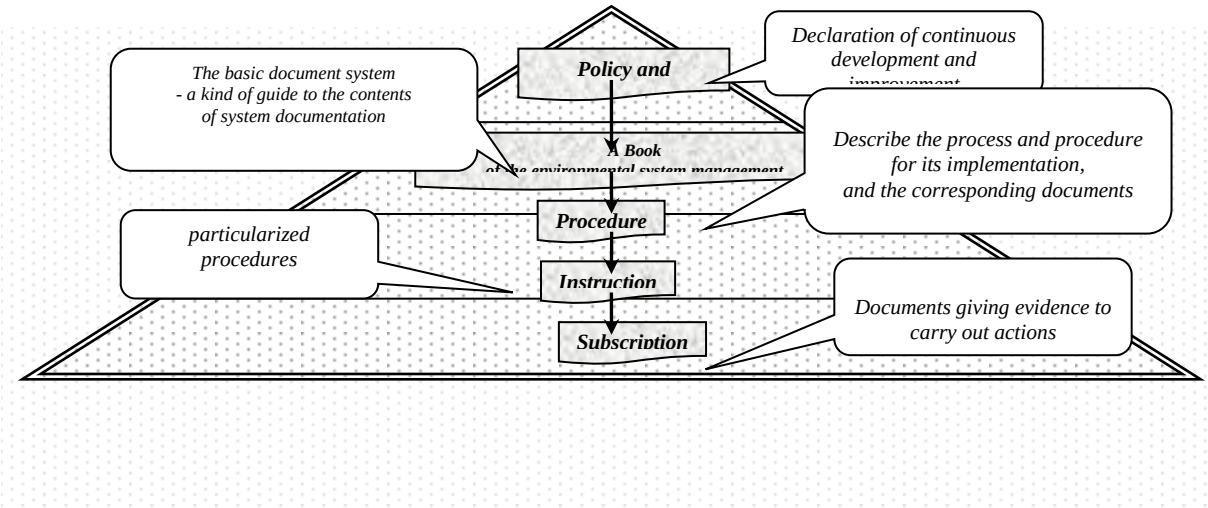

Figure 4. The system documentation structure [own elaboration].

IX. A supervision of environmental records should be established.

Establishing and maintaining environmental records is carried out in order to provide evidence of compliance with the requirements and evidence on effectiveness environmental management system. They are used to collect and archive information. This information is then used to demonstrate compliance with the environmental policy, applicable regulations and documentation system. Furthermore, the information contained in the records used for action improvement system.
The ISO 14001: 2004 in detail determines the type of documents that should be established in the environmental management system. They are: environmental policy, environmental objectives and targets, the scope of the environmental management system, other documents, including records, whose establishment is required.

X. Internal auditors should be trained.

It should theoretically and practically prepare employees appointed by top management on internal auditors to carry out an independent and competent assessment of the environmental management system in relation to: requirements of ISO 14001: 2004, the requirements laid down by the organization and the degree of implementation of the environmental aims. Such training is carried out by a specialist in the field of external training companies, which often also have powers in the field of certification of management systems. During these training candidates for internal auditors they gain the necessary knowledge of conducting audits, which includes in particular: the criteria of audits, their scope, frequency and methods of auditing. After the completion of the multi-stage organizations prepare for the certification process as a sign of compliance with the requirements of PN-EN ISO 14001: 2004 should be

carried out internal audit, which is to assess compliance with: requirements of the standard reference, management system requirements established by organization and effective implementation and maintenance of the system.

XI. Corrective and preventive actions should be implemented.

Stage of preparation and audit activities includes the appointment of a team to conduct the audit and the appointment of the lead auditor (initiating the audit), which is responsible for developing the audit plan and its proper conduct. Measures after audits include the implementation of corrective or preventive measures resulting from non-compliance and observations identified during an audit. These actions are the responsibility of the person responsible for the audited area. Documents related to internal audits are:

- audit program covering the scope and frequency,
- audit plan prepared for individual audits,
- audit report.

XII. A review of the environmental management system should be conducted.

The purpose of the review carried out by the top management of the organization is to ensure the continuing suitability and effectiveness of the system. Review of the system should include:

- analysis of the audits and after audit actions,
- environmental objectives and the degree of their implementation,
- review of environmental policy from the point of view of its relevance and topicality,
- timeliness of Environment Management system assumptions in the light of changing conditions,
- views of interested participants.

PN - EN ISO 14004: 2004 recommends that the review of the system also included an assessment of its effectiveness, that is, how the operating system helps to improve the impact of the organization on the environment. Minimizing the negative impact of the organization on the environment is in fact the overriding goal and essence of the implementation of the environmental management system. The standard does not require the development of a procedure for the review of the environmental management system. It is necessary only to maintain records of inspections made.

5. CONCLUSION

The main benefits that result from the implementation of the Environment Management System mainly include external benefits and marketing benefits. As for the external benefits, the most important are related to the increasing the confidence of customers and partners and new market opportunities. The marketing benefits is primarily to build a positive image of the company in its close and distant surroundings. This certification raises the company's reputation and certainly adds to its prestige.

The benefits associated with the implementation of internal environmental management system in the analysed enterprise include:

- ordering of problems related to significant environmental aspects,
- clarifying the issues concerning the legal requirements of environmental protection,
- stimulating awareness of all employees of the mine in the field of environmental management (training) and oblige the knowledge of the "Environmental Policy" as a declaration of the top management to continuous improvement,
- operational control, which focuses where significant environmental aspects arise,
- internal audit that gives evidence of the audit in the form of detected nonconformities,
- elimination of the detected nonconformities or other undesirable situation. An important element of the standard is also a principle of continuous improvement. It will force organizations to not only answer to the detected non-compliance, but also active involvement in taking preventive action in response to the potential non-compliance.

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THE CLEANER PRODUCTION PROBLEMS IN THE CHOSEN POLISH ENTERPRISE OF THE CONSTRUCTION INDUSTRY

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Abstract

Applying modern principles of the environmental management becomes not only an expression of entrepreneurs ecological awareness, but also an instrument of competitive rivalry. A possession and the use of environmental systems greatly improves the image of the company and facilitates of the market position creation. The paper presents research findings analysis on the contamination level resulting from the manufacturing process of the chosen Polish enterprise of the construction industry. The main objective is the analysis of the adjustment level of the chosen enterprise to the cleaner production requirements.

Keywords: *environmental management system,* ***cleaner production, cement production plant***

1. INTRODUCTION

The environmental management system is a part of the organization's management system used to develop and implement environmental policy and manage its environmental aspects. It is a set of interrelated elements used to establish policy and to achieve the set objectives. The system includes following elements: organizational structure, planning activities, responsibilities, practices, procedures and resources [4,10].

The ISO 14001 standard (Environmental management system. Specification with guidance for use - Environmental management systems. Requirements with guidance for use) is a normative document, which is used on a voluntary basis, widely available and accepted by accredited by the International Organization for Standardization (ISO) standardization body. The standard determines principles, guidelines or characteristics for the various activities and outcomes and it is designed for common and repeated use. It adopts a code of the good practice and principles of rational proceedings with the current level of technology. The primary objective of this standard is to support activities related to environmental protection and pollution prevention in a balanced way with the socio-economic needs. A formalized environmental management system in accordance with ISO 14001 consists of five

components: environmental policy, planning, implementation and operation, checking and management review [4].

Environmental policy is a definition of objectives and principles related to all of organization activities , which is the framework of activities undertaken by the enterprise, as well as enables establishing the environmental objectives and targets elaborated by the enterprise. Policy should have a reference to the actual activities, products and services provided by the organization and it must involve the enterprise in continuous improvement process through pollution prevention and compliance with applicable legislation. There is a clear link between policy and the ensuing goals and objectives. If the organizational unit is part of a wider group, which has its own environmental policy, the relationship with the policy of a wider group should be clearly defined.

Environmental policy should be periodically reviewed and amended as a result. Untimely changes are not desirable as they may lead to the fact that it ceases to be a clear guideline for the enterprise [5]. Environmental review recommended by ISO 14004 is based in particular on the identification of environmental aspects, assessing compliance with applicable laws and the choice of aspects significant [4]. Identification of environmental aspects is an ongoing process of defining the past, present and future, actual and potential impacts (positive and negative) of the enterprise influence on the environment. The standard suggests that there should be taken into account: the air emissions, the soil pollution, a consumption of raw materials and natural resources, the energy consumption and an energy impact on the environment (heat), production of waste and by-products.

2. PRINCIPLES OF THE CLEANER PRODUCTION

Principles of the Cleaner Production (CP) is [2]:

- the precautionary principle - this approach postulates the need to prove that the potential poisoner, its activities or products will not bring harm to the environment, shifting the burden of proof on the manufacturer, not the local communities that would prove which have already occurred damage. This approach rejects the use of quantitative computed degree of risk as a single factor in deciding whether to use a chemical or introduce a new technology. It does not ignore the science, but it notes that since industrial production also has a huge influence, in addition to the scientists also other people should have influence over those decisions;
- the principle of prevention - prevention of harm to the environment is cheaper and more effective than trying to "heal" the same environment after its destruction. Prevention requires going against the "current" production process to remove the source, the problems cause instead of trying to the outcome/damage control. Pollution prevention should replace pollution control;
- the principle of democratic control - Cleaner Production involves all persons affected by industrial activity such as: workers, consumers and local communities. An access to information and involvement in decision-making supports democratic control. As a basis it

should be assumed that local communities must have access to information on industrial emissions and registers, plans for the reduction of toxic substances in the production course, as well as data on the composition of products;

– the principle of an integrated and holistic approach - society must adopt an integrated approach for the use of natural resources and consumption. Contemporary production method ignoring interrelationships and dependencies allows moving emissions between air, water and soil. Reduction of emissions associated with the production itself does not lead to a reduction.

Strategy of the Cleaner Production can be applied to [2,3,7,9]:

– processes - including better use of raw materials, water and energy, elimination of toxic and hazardous substances, reducing the amount and toxicity of pollutants at the source of its creation, improvement of the existing process or to change it;
– product - by reducing its harmful effects in relation to the environment and human health and safety throughout the product life (from raw material extraction, through production, distribution and use, to waste disposal);
– services - by reducing negative impacts on the environment, both in its design and provision (consumption).

Waste concern also products with a negative economic value. Enterprises due to the large number of materials types in the waste are not able to fully determine its value. Negative economic value can be reduced or eliminated through the implementation of the cleaner production methods to prevent pollution at the source. Reducing the pollution burden on the environment is one of the main aspects of the Cleaner Production. Another aspect is to eliminate the negative economic value. This means that the CP projects benefit both the nature and the company. The Cleaner Production is helping to reduce or avoid the hidden costs of waste (Fig. 1).

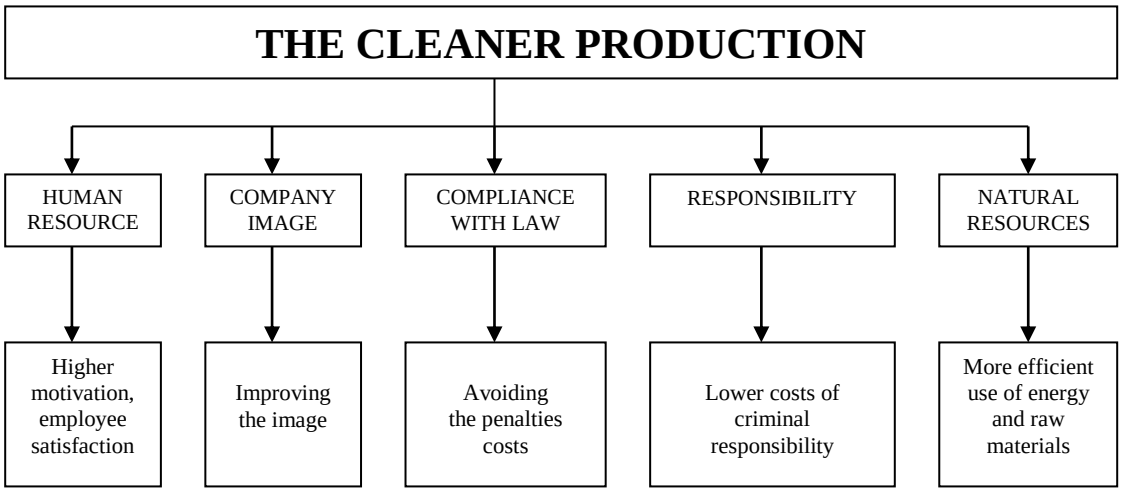

Figure 1. Areas of the hidden waste costs avoiding by using the Cleaner Production idea [2].

The objective of the work is an analysis of the contaminations identified in the chosen Polish cement production plant. The quantification of the contaminations level allows improving manufacturing process in the aim of the adjustment of the enterprise to the cleaner production requirements. The research analysis was elaborated based on data collected in the manufacturing process of the chosen Polish cement production plant situated in the central region of Poland.

3. RESERACH RESULTS IN THE FIELD OF ENVIRONMENTAL POLLUTION

The volume of the waste gas (exhaust) emitted from the analyzed cement plant as a result of thermal treatment of raw materials and waste depends on the air excess (full combustion follows when the furnace is adjusted to more than theoretically the required minimum amount of the oxygen or air) and its composition depends on the type of combusted fuel (technological properties of waste) and the temperature depends on the temperature at which the combustion is carried out [8].

The basic components of the waste gases from the thermal conversion of raw materials and waste are: fly ash, nitrogen oxides, carbon oxides (CO, CO2), sulphur dioxide (SO_2), water vapour (H_2O), hydrogen chloride (HCL), hydrogen fluoride (HF), heavy metals, dioxins and furans.

Waste gases from thermal waste treatment cannot be discharged into the atmosphere without purification. It is essential to their cooling and cleaning to the degree specified by the regulations. Using of fuel clinker in the production process which are a particular type of waste is also its consequences in the form of permissible concentrations of pollutants in waste gases, as well as preserving the relevant process requirements. According to the current law, national cement plants in their decisions on allowable emissions (emissions permits) have only reduce emissions (expressed usually in kg/h in terms of dust, sulphur dioxide, nitrogen oxides and carbon monoxide [6]. If cement plants make a recalculation of specified in permits the emission limit values for the concentration of pollutants in the emitter and refer them to the contractual conditions and the required oxygen concentration, it would be no doubt that these values are much more liberal than the value which will apply in the case of cement plant co-incineration.

3. 1. CHARACTERISTICS OF THE SOLID POLLUTANTS

Gas removal is the removal of these aerosol particles - solid. Dust collectors are used for the removal of particulate gases. Particles present in exhaust gases from thermal waste treatment plants impurities in the form of solid particles whose size is in the range of from 1 μm to 1 mm. To remove dust from waste gases in cement are used primarily:

- cyclones;

- filter dust collectors - mainly fabric filters;
- electrostatic precipitators.

In order to improve the extraction efficiency in the analyzed cement plant uses two cyclones connected in parallel. Cyclones cannot guarantee to obtain sufficient degree of removal of dust, because the purification of flue gases of waste are used only as a preliminary stage of the dust removal.

Cement also has a fabric filter dust collectors used for dust streams of waste gases from the combustion of waste, burning raw materials and grinding of cement raw meal, coal dust. The principle of the filter dust collectors operation is based on the aerosol flow through the porous baffle, and the deposition of particles on the elements of the partition. Fabric filters are among the most effective methods of extraction of dry gas. They have a high efficiency for all particle sizes. For particles up to 0.01 microns there can be obtained the extraction efficiency of 99.9%.

Cement also has electrostatic plate used for dust streams of waste gases from the combustion process. Electrostatic precipitators are used alternatively in relation to the fabric filter, especially if a facility are directed hot gas streams. They are characterized by high efficiency dust collection. They allow dust removal of large volumes of gas streams. Currently, the concentration of dust emitted in the cement clinker production is the result of the dry method, where the kiln clinker co-incinerate waste, the concentration ranges are specified in the environmental standards. The volume of the dust emitted by the total Cement plant in the last two years was shown in Figure 2.

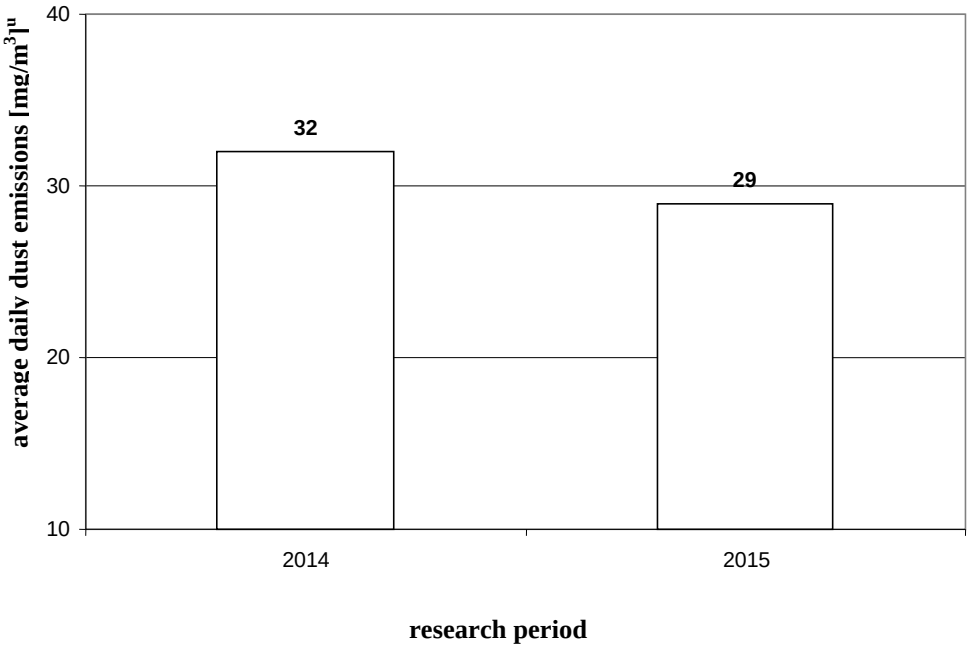

Figure 2. Dust emissions in 2014 – 2015 in the analyzed cement plant.

3. 2. CHARACTERISTICS OF LIQUID CONTAMINANTS

In the flue gas there are acid impurities (liquid) as HCl and HF. The method used for the removal of exhaust gas components acidifying is called the wet method. This method involves absorption in aqueous solution. Acidifying components are removed by washing with acid in a scrubber with an aqueous solution of reaction (pH) less than 1. The acidic wash stage is used primarily to cool the exhaust gas and the secretion of HCl and HF. HCl can be neutralized with sodium hydroxide. The resulting salt is then easier to use than hydrochloric acid. The amount of emitted HCL and HF Cement in the period of last two years are shown in Figure 3 and 4.

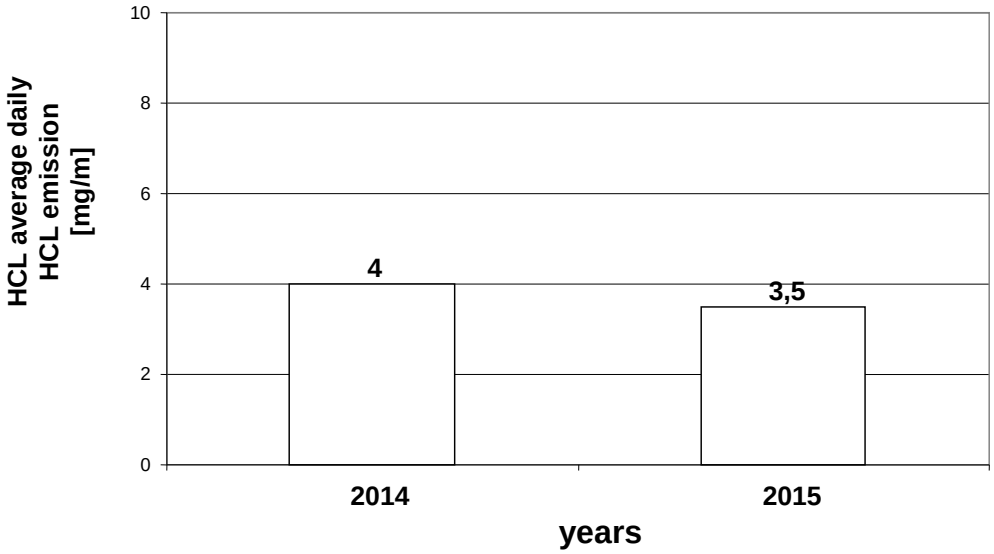

Figure 3. HCL emissions in 2014 – 2015 in the analyzed cement plant.

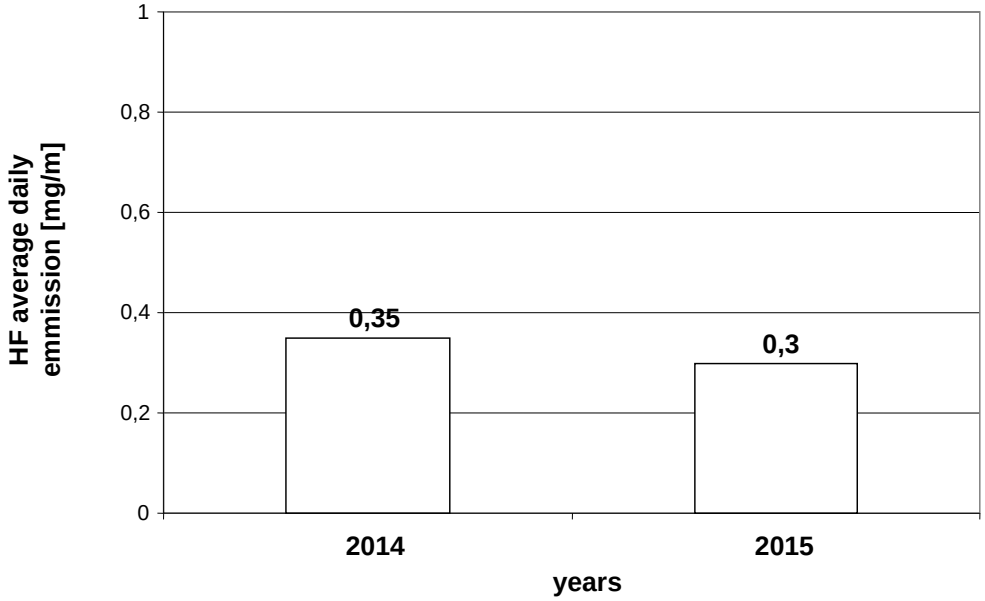

Figure 4. HF emissions in 2014 – 2015 in the analyzed cement plant.

3. 3. CHARACTERISTICS OF GASEOUS POLLUTANTS

The incineration of waste in the presence of air at high temperatures causes the emission of nitrogen oxides. The source of NO_x formation is the oxidation of N_2 from air at high temperature combustion conversation nitrogen chemically bound in the fuel NO_x. The presence of NO_x in the atmosphere in excess of the size of the trace, due to the natural nitrogen cycle in nature poses a serious threat to the environment. It is connected primarily with the formation in the atmosphere HNO_3 acid, stronger than H_2SO_4, which is one of the major components of acid rain.

The primary methods of reducing oxides of nitrogen (NO_x reduction) consist in preventing the formation directly in the combustion chamber. They are also referred to as low-emission combustion techniques. The primary factors that influence the formation of NO_x, and thus used to reorganize the combustion process to reduce NO_x emissions are:

- combustion temperature – in high combustion temperature NO_x rises;
- the ratio of air to fuel in the combustion zone;
- excess air;
- air distribution;
- the degree of mixing of fuel, air and combustion products.

Prevention of NO_x directly in the combustion chamber is performed by gradually dispensing the air, the combustion takes place in several stages. In the first stage, the shortage

of air is incomplete combustion. Only in the second or third stage combustion occurs completely after adjusting the extra amount of air. Combustion with deficiency of air causes the air in the first combustion zone is reducing, that is the idea of the method - prepared a combustion zone in which NO_x will be reduced. Leading to the second zone secondary air is needed to burn out residue from the first zone, primarily CO.

As a complement to the primary method is using a secondary method to reduce nitrogen oxides - the catalyst (Selective) reduction method. It consists in that the exhaust gas after removal of acidic impurities is fed to the catalyst, which is also administered urea and ammonia. The catalysts for reducing oxides of nitrogen is used in the exhaust gas temperature at 150-400°C (usually 300-400°C). The concentration of nitrogen oxides in flue gases obtained in this way are usually much smaller it achieves the highest efficiency up to 85%.

NO_x comes from clinker dry process (co-incineration of waste tires as an alternative fuel). Nitrogen oxides are the only standard issue, which seems to be the most difficult to achieve, in the case of a co-incineration in kilns. Currently, in the analysed enterprise nitrogen oxides are still controlled by the employees of the plant by a suitable computer program, a low concentration of nitrogen oxides corresponding assumptions BAT is the result of a rotary kiln with cyclone exchanger and percaliner.

3.4. ANALYSIS OF THE PERMISSIBLE LIMITS OF EMITTED POLLUTANTS AND THE

Obligations relating to the cement plant emissions of pollutants are presented in Table 1.

Table 1. Summary of pollutants emitted

The name of the substance	**Permissible limits for emissions [mg/m^3_u] (for dioxins and furans in ng/m^3_u) at the presence of 10% oxygen in the flue gas**	**Pollutant emissions from cement plant in 2015 in mg/m^3_u (for dioxins and furans in ng/m^3_u) at the presence of 10% oxygen in the flue gas**
total dust	30	29
nitrogen oxides (NO_x)	800	789
sulphur dioxide (SO_2)	50	43
carbon monoxide (CO)	2000	1998,5
hydrogen chloride (HCL)	10	3,5
hydrogen fluoride (HF)	1	0,3

heavy metals	0,5	0,11
dioxins and furans	0,1	0,025

As it was shown in Table 1, the pollution emitted by the analysed cement are within acceptable limits emissions. Analysed situation is the result of the use of appropriate mechanisms and exhaust gas cleaning processes and the prevention of excessive emissions.

4. DETERMINATION OF CEMENT PLANT CONDITIONS ADJUSTMENT TO THE CLEANER PRODUCTION PRINCIPLES

Polish law requires the management of each manufacturing plant responsibilities for the measurement, research and analysis, such as the even control the emission of pollutants from chimneys (emitters) site, measuring emitted from the plant noise tests and measurements in the work environment (noise, dust, lighting, the presence and concentration of harmful substances, microclimate, etc.). Regardless of imposed on the employer obligations and for measurements and environmental research and monitoring of the composition and characteristics of the fuel used and its correct analysis enable a far-reaching savings in technological processes, fees for the economic use of the environment, work organization, ergonomics, use of machinery and equipment and, above all, reduce the load on the environment and health of workers.

Laboratory of Environmental and Quality Control in the analysed cement plant have implemented a system of quality assurance in the laboratory in compliance with PN-EN ISO/IEC 17025:2005 "General requirements for the competence of testing and calibration laboratories". The confirmation of the competence of the Laboratory of Environmental and high quality services achieved in every year is authorization of the State Provincial Sanitary Inspector to make test and measurement environment throughout the country. The measurement results are honoured, among others, by the National Labour Inspectorate, State Sanitary Inspection, the State Environmental Protection Inspectorate. Competence Quality Control confirms the positive evaluation obtained during the inspection carried out by the Institutes: IMMB/MPA Krakow and Berlin and in the inter-laboratory tests conducted by SGS Laboratory Poland.

The analysed cement plant is one of the best equipped laboratory with the X-ray fluorescence X-ray spectrometer S4 PIONEER German that come from Brucker company. This equipment allows controlling chemical composition of the kiln, clinker and cement. Movement Laboratory also has a diffractometer D4 German that also come from Brucker company. Diffractometer is used to study the content of free lime and the mineralogical composition of the clinker, slag content in cement, minerals, etc. research. This equipment allows for even better conduct of inter-process cement production.

The situation on the cement market associated with stimulation of the Polish economy and high environmental awareness have become a determinant of development directions analysed

the cement. There was modernized a boiler. The first cost analysis indicated a high economic effect of the task, and made measurements of emissions confirmed how much environmental benefit is realized investment. Prior to modernization of the steam boiler a fuel oil consumption was 2,740 tons per year for a total amount of 2.5 million PLN. The use of the steam boiler in the plant was uneconomic and very difficult to adjust if only because of the need to maintain constant steam reception. In addition, significant amounts of steam were consumed for heating installations storage and transport of heavy fuel oil. After upgrading the heating system in the construction of the boiler room and the mono-functional WI and bi-functional WII with boilers with high efficiency and fully adjustable, fuel consumption has been significantly reduced. After analysis of the research period (2014 – 2015) predicted oil consumption WAR 2 amounted to 666 tons per year for a total amount of 978000PLN. Thanks to the modernization of the heating system the analysed cement plant achieved a reduction in fuel consumption in the amount of 2,074 tons per year or 74% per annum. Reducing fuel costs result in annual savings (61%).

In view of the impact on the environment, it can be concluded that achieved the desired results. Significantly reduced the emission of dust, as previously fired coal boiler was replaced by a cement oil boilers. Reduction of SO_2 emissions by 93% is a result of use as fuel, oil medium. It is also noted a smaller difference between the current situation and the earlier dust emissions. The slight difference due to dust from the original deck mazout boiler replaced by the fuel oil and not, as was the case on the packing.

According to research conducted by the Institute of Mineral Building Materials, annual emissions of sulphur dioxide decreased by 95%, nitrogen oxides by 77.8%, while dust emissions dropped to 93.7%. So significant improvement was achieved through the use of fuels with better physical and chemical indicators and the use of cutting-edge solutions used by VIESSMANN (world leader in heating technology).

Used low-temperature boilers are characterized by high efficiency of up to 94%. For comparison, the efficiency of coal-fired boilers generally used in heating the individual is 80%. It is worth indicate that it is possible to increase the efficiency of Viessmann boilers to 100% using the heat from condensation of water vapour contained in the exhaust gas.

The next step toward the environment adjustment was building four installations to reduce fugitive emissions associated with transport clinker stores, according to the agreement No ICE 1 1/2.4.1/2005/56/103u called "Reduction of installation used for clinker burning covered by the integrated permit".

Another of the tasks completed under this program (i.e. "Reduction of installation used for clinker burning covered by the integrated permit") was the replacement of the main burner technology line furnace No 5. A characteristic feature of the burner is the possibility of reducing the emissions of nitrogen oxides by the use of the patented technology of lowering the flame temperature (spray water). Whereas the control of the cement production process is carried out in two main directions. The first is the control of all the parameters related to the

quality of the manufactured product. Control covers all phases of production, from raw material extraction to study the quality of the cement sent to the recipients. They are studied chemical properties of raw materials, the composition and homogeneity of the raw mix fed to the firing composition and properties of calcined clinker and milled cement and cement storage silos. Given that the stream flowing material in various stages of production amounts to several hundred tons per hour, this control must be carried out very carefully, because any negligence threaten to producing the large batch of the product does not meet quality requirements. The second direction is to control the unit operating parameters. It aims to ensure meet the parameters compatible with the regime of technological production process, both in terms of the required machining parameters of the material at a given stage of the process, as well as safety devices. The control of the installation for clinker burning has a particular importance.

Monitored parameters include the parameters characterizing the facility's impact on the environment. In the case of furnace systems, which are the only emitter of pollutants from cement plants (apart from a small emission of gases from the boiler room) they are continuously measured emissions of dust, carbon dioxide, carbon monoxide, sulphur dioxide and oxides of nitrogen, and the co-combustion of waste: organic carbon, hydrogen chloride and hydrogen fluoride. Measurements of dust emissions include all emitters point in the analysed plant. These measurements document the compliance with the emission limits specified for the plant by the competent authorities for the province on environment. Process control occupy a priority place in the current activity of the cement plant. Internal laboratory and production facilities are equipped with high-class quality testing equipment and measurement and control.

5. CONCLUSION

Cement kilns are a viable and interesting alternative to take the thermal treatment of waste in the form of used oils. The problem of waste is a worldwide problem. Its number is increasing. They constitute a serious threat to the environment, pollute the soil, water and air. At the same time waste it is a huge, untapped sufficiently source of secondary raw materials and energy. Rational waste management is a huge benefit to the economy and the environment. Waste not suitable for use as a secondary raw material containing an energy, waste, broadly in could be used as an alternative fuel.

The use of cement kilns for the co-incinerating waste oil is conducive to a number of conditions. These include, among others: implemented into national law Directive of the European Parliament and of the Council of Europe 2000/76/EC, which clearly defines emission standards and process requirements related to the implementation of the process of co-firing in cement kilns, reported in the national strategy for waste management, as well as specific atmosphere and high temperature characterized the process of clinker burning, so in cement kilns is possible, much easier than in other systems, the behaviour required almost emission standards and process requirements.

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