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SCIENCE AND TECHNOLOGY

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CONTENT

Words from the Editor

Welcome to the latest edition of *Nauka i tehnologija / Science and Technology*, the esteemed scientific journal of the International University Travnik in Travnik. Published biannually, our journal is dedicated to addressing pressing issues in the fields of social, artistic, and technical sciences with a blend of scientific rigor and professional insight.

Our mission is to engage our readers with groundbreaking ideas and goals from these diverse areas, fostering a deeper understanding and appreciation of the advancements shaping our world. Each issue of *Nauka i tehnologija* offers a platform for scholars and professionals to share their innovative research and thought-provoking perspectives. We take pride in featuring not only original scientific and professional papers but also comprehensive review papers and insightful conference proceedings.

As a testament to our commitment to excellence, *Nauka i tehnologija* is indexed by several prominent services, including Google Scholar, Scilit, Dimensions, Semantic Scholar, and Lens.Org. This ensures that the valuable contributions of our authors are accessible to a wide audience, amplifying the impact of their work.

In this edition, Vol. 12, No. 1, 2024, we are proud to present a diverse array of papers that reflect the broad scope of our journal:

1. **"Mathophobia in High School Mathematics Teaching"** by Ahmed Palić and Almedina Hatarić - Palić explores the phenomenon of anxiety towards mathematics among high school students and offers strategies to mitigate this issue in educational settings.
2. **"Digitalization and Information Technologies in Tourism and Hospitality"** by Aleksandra Tolj and Dragan Golijan examines the transformative effects of digital technologies on the tourism and hospitality industry, highlighting current trends and future directions.
3. **"Elements Which Caused the Appearance of Innovations in Ministry and the Change of the Manager's Function in Healthcare"** by Elnur Smajić investigates the factors driving innovation within healthcare ministries and how these changes are reshaping managerial roles.
4. **"Certain Areas and Positive Practices of the Green Economy"** by Emir Ibrahimović delves into sustainable economic practices, emphasizing areas where green economy principles are successfully applied and their benefits.
5. **"Controlling as a Key Success Factor in Business Operations"** by Erdin Hasanbegović discusses the role of controlling in enhancing business performance and ensuring operational success.
6. **"Relationship Between Transition Curves (Clothoids) and Circular Curves in Road Alignment"** by Kerim Hrapović analyzes the geometric relationship between different types of curves used in road design, providing insights for improved road alignment techniques.
7. **"The Impact of Traffic Noise on the Environment of Healthy Living in Urban Areas"** by Maja Salkić - Smailkadić evaluates the environmental and health impacts of traffic noise in urban settings, proposing measures to mitigate these effects.
8. **"Application of Noise Protection Walls Along Road 'A' Transversal in Sarajevo"** by Venera Simonović presents a case study on the implementation and effectiveness of noise protection walls in reducing traffic noise along a major road in Sarajevo.

We extend an open invitation to authors from universities, research centers, and industry to submit their papers and become a part of our vibrant academic community. Your contributions are vital to the continued success and growth of this publication.

Thank you for your support and interest in *Nauka i tehnologija*. We look forward to presenting you with the latest advancements and discussions in the upcoming issues.

Sincerely,

Editor-in-chief

Prof. dr. Rajko Kasagić

MATHOPHOBIA IN HIGH SCHOOL MATHEMATICS TEACHING

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Summary

At the mere mention of the word mathematics, most students "go dark in the eyes". There are numerous reasons for this. Primarily, mathematics is an abstract science, so it becomes uninteresting and incomprehensible to children. This paper is based on mathophobia in high school students. Namely, mathophobia manifests itself as a fear of mathematics. A person who has a fear of mathematics avoids contact with mathematics in situations that have to do with mathematics. The range of symptoms extends from a mild discomfort when encountering quantitative information to a complete avoidance of anything resembling mathematics. The fear of mathematics among students in two secondary schools in Travnik and Žepće was examined with a representative sample of 288 respondents. Of these, 72 respondents are students of the fourth grade, 100 students are students of the third grade, 68 are students of the second grade and 48 are students of the first grade. The research itself showed very interesting facts, and indicators that fear is present to a certain extent among students. The topicality of the topic is evident, and the indicators themselves can be the introduction and starting point of some new research, based on the above.

Keywords: *school, mathematics, teaching, mathophobia.*

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1 INTRODUCTION

Emotions are the primary experiences that appear before all others in the development of a living being, although we know what is meant by the term emotion (experiences caused by some external or internal situation, characterized by the fact that they are mostly pleasant or unpleasant, and sometimes ambivalent), it is rare that the term in psychology so undefined (Petz, 1992).

While joy and anger are in a sense "emotions of approach", fear, on the other hand, is an "emotion of avoidance". He is characterized by running away from danger. An essential characteristic of the situation in which fear occurs is the perception of a dangerous object or threat, and the crucial thing here is the perception of the individual's lack of power or ability to fight the danger. An important component of many situations in which fear occurs is a forward-looking time perspective. Namely, the individual predicts what will happen in the future, and dwelling on those events creates states of strong anticipatory fear. The term phobia comes from the Greek word phobos, which means fear, flight. A phobia is a strong, irrational, persistent fear of certain situations, objects, activities, persons, and an exaggerated perception of impending danger associated with a specific situation or specific object.

The basic symptoms of a phobia are considered to be a strong, constant, uncontrollable conscious desire to avoid a certain unpleasant situation and a whole series of physical manifestations such as facial redness, tremors, dry mouth, sweaty palms, increased desire to urinate, defecate, palpitations (sensation of rapid or irregular heartbeat) and panic attacks. (Milivojević, 2007).

Mathophobia manifests itself as a fear of mathematics. A person who has a fear of mathematics avoids contact with mathematics in situations that have to do with mathematics.

In the last few decades, a large number of studies have been conducted with the aim of examining individual attitudes towards mathematics. Progress in this area of research has been slowed down due to the limited understanding of the concept of attitudes, and the inability to determine the numerous variables that make up that concept (Khine and Saleh, 2011).

In general, it is considered that human beings are not only cognitive but also social beings, with their own beliefs, emotions and attitudes, which influence their development. Human behavior and decision-making when faced with a task is determined more by one's own beliefs than by an individual's knowledge. Attitudes are an important part of human identity. Each individual feels, loves, hates, agrees or disagrees, accepts or does not accept a situation, object, concept, and the like. The authors conclude that attitudes represent the sum of such evaluations. Literature denotes attitudes as learned predispositions or the tendency of an individual to respond positively or negatively to an object, situation, concept, and even another person. Positive or negative feelings are sometimes permanent and especially resistant to change, although they can change under the influence of changed circumstances and new experiences (Rubinstein, 1986).

"Attitude is a mental and neural disposition, organized through experience, which has a directive and dynamic effect on the individual's responses to all objects and situations with which it is connected" (Hren, 2001: 3).

At the very beginning of the research on attitudes towards mathematics, Daniel Neale states that "attitudes play a decisive role in learning mathematics, and positive attitudes towards mathematics are the reason why students learn mathematics"

(Neale, 1969:631). Neale defines attitudes towards mathematics as "likes or dislikes, a student's tendency to persist or avoid mathematical activities, a student's belief that he is good or bad at mathematics, and the belief that mathematics is useful or unnecessary" (Neale, 1969:632).

According to a simpler definition, there are two main categories of attitudes about mathematics, namely positive or negative emotional dispositions towards mathematics (McLeod, 1994). A more complex definition defines attitudes as a three-component model: a positive or negative emotional response to mathematics, and the concept of mathematics, which implies how much an individual knows mathematics and the tendency to behave towards mathematics (Hart, 1989).

A group of measures of liking or disliking mathematics, the tendency to persist or avoid mathematical activities, the belief that someone is good or bad at mathematics, and the belief that mathematics is useful or useless" (Ma and Kishor, 1997:27). Research shows that most children start school with positive attitudes towards mathematics, but as they grow up, these attitudes become negative. When starting school, students' attitudes towards mathematics depend solely on their family environment. However, success or failure experienced in the classroom changes the initial state and shapes early school experiences that ultimately influence later situations (Lumsden, 1994). In accordance with the recognized increased negative attitudes towards mathematics, negative attitudes are the result of frequent failures in work, and repeated emotional reactions become permanent patterns of behavior towards mathematics. It seems that the pressure that students feel when dealing with high goals is often beyond their capabilities, together with uninteresting teaching and insufficiently positive attitudes of teachers, have a destructive effect on their attitudes towards mathematics (Philippou and Christou, 1998).

The beginning of schooling has been identified as the most significant period in the development of students' attitudes towards mathematics; in that period, teachers have both the opportunity and the responsibility to encourage positive attitudes and high student achievement (Ma and Kishor, 1997).

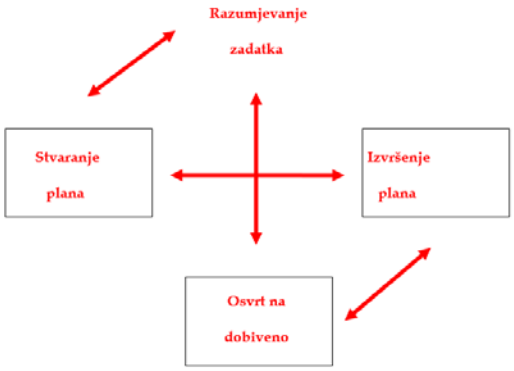
Despite the mixed results of research on the relationship between attitudes towards mathematics and academic achievement, teachers believe that students learn better and are more effective if they are interested in the content they are learning, and achieve better results if they like the content they are learning. Thus, students who enjoy mathematics increase their own intrinsic motivation for learning and vice versa. Therefore, there is a very obvious need to focus attention on the creation and development of positive attitudes in any subject.

In previous research, e.g. in Croatia, on a sample of 306 students from the 5th to the 8th grade of elementary school, it was shown that the respondents have a slightly positive attitude towards mathematics, with a significant statistical difference according to the age of the respondents. Younger students have a more positive attitude. Students generally do not believe that mathematical abilities are innate. A significant difference in understanding mathematics as a male domain was also obtained. Girls are less convinced of this, and boys' assessments are neutral.

However, it should be emphasized that the attitudes of students are influenced by many factors: growing up - initially puberty, class environment, relationship with the teacher, previous achievements, the interestingness of the class, the novelties that the teacher brings into his work, and the like.

Persistence in work and continuing to work after an experienced failure is associated with student self-confidence, so it is desirable to encourage students and constantly monitor their progress.

The prevailing opinion is that for successful mathematics, it is often more useful to solve the same problem in several different ways than to solve several different problems in the same way. By solving one task in several different ways, we can establish by comparison which of the ways is shorter and more rational, more elegant and more effective (Kadum, 2005). In this way, the student's abilities to solve problem tasks come to the fore.



Scheme 1: Solving mathematical problems

We schematically presented the relationship between the ability to solve mathematical problems. The same are expressed in:

- understanding the task,
- creating a plan to solve the problem,
- the realization, that is, the execution of that plan i
- analysis of problem solutions, i.e. review of what was obtained (Kadum, 2005).

"Dyscalculia is a partial disorder of the process of acquiring mathematics, which can appear in all or only certain areas of mathematics. At the same time, the child progresses in learning mathematics, but much slower than his peers and inadequate for his mental age. Acalculia is a term that denotes the complete inability to acquire material from mathematics, that is, the complete absence of mathematical thinking." (Sharma, 2001:15).

2 The empirical part of the research

The instrument used in the empirical part of the research is a survey questionnaire. Before the process of approaching the analysis and interpretation of the results, the reliability of the measuring instrument was tested using Cronbach's Alpha, and it is 0.762, which shows very good reliability and internal agreement of the scale for this sample.

After the mentioned test, the factor analysis was started. In order to check whether the data set is suitable for factor analysis, we checked whether the value of the KMO indicator (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) is equal to or greater than 0.6 and whether the value of the Bartlett's Test of Sphericity indicator is significant (ie that the Sig. value is 0.05 or less).

In our case, the KMO value is 0.706, which is the first indicator of the justification of the factor analysis, and the same is confirmed by the value of Bartlett's Test of Sphericity, i.e. significance (Sig.=0.000).
Based on all of the above, we see that the factor analysis is justified. According to Kaiser's criterion, we were only interested in components whose characteristic value is one or more. In our case, only the first four components have a value above 1 (4.696, 2.396, 1.623, 1.309).

Four factors were identified, with their names: *Fear and difficulties in mastering mathematics, Positive attitude and happiness when encountering mathematics, Prejudices and failure to master basic and fundamental mathematical concepts, Potential lack of fear of mathematics in certain circumstances.* Each factor is

assigned claims according to its membership in the *Total Variance Explained table.* The aforementioned four factors or components explain 66.83 percent of the variance. In accordance with the factors and the objectives of the work, sub-hypotheses or hypotheses were defined and tested using parametric methods.

Sub-hypothesis 1.: It is assumed that there is fear and difficulty in mastering mathematics, and that there is a statistically significant difference in relation to gender and the class from which the respondents come.

Varijabla	N	M	SD	95% Interval pouzda		t-test	P
				Donja granica	Gornja granica		
Postoji strah i teškoće u savladavanju matematike	288	2,82	0,989	-,2929	-,0636	-3,059	0,002

Table 1. Arithmetic mean values, standard deviations of the it - test - There is fear and difficulty in mastering mathematics

Observing and analyzing table 1, we can see that the t-test is (-3.059) and the value Sig.=0.002, while the arithmetic mean (M=2.82) thus we can generally see that there is fear and difficulty in mastering mathematics.

First of all, we will present a sample T-test on the variable there is fear and difficulty in mastering mathematics. The results are shown in Table 2.

Nezavisne varijable		N	M	SD	*t- vrijed./ ANOVA*	*p*
Spol	M	142	2,95	0,964		
	Ž	146	2,69	0,999	2,217	0,027
Razred	I	48	2,78	0,981	0,455	0,714
	II	68	2,78	0,890		
	III	100	2,78	1,071		
	IV	72	2,94	0,974		

Table 2. t-test and ANOVA - There is fear and difficulty in mastering mathematics

Looking at table 2, we see that the value t=2,217 as well as its significance Sig.= 0.027 which is below the threshold value of 0.05, analyzing this issue we see that there is a statistically significant difference of arithmetic means between male and female gender where the value (M=2 .95) in male subjects and (M=2.69) in female subjects. And with a higher standard deviation in female subjects (SD=.999) in contrast to male subjects (SD=.964). This indicates that there is a statistically significant difference between the sexes.

The findings of the research between respondents with regard to class (Table 2.), show that there is no statistically significant difference between respondents with regard to class (t=0.455; p=.714). By analyzing the arithmetic means, it can be seen that it is slightly higher in the respondents in the fourth grade category, and it is the same amount (M=2.94), while the lowest arithmetic mean was shown in the category of respondents in the first, second, and third grades (M= 2.78). . Taking into account the results of the standard deviation, we observe that the highest standard deviation (SD=1.071) was shown in the III grade, and the smallest (SD=.890) in the II grade category.

Sub-hypothesis 2.: It is assumed that there is no positive attitude and happiness when encountering mathematics, and that there is no statistically significant difference in relation to gender and the class from which the respondents come.

Varijabla	N	M	SD	95% Interval pouzda		t-test	p
				Donja granica	Gornja granica		
Ne postoji pozitivan stav i sreća pri susretu s matematikom	288	2,89	1,0702	-,2318	,0165	-1,707	0,089

Table 3. Arithmetic mean values, standard deviations of the it - test - There is no positive attitude and happiness when encountering mathematics

Observing and analyzing table 3, we can see that the t-test is (-1.707) and the value Sig.=0.089, while the arithmetic mean (M=2.89) thus we can generally see that there is no positive attitude and happiness when dealing with mathematics.

First of all, we will present a sample T-test on the variable there is no positive attitude and happiness when encountering mathematics. The results are shown in Table 4.

Nezavisne varijable		N	M	SD	*t- vrijed./ ANOVA*	*p*
Spol	M	142	2,93	1,081		
	Ž	146	2,86	1,061	0,581	0,561
Razred	I	48	2,84	1,097	0,344	0,793
	II	68	2,99	1,011		
	III	100	2,91	1,072		
	IV	72	2,81	1,118		

Table 4. t-test and ANOVA - There is no positive attitude and happiness when encountering mathematics

Looking at table 4, we see that the value t=0.581 as well as its significance Sig.= 0.561 which is above the threshold value of 0.05, analyzing this issue we see that there is no statistically significant difference in arithmetic means between male and female gender where the value (M =2.93) in male subjects and (M=2.86) in female subjects. And with a higher standard deviation in male subjects (SD=1.081) in contrast to female subjects (SD=1.061). This indicates that there is no statistically significant difference between the sexes.

The findings of the research between respondents with regard to class (Table 4.), show that there is no statistically significant difference between respondents with regard to class (t=0.344; p=.793). By analyzing the arithmetic means, it can be seen that it is slightly higher for respondents in the category of second grades, and the same amount (M=2.99), while the lowest arithmetic mean was shown in the category of respondents of the fourth grade (M= 2.81). Taking into account the results of the standard deviation, we observe that the highest standard deviation (SD=1.118) was shown in the first grade, and the smallest (SD=1.011) in the second grade category.

Sub-hypothesis 3.: It is assumed that there are prejudices and lack of mastery of basic and fundamental mathematical concepts, and that there is a statistically significant difference in relation to gender and the class from which the respondents come.

Varijabla	N	M	SD	95% Interval pouzda		t-test	p
				Donja granica	Gornja granica		
Postoje predrasude i nesavladavanje osnovnih i temeljnih matematičkih pojmova	288	2,70	0,8028	-,3882	-.2020	-6,239	0,000

Table 5. Arithmetic mean values, standard deviations of the it - test - There are prejudices and failure to master basic and fundamental mathematical concepts

Observing and analyzing table 5, we can see that the t-test is (-6.239) and the value Sig.=0.000, while the arithmetic mean (M=2.70) thus we can generally see that there are prejudices and lack of mastery of basic and fundamental mathematical concepts.

Nezavisne varijable		N	M	SD	*t- vrijed./ ANOVA*	*p*
Spol	M	142	2,81	,7777		
	Ž	146	2,60	,8153	2,264	0,024
Razred	I	48	2,55	,6848	2,973	0,032
	II	68	2,53	,8726		
	III	100	2,79	,7862		
	IV	72	2,85	,7968		

Table 6. t-test and ANOVA - There are prejudices and failure to master basic and fundamental mathematical concepts

Looking at table 6, we see that the value of t=2.264 as well as its significance Sig.= 0.024 which is below the threshold value of 0.05, analyzing this problem we see that there is a statistically significant difference of arithmetic means between male and female gender where the value (M=2 .81) in male subjects and (M=2.60) in female subjects. And with a higher standard deviation in male subjects (SD=.8153) in contrast to female subjects (SD=0.7777). This indicates that there is a statistically significant difference between the sexes.

The findings of the research between respondents with respect to class (Table 6.), show that there are statistically significant differences between respondents with

respect to class (t=2.973; p=0.032). By analyzing the arithmetic means, it can be seen that it is slightly higher for respondents in the category of fourth grades, and it amounts to the same (M=2.85), while the lowest arithmetic mean was shown in the category of respondents of second grades (M= 2.53). Taking into account the results of the standard deviation, we observe that the highest standard deviation (SD=0.8726) was shown in the second grade, and the smallest (SD=0.6848) in the first grade category.

Sub-hypothesis 4.: It is assumed that there is a potential lack of fear of mathematics in certain circumstances, and that there is a statistically significant difference in relation to gender and the class from which the respondents come.

Varijabla	N	M	SD	95% Interval pouzda		t-test	p
				Donja granica	Gornja granica		
Postoji potencijalni nedostatak straha od matematike u određenim okolnostima	288	3,20	1,173	0,0671	0,332	2,939	0,004

Table 7. Arithmetic mean values, standard deviations of the it - test - There is a potential lack of fear of mathematics in certain circumstances

Observing and analyzing table 7, we see that the t-test is (2.939) and the value Sig.=0.004, while the arithmetic mean (M=3.20) thus we can generally see that there is a potential lack of fear of mathematics in certain circumstances.

Nezavisne varijable		N	M	SD	*t- vrijed./ ANOVA*	*p*
Spol	M	142	3,18	1,191		
	Ž	146	3,23	1,158	-0,335	0,738
Razred	I	48	3,13	1,274	2,075	0,104
	II	68	2,99	1,082		
	III	100	3,20	1,073		
	IV	72	3,47	1,173		

Table 8. t-test and ANOVA - There is a potential lack of fear of mathematics in certain circumstances

Looking at table 8, we see that the value t=-0.335 as well as its significance Sig.= 0.738 which is above the threshold value of 0.05, analyzing this issue we see that there is no statistically significant difference in arithmetic means between male and female gender where the value (M =3.18) in male subjects and (M=3.23) in female subjects. And with a higher standard deviation in male subjects (SD=1.191) in contrast to female subjects (SD=1.158). This indicates that there is no statistically significant difference between the sexes.

The findings of the research between respondents with respect to class (Table 8.), show that there is no statistically significant difference between respondents with respect to class (t=2.075; p=0.104). By analyzing the arithmetic means, it can be seen that it is slightly higher in the respondents in the fourth grade category, and it amounts to the same (M=3.47), while the lowest arithmetic mean was shown in the category of respondents in the second grades (M= 2.99). Taking into account the results of the standard deviation, we observe that the highest standard deviation (SD=1.274) was shown in the first grade, and the smallest (SD=1.073) in the third grade category. It is important to note that in all classes the SD is greater than 1, and differs by several decimal places.

CONCLUSION

Fear of mathematics mathophobia, and it is an increasingly common phenomenon, which can take on serious clinical forms. Fear can appear after a specific unpleasant experience or when the student gradually stops following the professor's explanations and feels lost. Thus, he gradually loses motivation and "runs away" from everything related to mathematics. The concept of fear of mathematics has been of interest to researchers for years, and the earliest research was conducted in the middle of the 20th century, because it was noticed that many students feel emotionally bad when they do mathematics. The phenomenon itself is very current, and even in 1995 a "strict" definition of mathophobia

was reached, which reads *"Fear of mathematics can be defined as a feeling of tension and anxiety that interferes with manipulating numbers and solving mathematical problems in a wide range of everyday life and academic situations."* (Gierl and Bisanz, 1995:140). By examining the assumptions that we defined through the work, we came to the indicators that there is a fear of mathematics in high school mathematics classes, and that there are also difficulties in mastering mathematics. Furthermore, there was an indication that there is a statistically significant difference in the attitude based on the approach to mathematics in relation to gender, while in relation to class, the same does not exist. What can also be noticed is that in some situations the fear does not dominate, it is not expressed, which can be concluded that the fear of mathematics, i.e. mathophobia are not always "of the same amount". With this indicator, we arrive at new knowledge and new questions, which should be the subject and goal of some new research. We therefore conclude that the fear of mathematics and difficulties in mastering mathematical content in primary schools are evident, but that they are not always expressed in the same way. Also, it is concluded that there is no positive attitude of the respondents towards mathematics, which is one of the additional worrying facts.

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ELEMENTS WHICH CAUSED THE APPEARANCE OF INNOVATIONS IN MINISTRY AND THE CHANGE OF THE MANAGER'S FUNCTION IN HEALTHCARE

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Summary

The modernization of health care as a whole in the era of automation and the increasingly frequent use of ICT is noticeably reflected in the change in the structure of the education system of health workers, the program content of personnel education, the duration of education and training of personnel, mass at all levels of education, and more. All this resulted in significant changes within the entire health and education system. Due to the multitude of technical and technological achievements, the area of application of new technique and technology in the process of education and professional development could not remain outside the influence. By introducing this new factor (technological-technical) into education, it was learned that systematic changes will be needed, i.e. not only changes within the teaching forms and methods, but also changes in the function of the manager in the health organization. The existing models of education are beginning to be unsuitable, and the health organization, as one of the institutions of special social importance, is beginning to lag behind contemporary trends.

Keywords: *management, healthcare organization, education, innovations.*

JEL classification: I21

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1 INTRODUCTION

The acceleration of scientific and technical changes that are taking place in health care in parallel with economic and socio-political transformations has become more and more significant every day for the health care system, which has found itself at such a turning point as civilization has never known. The large steps taken by modern science bring entire systems of social reality into a very precarious situation, thus destroying the previous structures of values and knowledge in health care that were unchanging and universal for a long time. The impermanence of scientific knowledge and its constant variability bring the health system of our civilization under such radical changes that will have unfathomable consequences for generations to come.
Understanding the interdependence of scientific discoveries in general with economic and social development will determine our future because the educational system and its modernization will be given due recognition, especially in the health sector.

2 THE INEVITABILITY OF TRANSFORMATION OF EDUCATION IN HEALTHCARE

The presence of certain understandings that scientific and technical progress stops in front of traditional education because of its orthodox and inelastic attitude towards modern changes in all human domains of work and life, sounds surprising, paradoxical, and frightening. All the more so when it is known that the scientific understanding and progress of society has always been most tightly linked to the teacher and the school. The gap between social wills in relation to everything that educational institutions give us now presupposes urgent social interventions, the postponement of which will be more and more expensive and dramatic every day. Continuous reform interventions at all levels of the health and education system, and social movements on the basis of which solutions are approached, mark a historical transformation not only of changes within the educational system but also of its feedback effect on social resources. The various application and exploitation of scientific, technological and technical achievements bring great social changes not only in the economic but also in the health and educational field.

The modernization of health care as a whole in the era of automation and the increasingly frequent use of ICT is noticeably reflected in the change in the structure of the education system of health workers, the program content of personnel education, the duration of education and training of personnel, the mass at all levels of education, and more. All this resulted in significant changes within the entire health and education system.

Due to the multitude of technical and technological achievements, the area of application of new technique and technology in the process of education and professional development could not remain outside the influence.

By introducing this new factor (technological-technical) into education, it was learned that systematic changes will be needed, i.e. not only changes within the teaching forms and methods, but also changes in the function of the manager in the health organization. The existing models of education are beginning to be unsuitable, and the school, as one of the institutions of special social importance, is beginning to lag behind contemporary trends. Educational technique and technology gradually imposed itself as an imperative of modern social progress and, looking for its adequate place in teaching, it had to meet the demands of changing the function of managers in healthcare organizations as a kind of educator.

The interdisciplinarity of the study of phenomena related to the field of health and professional development opens up various problems related to the technological and technical structures of modern teaching. The personality of the manager in healthcare as a teacher, as an official participant in the educational activity, and especially his personal characteristics, in the new conditions of work, which are conditioned by the scientific-technical, psychological, biological, physiological, ecological and other achievements of modern society, appears now in new dimensions.

Reform attempts in the world and in Bosnia and Herzegovina (us) are assumed to arise from crisis situations in the health and education systems, especially from the point of view of the growing disproportion between the quality offered by the education systems and what is imposed in a super-industrial society as the need for accelerated professional , mostly by higher education.
Analyzing the reform interventions in the field of health and education, we come to the knowledge that the function of health managers in the complex of necessary changes is, if not the most important, then certainly one of the main factors in the entire system.

3 UNCERTAINTY OF PROGRESS

Just as in the industrial revolution, technology and its versatile application pushed man from the physical participation of his workforce in immediate production, thus the already rich assortment of innovations of a technical and technological nature imposes itself in the process of medical work, relegating the healthcare manager as a teacher from the sphere of broadcasting with his speech, that is, of personal participation, offering at the same time such technical solutions in front of with which both health and educational sciences found themselves in a dilemma. Will the technique of perfected electronic classrooms, television, computers, programmed machines, film and other media force the health manager as a teacher to retire or to maximally correct his previous status? These dilemmas have appeared recently and are causing a certain amount of uneasiness and professional uncertainty among some teachers and health professionals. This has led to a situation where some teaching and health professionals have become more conservative in relation to innovations than the traditional backwardness of some other activities.

The structure of the highly developed industry in healthcare requires personnel who will be able to permanently follow the acceleration of production trends, social standards and economic-political stability. Serious demands are placed on healthcare and educational organizations, healthcare managers and teachers: to provide the ideal type of healthcare professionals in the shortest possible time and at the lowest possible cost. In addition, a wide selection of the most modern technical means is offered.

4 CRISIS OF PROFESSIONAL EDUCATION IN HEALTHCARE

Is a crisis of professional development in healthcare on the horizon? The crisis of professional development and education in healthcare has been present on the world stage for a long time, not only in developing countries, which are underdeveloped, but also in highly developed countries. Through a short analysis of the periodization of the socio-economic development of highly developed countries, we will notice that the "waves" of the explosion of certain levels in society take place alternately (better to say legally) in a logical sequence: socio-economic and political conditions pave the way for the expansion of education at the

first (elementary, i.e. primary) level, followed by expansion in the second level (directed education, professional, vocational) and, finally, higher education - third level.

The issue of the second level, the level of education, has become a basic political preoccupation in many countries for a long time. Being between the growing needs for technically more perfect health care and the abundance of new scientific knowledge, heterogeneous and traditionally burdened second-level education shows its mutation not only with a crisis in the content of work, methods, forms and means, then with an "explosion" of knowledge, a system of learning and evaluation and student work, the concept of the teacher education system, but also the unstable function of all teachers involved in it.

If changes in society, and especially in health care, will require an economic basis for the modernization of the existing educational system, then as part of these predictions, the problem of forming managers as educators for those generations that will live in the 21st century cannot be avoided. . Are these the current healthcare workers who were educated until a few years ago? Is it possible to know with certainty what their technical-technological (teaching) efficiency is? In the last case, are there such personnel at the current faculties and schools who are capable of making such radical changes in the process of education of (future) healthcare workers that will meet the "profile of the healthcare worker of the future"? What changes in the health education system (second level) leave the possibility of further development of (new) medics? Where to with the existing staff who are nearing the end of their working life? What should be done to reorganize the education of healthcare workers who are constantly "crying" for new branches of medicine?

Answers to many questions must be asked and viewed in the interdependence of several factors, and among them are problems related to changes in education, on the one hand, and the impact of scientific and technical changes on social needs in the sphere of not only health but also education, on the other side.

5 THEORIES OF LEARNING AND CHANGES IN EDUCATIONAL METHODOLOGY IN HEALTHCARE

Among scientists, in the last few years, the understanding that the "explosion", that is, the expansion of technique and technology has entered a serious dimension, and that their "perfection" and maximum automation have partially solved several of the most urgent problems humanity has been around for many years. There are also plenty of those who have always been distrustful of technical technological inventions in medicine. However, the inspiration and fearlessness of those who want progress seems to have no limits. Their visionary assumptions of the broadest humanistic dimensions seem to be only a temporary obsession of their complicated "composition, which occupies and fascinates the average health worker far more than one might expect.

Such tendencies seem to have been fueled by the abundance of new research in the last few years in biology, biochemistry, genetics, medicine, physiology, philosophy, and especially psychology, towards the search for solutions to the uncertainty faced by man in order to solve the present problems (ecology, nutrition, industry, childbirth, treatment, upbringing and education). Beliefs that scientific research in psychology will be able to be applied very quickly in the daily life of modern man seem to have gradually started to be lost precisely because of the contradictions in

the understanding of psychologists as fundamental problems that psychology has faced since the time it separated from philosophy. This gap leaves at the same time the vagueness of psychology in everyday educational practice and the enormity of the potential of still insufficiently examined human characteristics trapped in new technology. Perhaps some "hidden" human potential will be able to develop faster only as part of new technical inventions. But their vagueness and surprises have a different prognosis in all spheres of society.

Neither philosophers, nor psychologists, nor pedagogues, nor doctors can remain indifferent to the challenges posed by genetics.

The human sphere of expanding knowledge and power will now be reduced more and more to the concept of human wisdom, which, without the slightest hesitation, must be studied far deeper in the interdependence and dialectical contrast within, genetics, psychology and pedagogy. The sciences have gone so far in individual intensive research that scientists are now faced with much more serious and complex problems in unifying and realizing their achievements, especially in terms of the development of personality traits.

Humanity has always sought the greatest source of its potential in the rational application of knowledge, as well as in the education of the young generation. the historical path of psychology, which straddled between "abstract", rational and concrete natural life, could not be lost in the contemporary currents of philosophical and psychological directions, although it sometimes seemed that originality had been found in "modern" psychology or that they were intense research gave "recipes" for solutions to age-old problems, especially in the field of learning and education.

Thus, among numerous theories of learning, external and innate factors of knowledge must be equally respected, and their application in terms of education and training in terms of professional development is becoming more and more complex.

Long-term disagreements among psychologists about whether maturing and learning have a dominant influence on the development of human behavior, however significant it may be for the development of psychology, at the same time introduced serious obstacles to the creation of a firmer basis regarding the educability of certain personality traits and boundaries. the scope and possibilities of education in general.

Proponents of the Gestalt theory of learning, based on numerous researches, present the understanding that psychological contents, specifically learning processes and flows of human thinking, do not consist of individual parts (elements), so they are not formed by simply summing up their parts, but represent a unique whole. When learning and solving some problems, according to the Gestaltist's understanding, some phases that are typical (preparation, incubation, illumination and verification) and completely given inevitably take place. Thus, it is said that learning does not represent the accumulation of experience, but rather its permanent and expedient re-organization. Very significant research with children and people in classes was carried out by Wertheimer, who believes that teaching based on logical-formal and associative foundations significantly disrupts and slows down the development of productive thinking in young people and adults. His warnings that after a certain time the learned rules, forms, theorems and laws are forgotten, thus hindering problem solving, can be accepted to a certain extent, because when students understand essential instead of formal procedures, then they will, without knowing (or remembering)

formulas, rules and theorems to be able to successfully solve problem situations. This understanding is essentially far more acceptable than the associationist and formal-logical type of teaching, but for those of us who deal with the education of young people, the question remains unsolved:

- How quickly can all "students" solve problems in this way?
- What about those students who are lagging behind or have a very hard time solving problems? and
- Is everyone interested in acquiring new knowledge and skills completely, able to solve problems without learning formal procedures, laws, theorems, formulas and the like?

However, the Gestalt theory of learning made a significant contribution to the development of teaching because, contrary to the formal-logical type of teaching, it enabled teaching to be directed much more towards learning with understanding and design. Therefore, even now, the question of the speed of understanding certain contents in classes where modern techniques and technologies in the direction of ICT are applied is more serious and expedient. The problem arises in situations when the educator presents certain content to all interested parties at the same time with the help of some media, while knowing that the consumption of this content will not occur with the same speed and intensity for everyone. His role must change significantly in relation to the adaptation and choice of methods and media he uses in his work. There is a problem of determining, diagnosing and predicting adequate work (learning) systems that - regardless of the teaching technology - will give maximum cognitive effects in relation to the formation of the personality of the participants of education and teaching.

In the field of learning and education, Skinner's theory of reinforcement in the last twenty years has been quite well received not only in the psychology of learning, but also in pedagogical psychology and didactics. It is to Skinner's credit that, with his scientific research, he enabled the wider application of machines in learning, and thus the creation of a new, in the true sense of the word, a revolution in teaching.

In his work "Scientific development of teaching", Skliher presents his views on contemporary trends in the development of learning and teaching. Drawing a distance between the organism's response to external stimuli and operational behavior that is proportional to reinforcement, he reduces human learning to an activity that is tied to a predetermined goal.

Presenting three basic concepts, which he calls metaphors, in human behavior, he critically looks at the numerous shortcomings and vagueness in the explanations of the attempts and application of many experiments with animals to come up with certain theories of human behavior. These are: (1) learning in action, where problem solving is emphasized; (2) learning from experience to a situation where solutions appear that cannot independently, or in combination with each other, give a more complete conception of human learning, because the problem should be focused on the analysis of changes that occur precisely at the moment when a person learns something; (3) positive and negative reinforcers - reinforcements that are often very few or almost none in the classroom.

Skinner's criticism of the traditional conception of learning boils down to:
Skinder directs the harshest criticism to the traditional school and the lack, or rather very weak reinforcement, that is, confirmation during learning, which most often comes only from educators.

Overcoming difficulties in traditional teaching and learning is possible with the well-designed application of experiments

that have been carried out to date and that can be applied under certain conditions in our educational work (in healthcare). The reinforcement of educators in classical teaching was really weak and the education candidate did not have the opportunity to correct his work. In the new conditions, where technique and technology are applied in classes, the educator will have significantly more opportunities to inform the student (that is, to support him) about the course of the immediate learning process and thus enable him to work better and progress faster.

For us, Skinner's understanding that in teaching and learning is not of first-class importance is not reinforcement, but modeling of the continuum of procedures that achieve the adoption of some content, because the subject is affected by very subtle details that escape the deliberate control of the human organism. Therefore, the experimenter must be replaced, so to speak, by mechanical or electrical devices, but not at all costs and not in all situations, because the permanent connection of the educator in the learning process with the young healthcare worker and an emotionally positive attitude towards them in certain work situations is irreplaceable and is of inestimable value. What we want to highlight for teaching technology is the aspiration to maximally eliminate the aversive situation in the traditional education methodology created by the educator's reaction (evaluation) of the candidate's problem solving and learning itself.

CONCLUSION

Numerous studies show that some solutions must be quickly applied in the professional development and education of young health workers, but a significant part of these studies will require experimental checks and careful measurements of some results that will not be possible in our cultural environment and in our socio-political aspirations. to catch That is why care must be taken about the models and structure of the training of current and future more experienced doctors who could be involved in the modern trends of scientifically proven innovations in health education. This obliges us to the need to introduce significantly more intensive and extensive research and teaching-educational work, without which it is not possible to move forward in solving many problems.

Discoveries that in the last twenty years have brought epochal changes in biology, genetics, anthropology and medicine impose serious reasons for revising some pedagogical and psychological settings in healthcare. There are, first of all, unimagined possibilities of scientific knowledge about the biochemical and genetic structures of man and their influence on the development of certain personality traits, as well as scientific assumptions that the structural specificities of the cerebral cortex are so individual that they must be ignored as soon as possible or, better said, reject some long-standing tradition and that we must make very bold and radical moves in terms of respecting and tolerating human authenticity and individuality, and not be slaves to the statistical inexorability of the "mass" which is based on the construction of the "average man" (average health worker). Thanks to a lot of scientific knowledge in the field of tangential sciences with pedagogy and psychology, management, as well as the attempts of various learning theories to introduce more new solutions into health and educational activities, the traditional system of organizing education and professional development and learning is facing one of the biggest change in its very long history. The acceleration of these changes was conditioned by the increasing pressure of technical and technological innovations, which, with their diverse applications, not only in medicine but also in education in general, made great changes in relation to the sources, transfer and

consumption of knowledge, which until now was reserved only for teachers. and represented his indisputable function. Those jumps in the processes of changed conditions of education and educational relations drastically disrupted and seriously threatened the traditional understanding of the function of the manager in healthcare, his exclusion and suppression from some processes in which he was a key and irreplaceable factor.

Learning theories and their application in the teaching of medicine imply not only changes in relation to the organization and contents of work, but also a thorough change in the education of leaders, managers, who will be able to professionally organize teaching adapted to the new requirements of medicine. This means changing the system of education and permanent training of managers as managers with the aim of assigning the manager an adequate function in the new conditions that cannot be replaced by any technical-technological medium.

The complexity of the issue of learning and professional development, which is treated differently in theories, then the changes that in modern technique and technology of medicine impose the need for new searches in the activities of a healthcare manager who leaves part of his former activities to modern media, comes to a new situation that requires him to change his activity . The constellation of factors that determine the change in the manager's function in innovation significantly determines the dimension of the manager's influence on the young generation. Thus, the problem of the function of leaders, managers in the health sector in the new conditions must be studied much more intensively, because the fundamental role of the manager does not change in the health process, but it appears in the changed conditions that bring innovations, with a much more specific activity as an educator to young people.

CERTAIN AREAS AND POSITIVE PRACTICES OF THE GREEN ECONOMY

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Abstract

One of the goals of writing this paper is to encourage younger generations, especially pupils and students, to get more involved in solving environmental protection issues. In this paper, we will try to examine the significance of the new economic model, the green economy, and its contribution to solving climate change problems that have far-reaching consequences for the lives of people, plant, and animal species on planet Earth. The importance of environmental protection for the survival of the Planet in its current state is highlighted by the fact that many governments, corporations, institutions, governmental and non-governmental organizations have supported the implementation of projects in this area. We will present several areas where the green economy currently a dominant role and where respectable results has have been achieved, which have a significant impact on the development of the green economy. Additionally, we will showcase some positive practices that ultimately result in environmental protection and the creation of new green jobs. However, the green economy and the projects it brings positively affect both environmental protection and the increase in the living standards of the population.

Keywords: *Green economy, environmental protection, sustainable.*

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1 INTRODUCTION

Thanks to the rapid progress in the development of the green economy worldwide, and recently in our country, this paper will not be able to cover all segments and aspects of the green economy as a comprehensive response to climate change and the preservation of the quality of life on planet Earth. However, one of the basic goals of writing this paper is to encourage people of all ages and generations, as well as entrepreneurs, to think critically and explore topics related to preventing further environmental degradation, and to promote a new economic model that should play a new role in creating an environment for a fairer society and better living conditions for all people on planet Earth. Additionally, one of the goals of writing this paper is for younger generations, especially pupils and students, to participate and contribute, to some extent, to the development of a new economic model that will be capable of meeting people's needs, transforming artificial scarcity into a sense of sufficient possession of everything people need. In brief terms, we will present the significance of the green economy as the economy of the future on which the future economic development of countries should be based without disrupting the current level of economic development. Since the green economy encompasses many economic areas, we will not be able to cover all areas in this paper, but we will present only the most important ones that have the greatest impact on the development of the green economy, such as renewable energy sources, forest and biodiversity protection, waste management and various recycling areas, green architecture and construction, ecological agriculture, and water management. Today, there are numerous positive practices and benefits associated with the implementation of projects in the field of the green economy. In our paper, we will present some of them and show the significance of projects that protect the environment and their impact on people and the natural environment in which we live.

2 Green Economy

Recently, a special economic model has emerged. This economic model is particularly present in the most developed countries of the world, although many developing and medium-developed countries are increasingly turning to the new economic model. Its task is economic development without endangering the environment. As is already known, the main goal of the new economic model, the green economy, is to create new jobs and maintain a healthy and happy population in the future. For this to happen, a change in human consciousness is necessary if we are interested in surviving on planet Earth. It is encouraging that many companies have already adopted the new economic model and are increasingly involved in projects that support environmental protection. The largest number of companies receive wholehearted support from the governments of countries that have committed to greater financial support for projects in the field of green economy development. For the green economy to develop faster, it is necessary for countries to go through a green transition as soon as possible. The green transition is the basic prerequisite for the development of the green economy. The green transition should gradually bring planet Earth to a green economy, which is our future and something without which we will not be able to survive. The green transition should bring about a real transformation of society and the economy to accelerate the transition from the conventional to the green economy. Although today there is a respectable number of entrepreneurs who believe that ecology and the economy cannot go together, is this claim correct? The answer to this question should be given by the green economy.

Through the transition, it is necessary to promote five critical areas, such as:

- Greening the economic sector,
- Combating inequality,
- Valuing nature,
- Measuring and managing,
- Reforming the financial sector.

3 The Importance of the Green Economy

Thanks to the green economy, we first and foremost obtain certain guidelines, particularly for economists who receive information about the unlimited possibilities through a series of technological innovations connected to the natural environment. As many economists believe, ecological sustainability is not in conflict with business profitability, as they are not mutually exclusive. On the contrary, some opinions confirmed in practice suggest that they are even compatible in some segments. Sciences and their disciplines, such as physics, biology, chemistry, and others, confirm that it is possible to apply new scientific achievements and knowledge from these fields in the new economic model, particularly in renewable sources of raw materials and energy. The need to adopt new rules and regulations aims to support new research approaches as well as economic development by promoting new strategies and market mechanisms. By adopting new strategies and rules, we can contribute significantly to solving the accumulated problems. However, there are solutions to these problems, and they need to be accepted and applied as soon as possible.

Many scientists believe that the world is experiencing the sixth wave of extinction. Much of the blame for this wave of extinction lies with the current economic models and excessive human greed for acquiring greater profit, regardless of the threat to plant and animal species, natural habitats, and ecosystems. Among the many interesting topics in this digital era, the green economy has also become one of the more interesting topics, especially considering the consequences of the rapid onset and effects of climate change.

What are climate changes or global warming? Global warming, often referred to as climate change, occurs when the average temperature on planet Earth begins to rise. This is significant because global warming can cause sea levels to rise, intensify storms, alter typical climate characteristics, and increase the likelihood of new diseases spreading across the planet faster and further . In scientific circles, this topic is gaining increasing importance, and many experts from different scientific fields are addressing it. The results of their research are presented in numerous professional and scientific journals, as well as at international symposia, conferences, and round tables, where this topic is increasingly discussed and gaining importance. Occupying more space in scientific circles, the green economy has become an interesting topic, especially due to sustainable development and the utilization of natural resources in a way that preserves and protects the environment. Besides economists, many other experts also consider the green economy something that should protect natural resources from increasing devastation and improve the quality of life for people on planet Earth. They contribute increasingly through research in developing new technologies that will protect the environment, and they generously present the results of their research to accelerate the development of the green economy to protect nature and mitigate the consequences of climate change as soon as possible.

Thanks to the collaboration of experts and scientists from various fields, positive changes in the development of the green economy are becoming more evident, as is the new approach of all interested parties regarding the importance of environmental

protection. In a word, the green economy can be said to represent the synergy of various sciences and their disciplines. The emergence of the green economy can be attributed to experts from different fields such as ecology, biology, physics, chemistry, natural sciences, social sciences like economics, and its various disciplines. The whole world is facing a disturbed climate in all aspects. However, there has emerged a need for new systems, such as new forms of water supply, the creation of green infrastructure, green agriculture, green architecture, green banking, green tourism, and other economic activities that directly or indirectly affect climate change. The existing systems have not proven sustainable, and they should be replaced with new ones that would enable the faster development of the green economy. The importance of the green economy as a new economic model, especially in the current time of climate change and disrupted natural balance, is increasingly gaining significance in both the economy and society. In the future, the green economy will be one of the most significant economic models that can greatly contribute to the survival of human life on planet Earth. Besides its economic significance, the green economy has particular importance in the ongoing fight to protect the environment.

To stimulate the development of the green economy, it should be supported at all levels and as well as in all institutions that influence its development, particularly in those countries that, due to rapid industrial development, especially in developing and medium-developed countries, have had large industrial and processing capacities that have so far negatively impacted environmental pollution through their regular business activities. Industry is not the only polluter; many large cities also fall into the category of major polluters. Besides the changes we are discussing in the production sector, attention should also be paid to many other areas, such as the consumption process. This area should not be neglected, as much more could be done to change the mindset regarding the consumption of existing products and services, which could significantly contribute to the rational use of limited natural resources in the present and future.

4 Specific Areas of the Green Economy

As previously mentioned, the green economy as a new economic model should integrate various sectors of the economy. However, due to limited space in this paper, we will not be able to cover and present all areas, but we can highlight some of the most important ones, such as:

- Renewable energy sources,
- Protection of forests and biodiversity,
- Waste management and various recycling areas,
- Green architecture and construction,
- Ecological agriculture,
- Water management.

Speaking of economics as a science, we can conclude that it can provide answers to numerous questions that arise daily in the field of the green economy. Economics as a science should also support the development of all other sectors within the economy to be prepared to face new challenges that await us in the fight against all the adversities brought by climate change. These changes have already disrupted the natural balance on Earth, with a tendency to continually devastate both natural and other material goods necessary for human needs. However, climate change directly or indirectly affects the increasingly frequent occurrences of droughts, floods, strong winds, earthquakes, and other negative natural impacts on the environment, security, and quality of life for people, plants, and animals.

4.1 Renewable Energy Sources

When it comes to renewable energy sources, we can ask, what is meant by

renewable energy sources? From the name itself, we can conclude that it is energy that is constantly renewing or regenerating and cannot run out because its source is renewable in nature. The advantage of this energy source over others, especially fossil fuels, is that its use, i.e., combustion, does not release CO2, one of the major pollutants contributing to the greenhouse effect and negatively impacting climate change, which is responsible for today's weather disasters affecting the entire planet and all living beings. The impact of climate change on altering Earth's climate can be seen through the occurrence and prolonged effect of droughts without precipitation, even in areas that previously had a high number of rainy days, which now regularly experience droughts with severe consequences, especially in open-field agriculture. Frequent floods are another significant weather disaster, causing not only human casualties but also negative impacts on the devastation of nature and material goods. Additionally, strong winds cause significant damage, particularly in areas where they were previously uncommon, but now due to climate change, they occur with great material damage to residential buildings, industrial halls, movable and immovable properties, and other material goods. However, the devastating impact on nature is also significant.

The most included renewable energy sources are solar energy, wind energy, hydro energy, ocean energy, geothermal energy, biomass, and biofuels. All these energy sources are quality replacements for fossil fuels and help reduce greenhouse gases, diversify energy supplies, and decrease dependency on unreliable and unstable fossil fuel markets, especially oil and gas. We will mention an interesting fact supporting the exploitation of renewable energy sources. The European Union's legislation promoting renewable energy sources has significantly developed in the last decade. According to official data from the European Union, energy from renewable sources reached 21.8% of the final gross energy consumption in the EU in 2021. From the presented data on the importance of renewable energy sources in the EU, it is evident that if the promotion of their use continues, these energy sources will soon become irreplaceable, reducing the use of fossil fuels.

4.2 Protection of Forests and Biodiversity

The importance of forests for the uninterrupted life of humans, plants, and animal species is well-known. Forests support biological diversity, promote traditional lifestyles of indigenous communities, and protect forest ecosystems. For a long time, human activities have caused negative impacts that damage and degrade many habitats for various plant and animal species whose natural habitat is the forest. Deforestation significantly affects the habitat changes for many animal species. More than 50% of the Earth's biodiversity is found in forested areas. About 90% of the world's forest species are tropical forests. Biodiversity is the foundation of forest ecological services, productivity, and resilience. Many natural processes could not occur without forests, especially ecological processes such as plant growth, carbon sequestration, pollination, seed dispersal, nutrient recycling, all of which depend on biodiversity, a crucial condition for food safety and security. Therefore, maximum attention must be paid to protecting forest ecosystems. Forest biodiversity is decreasing due to irresponsible human behavior and excessive exploitation of forests. It is necessary to reduce pressure on forests, restore ecosystems, and use biological resources rationally and sustainably. Protecting forest ecosystems and biodiversity should be implemented in all forest areas, whether managed for production, conservation, or other purposes. It is essential to preserve genetic resources and ecosystem diversity, including vulnerable and endangered species. In simple terms, productive and protective

forests must be protected from forest fires, illegal activities, invasive species, and pests. We believe that preserving biodiversity requires intersectoral efforts to reduce habitat fragmentation and protect forests, which is crucial for our survival on this planet. Numerous international organizations continuously warn about the importance of forest protection and biodiversity expansion.

4.3 Waste Management and Various Recycling Areas

Waste today represents one of the significant sources of raw materials. Its processing and recycling involve the separation of raw materials from waste and their reuse. The recycling process includes collecting waste, separating useful materials, processing, and making new products from recycled materials. After collecting waste, one of the important tasks is the targeted separation of materials that can be recycled and quickly put back into use. The most common materials separated from waste that can be recycled are metal, paper/cardboard, plastic, glass, Tetra Pak, and biodegradable waste. In the case of paper/cardboard, plastic, and Tetra Pak recycling, the same or similar raw materials are obtained, albeit of slightly lower quality. Glass recycling involves melting and can be reprocessed into new products. Metal recycling saves a large amount of energy. Biodegradable material is the easiest to process because it can be turned into fertilizer and quality humus, and often, thermal energy can be produced in bioenergy plants. Experts consider plastic waste to be the most problematic among all recyclable waste. If not properly disposed of, plastic waste and synthetic materials can end up in drinking water, rivers, lakes, seas, and very often enter the human food chain. According to expert estimates, close to 8 million tons of plastic enter the oceans every year. The extent of the problem of unmanaged waste for the environment can be easily understood. However, if something is not done quickly to address the organized and planned management and recycling of large amounts of waste material, we will not have a bright future. Now it is up to us and our conscience regarding the importance of protecting the environment from excessive pollution caused by unmanaged waste.

4.4 Green Architecture and Construction

Green architecture or green construction mainly advocates for the conservation of energy and the reuse and increased safety of new and currently emerging construction materials. One of the main goals of green construction is to build and position buildings and construction projects with minimal environmental impact, such as the construction of passive houses or low-energy houses. However, recently, new collaborative incubator spaces have been developed in this manner. Thanks to newly discovered materials, an unusual design of buildings is rapidly developing today, aiming to achieve minimal negative impact on existing ecosystems. To achieve this, it is necessary to use available materials and energy efficiently. The construction sector today is considered one of the fastest-growing sectors, continually adapting to new circumstances. Daily research in this sector leads to the emergence of new construction materials. Additionally, new ideas and construction techniques have emerged, which could not have been imagined just a few years ago. Despite the rapid development of the construction sector, many materials and construction techniques are still in the testing phase, which does not mean they will not dominate the market shortly. We live in a time full of new discoveries that can quickly be implemented in practice. By developing this sector, many "green" buildings have been constructed worldwide, featuring well-designed and functional eco-friendly designs that can serve as good examples for future green construction.

4.5 Ecological Agriculture

Food production is increasingly dependent on the quality of the soil on which agricultural production takes place. Recently, serious consideration has been given to the consequences of conventional food production methods. Climate change has prompted more serious thinking about new models of agricultural production, such as ecological agriculture. The conventional way of agricultural production has not proven to be a method that can preserve soil from the excessive use of chemical fertilizers and protective agents, which ultimately aim for higher agricultural yields regardless of the ecological consequences. Agricultural experts have proposed a new model of agricultural production that will preserve the soil and reduce greenhouse gas emissions from agriculture, which is ecological agriculture.

Ecological agriculture is a new model of food production with a limited impact on the environment while encouraging responsible use of energy and natural resources, maintaining biodiversity, ecological balance in regions, increasing soil fertility and quality, and maintaining water quality, etc.. Ecological agriculture aims to preserve the health of the soil, ecosystems, and people. It relies on ecological processes, biodiversity, and cycles adapted to local conditions, avoiding practices and materials with harmful consequences for the soil. Ecological agriculture combines tradition, innovation, and science to protect the environment and improve people's quality of life. Basic principles such as health, ecology, and fairness are fundamental to the development of ecological agriculture.

The significance of ecological agriculture in maintaining human health through environmentally friendly food production is evident. Today, organically produced food is increasingly accepted worldwide, with many consumers despite its higher price compared to conventionally produced food. However, people prefer organic food due to its quality and positive impact on human health. Therefore, we believe that in the future, countries that focus more on ecological agricultural production will have healthier populations and will work more on environmental protection, which is one of the main goals of the green economy.

4.6 Water Management

Humans and the entire plant and animal world depend on water. If we take a moment to think, we can observe that the freshwater we need is becoming scarcer in the form necessary for everyday life and work. The water we can use daily is found in nature, constituting only 0.08% of the total water surfaces. We primarily use clean water for drinking, cooking, and maintaining hygiene, but agriculture and other economic activities are also impossible to imagine without water. Unfortunately, many of us fail to see or do not want to see that through everyday use, this water becomes constantly contaminated, resulting in less clean drinking water in nature with each passing day. If we continue to behave towards water as we have been doing so far, there will undoubtedly be a reduction in clean water unless urgent action is taken to protect it.

One of the primary tasks of green economy is to protect water from further pollution and from excessive and irrational use. Additionally, the purification of already polluted waters must be a priority of the new economic model. Special attention must be devoted to conserving water and ensuring enough safe drinking water for the entire population and all living organisms whose growth and development depend on water.

Green economy, as a new economic model, must pay special attention to quality water management. Furthermore, it is necessary to ensure secure planning of water resources, the distribution of water

resources, quality management, and optimal utilization of water resources in the future.

5 Positive Practices of Green Economy

In this paper, we are not able to present all the positive practices and benefits that come with the green economy. However, we can only partially touch on some of them. The results of transitioning to the implementation of the green economy are visible in developed countries through the reduction of CO2 emissions. Additionally, in these countries, there has been purification of rivers, streams, and other water bodies, as well as the creation of larger forested areas. Now it's time for cleaner air due to the closure of thermal power plants and other energy facilities that use fossil fuels as energy sources. There is an increasing use of electric vehicles and increased use of renewable energy sources. However, there has been more rational exploitation of natural resources. A greater number of green jobs have been created. The standard of living of the population has improved, and many other benefits have emerged. Given that a larger number of economic sectors can be directly or indirectly linked to the development of the green economy, we see a great business opportunity for future economic development. However, we will not be able to avoid transitioning to new global market conditions; instead, we will have to become an integral part of it if we want to survive on planet Earth.

The significance of implementing projects in the field of the green economy is evidenced by the fact that many green jobs have been created in recent years. Additionally, a large number of new professions have emerged, such as: Environmental technician, solar system installer, wind farm installer, wind turbine service technician, biomass exploitation expert, environmental analyst for environmental protection, environmental police officer, green building architect, energy efficiency engineer, energy policy advisor, organic food producer and processor, green lawyer, green banker, renewable energy manager, energy auditor, and many other professions. Each of the mentioned professions is highly attractive today, and workers employed in these jobs are generally well-paid and adequately rewarded, while companies opening green jobs are increasingly socially recognized and financially supported both by states and international organizations providing growing support for the development of the green economy.

CONCLUSION

Based on the research we conducted for the purpose of writing this paper, we can conclude that although it seems that not much is being done in Bosnia and Herzegovina regarding the promotion and support of the new economic model of the green economy, we can still say that significant progress has been made from the very beginning. At certain moments, we can observe that many activities that may not seem to us to represent anything spectacular for the development of the green economy are, in fact, significant steps that have a significant impact on environmental protection. We have presented six areas that are very important for the development of the green economy. In each of these areas, if we analyze, we can see that we have come quite far from the beginning. When it comes to renewable energy sources, it seems to us that there is hardly any populated place where at least one solar power plant has not been built. Almost all urban and many rural settlements have organized waste collection and sorting for recycling. Additionally, there is an increasing number of greenhouses, plastic tunnels, and open agricultural areas where food is produced in an environmentally friendly manner without excessive or uncontrolled use of chemical mineral fertilizers and chemical

pesticides, as was the case until recently. Recently, we have noticed a new way of green building construction where green architecture or construction mainly advocates for the preservation of energy, as well as the reuse and greater safety of new and emerging construction materials. However, we have noticed that one of the primary tasks of the green economy is to protect water from further pollution and from excessive and irrational use. Numerous projects have been launched to encourage the purification of already polluted waters, and it is one of the priorities of the new economic model. Special attention has been devoted to water protection and ensuring sufficient quantities of safe drinking water. There are many benefits that the new economic model has brought, such as the reduction of CO2 emissions, purification of rivers, streams, and other water bodies, as well as the creation of larger forested areas. A greater number of green jobs have been created. The standard of living of the population has improved, and many other benefits have been achieved.

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CONTROLLING AS A KEY SUCCESS FACTOR IN BUSINESS OPERATIONS

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Abstract

This paper explores the theoretical characteristics of controlling, focusing on its historical development, conceptual definition, types, instruments, and methods, as well as the implementation of controlling in enterprises. Through a literature analysis, the paper identifies key elements and steps in controlling implementation, highlighting the importance of management engagement, collaboration, and communication. Additionally, the paper examines the role of controlling in various business functions, emphasizing its vital role in monitoring, analyzing, and managing organizational performance.

Keywords*: controlling, enterprise, implementation*

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1 INTRODUCTION

In today's contemporary business environment, effective management of organizational performance becomes a crucial factor for success and sustainability in the market. In this context, the function of controlling is gaining increasing significance as a key mechanism for monitoring, analyzing, and managing performance, both financial and non-financial, in organizations of various sizes and industries. This paper explores the theoretical characteristics of controlling, focusing on its historical development, conceptual definition, various types, instruments, and methods, as well as the process of implementation in enterprises.

The historical development of controlling dates back to the 19th century, paralleling the evolution of industrial facilities and the initial forms of accounting and control. Over time, controlling has evolved through various phases, from its origins in accounting to today's integrated approaches to performance management, with technological advancements and changes in the business environment playing a crucial role in this process.

The conceptual definition of controlling encompasses the definition, objectives, and functions of this key business function. Controlling can be defined as a function that involves the analysis, planning, control, and optimization of the financial and non-financial performances of an organization, providing relevant information to management for informed decision-making and efficient resource management.

Types of controlling present in organizations include financial, operational, strategic, and non-financial controlling, each with specific characteristics, focus, and tasks. Through the combination of these types, organizations can effectively monitor and manage various aspects of their performance.

Controlling instruments and methods provide tools and techniques for efficiently monitoring, analyzing, and managing organizational performance. From traditional tools like budgeting and cost accounting to modern approaches like balanced scorecards and variance analysis, controlling employs various methods to provide management with the necessary information for informed decision-making.

The implementation of controlling in an enterprise is a complex process that requires careful planning, organization, and engagement of all relevant stakeholders in the organization. This process is crucial for achieving effective performance monitoring and management, as well as for realizing the organization's business goals. Through needs and goals analysis, controlling system design, implementation of controlling processes, and continuous monitoring and improvement, organizations can ensure efficient controlling that supports their business activities.

Through the exploration of these theoretical foundations, this paper aims to deepen the understanding of the concept of controlling and its significance for contemporary business, as well as to provide guidance for its practical application in organizations.

2 THEORETICAL CHARACTERISTICS OF CONTROLLING

2.1 Historical development of controlling

Controlling is a key function in modern business, dealing with the analysis, planning, and control of both financial and non-financial performance of an organization. The development of controlling is a complex process that has evolved through various phases over time, from its roots in accounting to today's integrated approaches to performance management.

The beginnings of controlling can be traced back to the 19th century, when primitive forms of accounting and control began to develop in industrial facilities. Taylor's

"scientific management approach" and the emergence of the first budgetary control in the United States during the early 20th century represent key precursors to modern controlling (Horngren, Datar, & Foster, 2006). In Europe, especially in Germany, controlling experienced significant development throughout the 20th century. The concept of "Kostenrechnung," or cost accounting, which developed in Germany during the 1920s, became the foundation for modern controlling in European companies (Malmi & Brown, 2008). In recent decades, technological advancement has played a crucial role in the development of controlling. The introduction of computerized information management systems and data analysis software has enabled controllers to analyze financial data more quickly and accurately and provide relevant information for decision-making (Chapman, Hopwood, & Shields, 2007).

Controlling will continue to evolve to meet the changing demands of the business environment. The integration of data analytics, artificial intelligence, and predictive analytics tools is likely to shape the future of controlling, enabling organizations to respond more quickly to changes and optimize their performance (Davenport & Harris, 2007).

2.2 Conceptual definition of controlling – definition, objectives, and functions

Controlling, as a crucial business function, aims to provide relevant information to management for making informed decisions and efficiently managing resources (Langfield-Smith, Thorne, & Hilton, 2006). According to Langfield-Smith, Thorne, and Hilton (2006), controlling can be defined as a function that encompasses the analysis, planning, control, and optimization of both financial and non-financial performance of an organization.

The main objectives of controlling include performance optimization, planning and control, management support, and resource efficiency (Kaplan & Norton, 2004). Kaplan and Norton (2004) highlight key functions of controlling, including analysis and planning, control and monitoring, reporting and informing, as well as advising and supporting management.

2.3 Types of controlling

Controlling is a complex function that can manifest through various types, approaches, and methods depending on the specific needs and characteristics of the organization. This diversity allows controlling to adapt to different situations and demands of the business environment.

Financial controlling: Financial controlling focuses on monitoring and analyzing financial data to ensure financial stability and compliance with legal regulations. It involves the preparation of financial statements, budgeting, cost and revenue analysis, as well as monitoring liquidity and profitability (Atkinson, Kaplan, Matsumura, & Young, 2012).

Operational controlling: Operational controlling concentrates on controlling and optimizing operational processes within the organization to increase efficiency and productivity. This includes monitoring operational performance, identifying process efficiencies, and implementing improvements in operational activities (Langfield-Smith, Thorne, & Hilton, 2006).

Strategic controlling: Strategic controlling relates to long-term planning and setting strategies for the organization. This type of controlling focuses on market analysis, identifying competitive advantages, and aligning business objectives with strategic plans (Simons, 1995).

Non-Financial controlling: Non-financial controlling involves monitoring and analyzing non-financial performance, such as customer satisfaction, product or service quality, innovation, and sustainability. This type of controlling is increasingly gaining

importance in modern organizations that recognize the significance of non-financial factors for long-term success (Bourguignon & Malleret, 2018).

3 INSTRUMENTS AND METHODS OF CONTROLLING

Controlling utilizes various instruments and methods to enable efficient monitoring, analysis, and management of organizational performance. These tools provide controllers and managers with the necessary information to make informed decisions and achieve business objectives.

Controlling instruments:

- **Budgeting:** Budgeting is a classic controlling tool used for planning and controlling the financial resources of an organization. This process involves setting financial goals, allocating funds, and monitoring actual results against planned budgets (Horngren, Datar, & Foster, 2006).
- **Balanced Scorecard (BSC):** BSC is a strategic tool that combines financial and non-financial indicators to provide a holistic view of organizational performance. This approach allows management to assess performance through four perspectives: financial, internal, learning and growth perspective, as well as customer perspective (Kaplan & Norton, 1992).
- **Cost accounting:** Cost accounting is a method used to track and allocate costs to different products, services, or activities. This tool enables organizations to better understand the cost structure and identify efficient cost management methods (Drury, 2007).

Controlling methods:

- **Variance analysis:** Variance analysis is a method used to compare actual results with planned results to identify differences and causes of deviations. This method allows controllers to identify areas where corrective actions are needed (Garrison, Noreen, & Brewer, 2010).
- **Benchmarking:** Benchmarking is the process of comparing an organization's performance with that of competitors or industry best practices. This method enables organizations to identify their strengths and weaknesses and adopt best practices to achieve superior performance (Camp, 1989).
- **Utilization of information management systems:** Information management systems enable automated processing and analysis of data, facilitating the process of performance monitoring and decision-making (Chapman, Hopwood, & Shields, 2007).

The combination of these instruments and methods enables controlling to effectively manage organizational performance and contribute to achieving its goals.

4 APPLICATION OF CONTROLLING IN BUSINESS

4.1 The role of controlling in different business functions

Controlling is a critical business function that plays a vital role in all segments of an organization. Through various functions, controlling provides support to management in monitoring, analyzing, and managing performance to achieve business objectives and enhance operational efficiency.

Within financial functions, controlling plays a crucial role in monitoring financial performance, budgeting, risk management, and ensuring regulatory compliance. Controlling provides management with relevant information and analysis necessary for making financial decisions. In

operational functions, controlling supports management in managing operational processes, identifying process efficiencies, and implementing improvements. Through analysis of operational performance and costs, controlling helps organizations optimize operational processes and increase productivity. In strategic functions, controlling contributes to long-term planning and strategy formulation for the organization. Through market analysis, competition identification, and internal resource analysis, controlling aids in identifying strategic opportunities and challenges, supporting management in making informed strategic decisions. Non-financial functions are becoming increasingly important in today's business environment. Controlling plays a crucial role in monitoring non-financial performance, such as customer satisfaction, product quality, innovation, and sustainability. This information is essential for making strategic decisions and creating long-term value for the organization. Through its role in different business functions, controlling contributes to efficient operations and achieving competitive advantage in the market.

4.2 Implementation of controlling in an enterprise

Implementing controlling in an enterprise is a complex process that requires careful planning, organization, and engagement of all relevant stakeholders in the organization. This process is crucial for achieving effective monitoring and management of performance, as well as for achieving the organization's business objectives.

Steps for implementing controlling:

- Needs and objectives analysis: The first step in implementing controlling is a detailed analysis of the organization's needs and objectives. This includes identifying key performance indicators and success metrics to be monitored, as well as setting clear implementation goals for controlling.
- Designing the controlling system: After identifying needs and objectives, the next step is designing a controlling system that will enable monitoring and analysis of defined performance metrics. This includes selecting appropriate methods, techniques, and controlling tools to support the organization's needs.
- Implementing controlling processes: Once the controlling system is designed, the next step is implementing controlling processes within the organization. This involves training employees, establishing clear procedures and guidelines for data collection, analysis, and reporting.
- Continuous monitoring and improvement: Controlling implementation is a continuous process that requires ongoing monitoring and evaluation of the effectiveness of the controlling system. Organizations need to be prepared to identify and respond to changes in the environment to continuously improve their controlling processes.

Key factors for successful implementation:

- Management engagement: Active involvement of management in the controlling implementation process is crucial for success. Management needs to support controlling initiatives, define clear objectives, and provide resources for implementation.
- Collaboration and communication: Effective communication and collaboration among different departments and teams in the organization are critical for successful controlling implementation. Teamwork allows for the exchange of information and ideas, as well as faster response to changes and challenges.

Implementing controlling in an enterprise requires a holistic approach and engagement of all relevant stakeholders. Careful planning, system design, process implementation, and continuous monitoring are key steps towards achieving effective performance management and business objectives.

CONCLUSION

In today's dynamic business environment, controlling emerges as a crucial mechanism for successfully leading organizations and achieving business objectives. Through research into the historical development, conceptual definition, different types, instruments, methods, and processes of controlling, we have discovered that this function is indispensable in modern business.

The historical development of controlling has followed the evolution of the industry and changes in the business environment, from early forms of accounting to integrated performance management approaches. Through this development, controlling has become an essential part of managing organizations of all sizes and industries.

The conceptual definition of controlling clearly defines its role in analyzing, planning, controlling, and optimizing the financial and non-financial performance of an organization, providing relevant information to management for making informed decisions.

Different types of controlling, such as financial, operational, strategic, and non-financial, enable organizations to adapt to the specific requirements and characteristics of their business, while controlling instruments and methods provide tools for effectively monitoring, analyzing, and managing performance.

Implementing controlling in an enterprise requires a holistic approach, including needs and objectives analysis, designing controlling systems, implementing controlling processes, and continuous monitoring and improvement.

Through all these aspects, controlling is reaffirmed as a key factor for the success of organizations in the modern business world. Its role in supporting management, optimizing performance, and achieving competitive advantage cannot be overstated.

Through further research and application of acquired knowledge, organizations will be able to more effectively use controlling as a means to achieve their goals and realize long-term sustainability and competitiveness.

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RELATIONSHIP BETWEEN TRANSITION CURVES (CLOTHOIDS) AND CIRCULAR CURVES IN ROAD ALIGNMENT

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Summary

The transition from a straight line to a circular curve is always abrupt, even if this is not readily noticeable at very large radii or low driving speeds. On the straight section the steering wheel angle is zero, on the arc section the steering wheel angle must have a certain value, as stated above, which is greater the tighter the curve. This in turn would mean that you would have to turn the steering wheel jerkily at the transition between the straight section and the circular curve section. Otherwise you would go off track. Even in the case of large radii without transition curves, the lines of a road appear inelastic and can satisfy neither aesthetically nor driving psychologically down to the last detail. In perspective foreshortening - how the road is seen by the driver - sudden kinks appear despite the large curve radii.

Keywords: *clothoid, curve radius, road, road alignment, road safety, transition curve*

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1 INTRODUCTION

1.1 Basic principles of road alignment

The alignment of a road is the definition of the route according to direction and inclination. The decisive factors are the type of road (road significance) and the existing terrain. Routing is a technical and design task. The route must be harmoniously coordinated in the site plan and longitudinal section and its good integration into the terrain must be aimed for. The spatial effect on the road user after the construction of the route must therefore always be taken into account. Driving dynamics, traffic safety and aesthetics demand a continuity of the alignment in order to enable a psychologically consistent sensation and a balanced driving style. The course of the road must be unambiguous from the driver's perspective. A traffic route design is shown in three different plans (= different drawing levels) [1]:

- Site plan (= layout),
- Longitudinal section, and
- Cross section (= profiles).

1.1.1 Principles for the use of straight lines

Since the straight line is the direct and thus shortest connection between two points, it is the historical ideal in terms of road layout. In today's road design, longer straight lines with a constant longitudinal gradient should be avoided for roads outside built-up areas. They make it difficult to estimate distances, which has a particularly negative effect on overtaking, they tire the driver, at night there is a risk of glare from oncoming traffic and the fit into the terrain is usually unsatisfactory. However, it can also be advantageous to route with straights, e.g.:

- In plains and wide valleys, especially for routing parallel to existing railway lines, canals or the like,
- If, for traffic engineering reasons, routes with a large visibility range are required for unbundling procedures or for the clear layout of junctions, and
- For the creation of overtaking sight distances on two-lane roads of EKL 3.
- In these cases, the length of straights should always be limited to a value that is still reasonable for the driver. According to RAL [2], the empirical value is usually max L_G = 1,500 m [3].

For safety reasons, the length of straight lines and subsequent circular curves should be in a balanced ratio. This requires both a minimum length of straight lines between circular curves and a minimum radius following straight lines of a certain length. In the following illustration (Fig.1) of the permissible radii following straight lines according to RAL [2], only the good range with $R/L_G > 1.5$ or R > 450 m is provided as a rule for the design classes EKL 1 to EKL 3 [3].

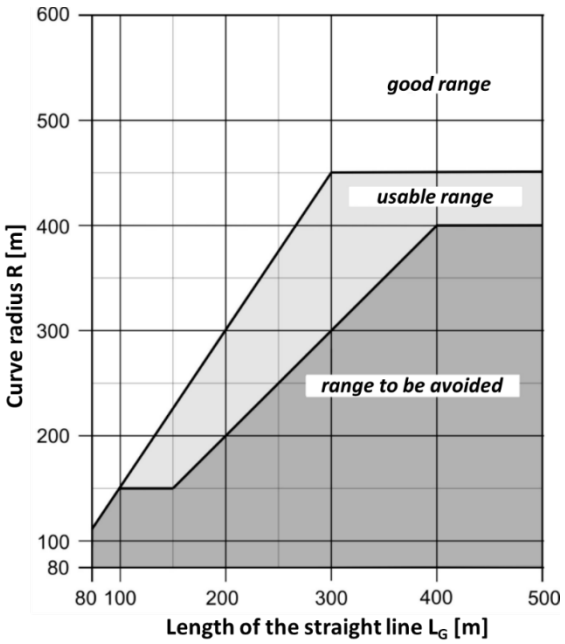

Figure 1. Permissible radii following a straight line [2, 3] (edited by author)

Straight lines between bends curved in the same direction should be avoided; instead, a larger continuous circular curve should be used, for example. If this is not possible, their length should be at least 600 m for roads in EKL 1 to EKL 3 and at least 400 m for roads in EKL 4 [3].

According to the RAL [2], the cross-section design is a defining feature for the principle of standardised and recognisable road types. A one-lane standard cross-section and a special form of marking are provided for each design class (Fig.2) [4].

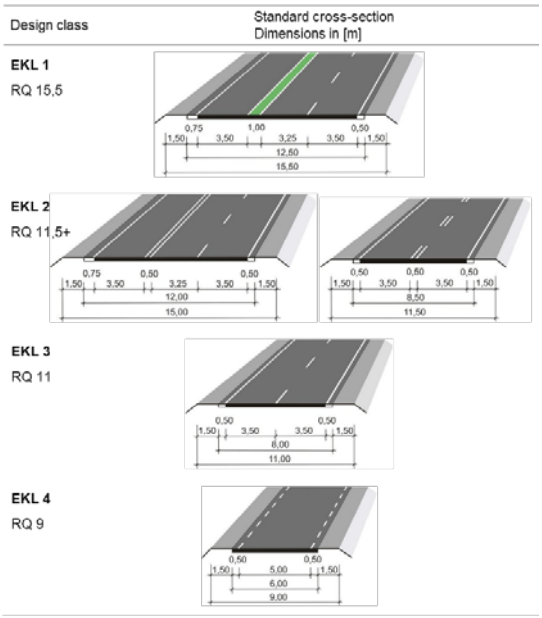

Figure 2. One-way standard cross-sections in accordance with the RAL [4] (edited by author)

1.1.2 Principles for the application of circular curves

The circular curve is the most commonly used alignment element. It is characterised by its radius and the arc length utilised for the road axis. The radii used and their consequences should enable smooth driving at a speed appropriate to the design class and be in harmony with the topography. In addition to the lower limits of this radius size, which are necessary from the point of view of driving dynamics, the RAL [2] also specify upper limits of the recommended radii. These are intended to ensure that both excessively stretched line layouts in the design classes EKL 3 and EKL 4 with possibly suggested overtaking possibilities are avoided and that the intended overall effect of the different road types and their distinguishability is maintained.

The recommended radii (Table 1) can be undercut by a maximum of 15% for roads in EKL 2 to EKL 4 in exceptional cases that must be justified. The prerequisite for this, however, is that the ratios of successive radii are then in the good range. The minimum lengths shown guarantee a minimum passage time and thus the perceptibility as an independent element [3].

Table 1. Recommended radii and minimum lengths of circular curves [2, 3] (edited by author)

Design class	Radius ranges R [m]	Minimum lengths of circular curves min L [m]
EKL 1	≥ 500	70
EKL 2	400 – 900	60
EKL 3	300 – 600	50
EKL 4	200 – 400	40

A special role is played by the balanced ratio of successive circular curves, which helps to avoid significantly different speed levels in successive curves. In design classes EKL 1, EKL 2 and EKL 3 the good range is decisive; for roads in design class EKL 4 the usable range is sufficient (Fig.3) [3].

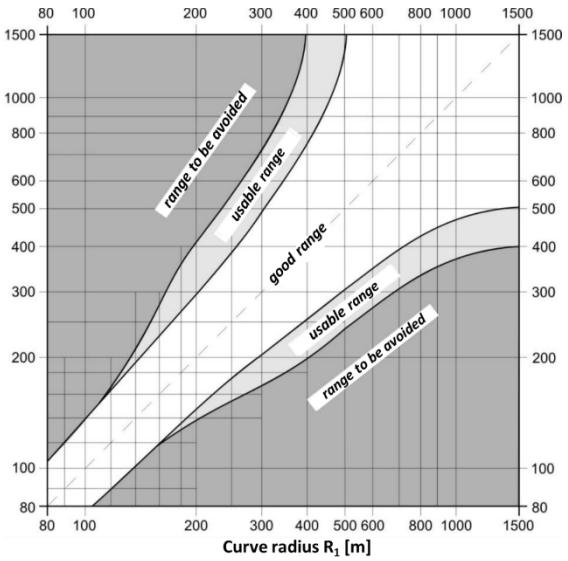

Figure 3. Ratio of successive radii [2, 3] (edited by author)

Short curves should be avoided as far as possible:

- Successive short curves tempt to "drive straight through"; replace with straight line or large curve;
- Short arcs with a small radius appear as a kink (applies in the site plan as in the longitudinal section); replace by a large radius with a longer curve length.
- Use small radii in good coordination with the radii of adjacent circular curves (relation alignment):
- In the case of small radii between large radii or after straight lines, unexpected curve discontinuity occurs with increased risk of accidents; replace with a larger radius or implement safety-improving measures.
- Curve discontinuity is present with subsequent similarly small/large radii: successive radii should be coordinated with each other in order not to cause large speed differences (Fig.4) [1].

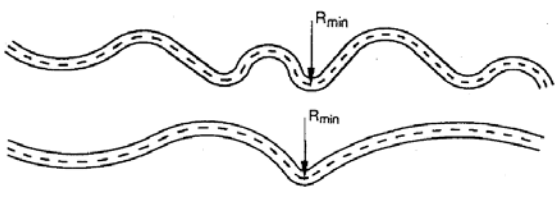

Figure 4. Principle of a curvilinear (top) and non-curvilinear (bottom) alignment [1]

The curvature k = 1 / R in the circular curve is constant, since the radius in the circular curve is also constant. This results in the following curvature band for a right-hand curve (Fig.5):

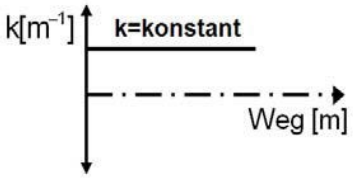

Figure 5. Curvature diagram of the circular curve (right-hand curve) [1]

The design speed (V_P) is the basis for determining the minimum lengths of the clotoids and circular curves, the fillets in the longitudinal section (crest and trough radii) and the minimum values for the required sight distances. As a rule, the line layout is to be selected in such a way that the design speed does not change abruptly. For motorways, the design elements of location and height are to be selected in such a way that they do not result in a lower design speed than 100 km/h [1]. The relationship between radius (R), longitudinal slope s and speed (V_{85}) for freely moving passenger cars according to the Guideline for Planning, Construction and Maintenance of Roads RVS 03.03.23 [5] is shown in Table 2:

Table 2. Relationship between radius (R), longitudinal slope s and speed (V_{85}) for a freely moving passenger car [5]

V_{85}	[km/h]	40	50	60	70	80	90	100	110	120	130
R	[m]	30	50	80	130	200	300	400	500	600	800
s	[%]	12	11	10	9	8	7	6	5	4,5	4

1.1.3 Principles for the use of clothoids

Due to driving dynamic, drainage, visual, driving psychological and aesthetic considerations, a transition curve is used when the curvature is changed. The transition curve has three tasks to fulfil [1]:

- It is intended to provide a steady change in the centrifugal acceleration occurring

during cornering when transitioning from one curvature to another.
- It is used as a transition section for roadway twisting (change of cross slope).
- It ensures a fluid line course through a gradual change in curvature and thus serves a visually satisfactory alignment (Fig.6).

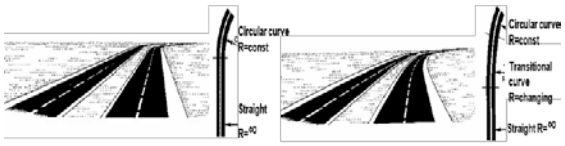

Figure 6. Route without (left) and with (right) transition curve [1] (edited by author)

In general, the following requirements are to be placed on a function that is to be used as a transition curve [1]:

1. Continuous change of the curvature, preferably proportional to the length;
2. A range as long as possible in which it can be used as a transition arc;
3. Points of inflection with place R = ∞ or curvature = 0 for connection to a straight line;
4. Simple mathematical handling.

In road and railway construction, only the clothoid is used as a transition curve, as it optimally fulfils the first three of the requirements. The so-called preliminary arch as a transition curve is no longer provided for in the Austrian guidelines. The clothoid is used as a transition curve in road and railway construction. The clothoid is a spiral curve with steadily increasing curvature, for which the product of the curve length L and the associated radius of curvature R is constant [1]:

$A^2 = L * R$

R ... Circular curve radius [m]

L ... Length of the transition curve (clothoid) [m]

A ... Parameters of the clothoid [m] (Fig.7).

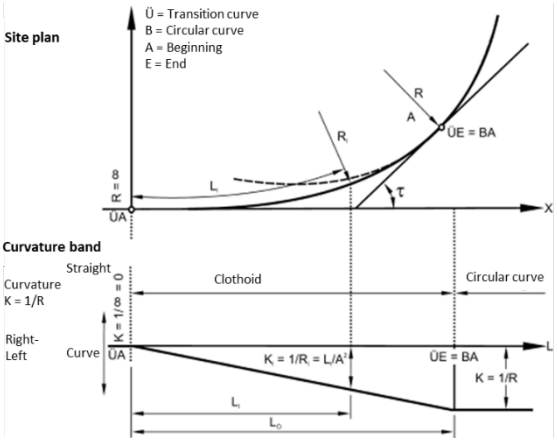

Figure 7. Design elements in the site plan: Curve and clothoid [6] (edited by author)

In principle, a radius as large as possible should be chosen in the routing. In any case, certain minimum radii are to be maintained according to the design/project planning speed (risk of skidding). Furthermore, the ratio of successive radii should be in the range of 1:1 to 1:3. The total curvature (sum of the tangent angles) should also not be too large, otherwise the design speed cannot be maintained. If, on the other hand, the curvature is far above this, the roadway must be made narrower so as not to tempt users to speed.

Since the curvature of the clothoid changes linearly with the length of the curve, this has the effect for the driver that he must turn his steering wheel at a constant angular velocity at constant speed in order to drive the traced transition curve [4]. The clothoid parameters should lie in the following range:

$$R \geq A \geq R/3$$

With the clothoid, a steady curvature progression is made possible when transitioning from one curvature to another or straight lines to a circle. The curvature band of the clothoid as well as the most important formulas are shown in Fig.8.

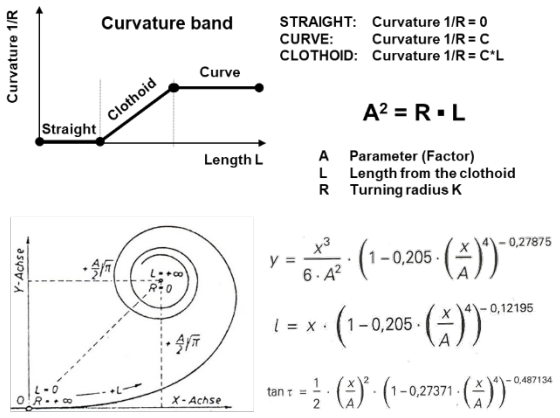

Figure 8: Curvature band of the clothoid and the most important formulas [7] (edited by author)

The minimum length of the clothoid L_{min} depending on the design speed according to the Guideline for Planning, Construction and Maintenance of Roads RVS 03.03.23 [5] is shown in Table 3.

Table 3. Minimum length of the clothoid L_{min} depending on the projecting speed [5]

V_P (km/h)	40	50	60	70	80	90	100	110	120	130
L_{min} (m)	15	20	30	39	44	50	56	61	67	72

1.2 The connection between curve radius and accident occurrence on roads

The correlation between curve radius and accident occurrence was investigated by Krebs/Klöckner [8] and Leutzbach/Zoellmer [9]. As the following graph shows (Fig.9), the accident rate decreases with increasing radius [10].

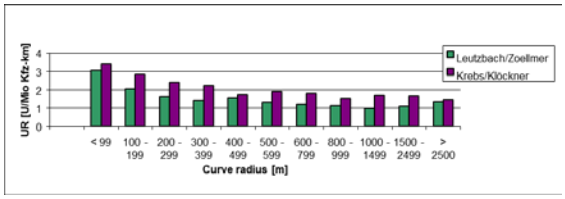

Figure 9. Accident rates (UR = germ. Unfallraten) as a function of curve radius [10] (edited by author)

Furthermore, Leutzbach/Zoellmer [8] investigated the element sequences straight line - circular curve or straight line - clothoid - circular curve. The results showed a clear increase in safety with increasing radius up to a size of R = 200 m. Above this threshold, no systematic correlations could be detected. Above this threshold, no more systematic correlations could be detected. In the range up to R = 200 m, the sequence "clothoid before radius" showed lower values in the accident characteristics than the sequence "straight line before radius". This thesis illustrates the contribution of clothoids to road safety, especially for small radii. [4].

The radii obtained by the Geometry Classifier programme are divided into classes of 50 metres. Radii greater than or equal to 1,000 metres are combined in one class, since only 4 UPS (germ. *Personenschadenunfälle*) (personal injury accidents) occurred in the radius range of 1,000 to 2,000 metres. Figure 10 shows the distribution of accidents among the radius classes, the class width is 50 m [10]. UPS = "Accidents with personal damage" Accidents with personal damage.

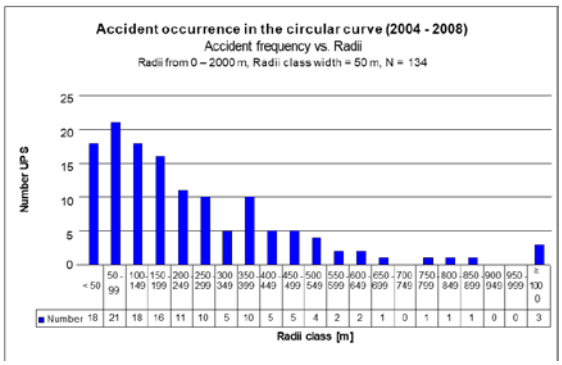

Figure 10. Accident frequency by radius, class width 50 m [10] (edited by author)

The highest averaged accident rate and the highest relative accident risk occur at radii of 50 to 99 m. Both accident indicators show a clear trend. With increasing radius, both accident indicators decrease, any deviations can be considered as outliers. This confirms the statement from the literature research that the risk of accidents decreases with increasing radius. The study shows that smaller radii have a greater accident potential than larger ones. As the literature research has shown, it is not only

the individual radius that is responsible for the accident, but also the coordination of the radii in the course of the road. Already during the planning phase, care should be taken to ensure that the alignment elements are coordinated with each other and that there is a good view of the route [10].

The guideline values of Lippold [11] can be found here as the boundary between the usable range and the range to be avoided. The transition to the good range is 50 % above the usable range (150 m ≤ L_G ≤ 300 m). From straight line lengths of L_G = 300 m, radii of R ≥ 450 m are to be provided [4].

In the course of the investigations [12], suitable stretches of road with standards similar to those of EKA 2 according to RAA [13] were selected in the existing network of motorway-like federal roads in the extended Stuttgart metropolitan area. The existing curve radii were evaluated according to their frequency of occurrence and their accident risk. The investigation focused on curves with radii R ≤ 1000 m, as these had been shown to have a higher accident risk according to previous research.

The investigation of the routing in the site plan was carried out using the road data stored in the road database (TT-SIB/Infosys). The frequency of circular curves with radii R ≤ 1000 m was evaluated and, in the case of circular curves with an identified higher accident risk, also the relation of the radii of successive circular curves and following a long straight line. The study included 173 km of motorway-like federal roads. These have a total of 213 circular curves. Of these, 72 circular curves have radii with R < 1000 m (33.8%), for which an increased accident risk can be assumed according to [1]. Circular curves with small radii with R ≤ 750m are represented by 33 (15.5%), including 16 circular curves with R < 650 m (7.5%). All circular curves with radii R ≤ 650m were assessed qualitatively according to their statistical accident risk as well as with the help of the electronic accident maps and video images [12].

The investigations showed that circular curves with radii R < 650 m, especially in left-hand curves, always have accident clusters and statistically have about twice the accident risk than radii with R ≥ 650 m, despite sometimes drastic speed restrictions. This also tends to apply if the radius ratio R1 / R2 ≤ 1.5 is observed [12].

1.2.1 What exactly happens when driving at high speed into the curve with radius without clothoid after long straight line?

The transition curve is an alignment element used in the construction of traffic routes as a connection between a straight line and a circular curve or between two circular curves. It is characterised by the fact that it has a different radius of curvature at each point, like an ellipse and in contrast to a straight line and a circular curve. This has the effect that in the transition between a straight line and a circular curve, the curve narrows only gradually and not in leaps and bounds.

On a road without a transition curve, the steering wheel would have to be turned in jerkily (suddenly) when going from a straight lane into a curve. Even if, despite the abrupt steering movement, the car stays in the lane (which is extremely difficult to do even on a dry road!), the driver is jerked - he (and the car) experiences a jolt! Transition curves, on the other hand, can be used to steer slowly from the centre position to the necessary steering wheel turn. The purpose of a transition curve is to continuously build up or reduce the centrifugal forces occurring in the curve when driving through it, and not to suddenly.

Without a transition curve, the acceleration forces on the passengers and the construction would also be too high when entering the loop of a roller coaster. Let's

assume that the driver has somehow managed to enter a smaller circular curve (quarter circle) with his car at high speed. Since its curvature k is constant, the driver can keep the steering wheel in a fixed position if he drives optimally. The centrifugal force pushes the driver outwards. At the end of the quarter circle, there is suddenly a straight line with zero curvature. The driver must now abruptly bring the steering wheel into the straight-ahead position. Even if the car stays in the lane despite the abrupt steering movement (which is extremely difficult to do even on a dry road!), the driver is jerkily moved back to his normal sitting position (or beyond) - he (and the car) experiences a jolt.

1.2.2 Catastrophic accident on the motorway-like route with small radius after long straight line

On 23 November 2021, this terrible accident with 46 deaths occurred on the motorway near the village of Bosnek in western Bulgaria. There are no words to describe this horror, especially because the children were also victims. Looking at this photo of the accident site alone, one immediately notices that the curves of this motorway route were probably not projected with transition curves (clothoids), which is a must, especially as possibly here with the most unfortunate combination of small radius curve after long straight. The curves with smaller radius and without clothoids are visually perceived as kinks (Fig.11).

Figure 11. The terrible accident with 46 dead on the motorway near the village of Bosnek in western Bulgaria [14]

How a curve with the clothoid looks visually, especially important for direct comparison with fig.11, can be seen in fig.12.

Figure 12. A route with the clothoid [15]

According to European Commission data, Bulgaria had the second highest rate of road deaths in the European Union in 2019, with 89 fatalities per million inhabitants. "*We hope that we can learn our lessons from this tragic incident and prevent such incidents in the future*" said Bulgarian caretaker Prime Minister Stefan Yanev, who also visited the scene of the accident [14].

The following photo (Fig.13) shows a very significant example of upper designs of road alignment: the left bridge is designed in a long straight line, where the curve comes immediately after the end of the bridge. The middle, higher bridge, on the other hand, is projected in its entire length as well as in the further course of the motorway with clothoids and large curve radii. The bridge on the far right is still under construction and represents a railway bridge.

Figure 13. The construction site of the Nahuai River Bridge on the Panzhou-Xingyi High-speed Railway [16]

CONCLUSION

A circular curve has a constant curvature. This means that its representation lies parallel above the abscissa axis. A straight line also has a constant curvature, for which the radius is infinite and the curvature (in contrast to the circular curve) is therefore zero. Thus the representation of the curvature coincides with the abscissa axis. If a straight line is tangentially connected to a circle, the curvature at the point of contact takes on two different values, depending on the side from which this point is approached. This results in a jump in the curvature pattern. For the driver, this would mean that he/she would have to turn the steering wheel in time t = 0 so that the wheels are steered at this point according to the changed curve, which is unrealistic. In addition, the full centrifugal force acts on the vehicle occupants at this point. Therefore, a gradual transition from driving in a straight line to driving in a circular curve must be designed. This is made possible by the use of a clothoid between the straight line and the circular curve in such a way that the curvature or the radius of the circle changes linearly with the path length.

Checking the routing is an essential step in order to avoid later accident black spots or new planning apriori. A small radius in the horizontal curve, especially after a long straight line, represents a very unfavourable routing and element selection with an "optical kink" is marked. Even though the multitude of requirements for a good alignment may seem complex at first, they are normal for an experienced planner. However, since the effects of good or bad routing are often difficult to explain to clients or third parties or only become apparent later, it is quite common to make the routing results in difficult terrain conditions recognisable with the help of visualisations or simulations

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THE IMPACT OF TRAFFIC NOISE ON THE ENVIRONMENT OF HEALTHY LIVING IN URBAN AREAS

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Abstract

Traffic noise has a great impact on the quality of public health. The paper shows the main characteristics and importance of green dams in urban areas, the role of green dams; area, layout, ground cover, planting density, vegetation and the like. Green dams were demonstrated and presented as the best solution for noise regulation arising from traffic in urban areas.
For the purpose of researching this issue, a survey was conducted with the aim of gaining insight into the attitudes of the population in terms of traffic noise in urban areas.
Green dams play a major role in urban areas, firstly they affect the reduction of environmental pollution, and then they play a major role in the reduction of noise in urban areas from city traffic.

Keywords: *traffic noise, green dams, public health ,urbanity*

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1 INTRODUCTION

Noise, in general, means loud, unwanted and unpleasant sounds in the range of 20 to 120 dB. Noise can also be defined as any sound whose level exceeds the permitted level prescribed by law, taking into account the time and place where it occurs and the environment in which people work and live. A source of noise is considered any object with means of work and transport, devices and installations, as well as the noisy activities of people and animals, as well as other objects and actions that spread sound, and which exceed the permitted level for that type of noise. Traffic noise has a great impact on the quality of life, mental and physical health. Noise in the environment is unwanted or harmful sound for human health and the environment in outdoor space caused by human activity, including noise emitted by: means of transport, road traffic, rail traffic, air traffic, maritime and river traffic, as well as facilities and operations for which according to by special regulations in the field of environmental protection, obtains a decision on the unified conditions of environmental protection, i.e. a decision on the acceptability of interventions for the environment.

According to the World Health Organization, noise is the second biggest cause of health problems related to the environment, right after the effect of air pollution (floating particles). Long-term/year-long exposure to noise affects the cardiovascular and metabolic system, cognitive impairment in children, sleep disorders, etc.

In the observed region of the Central Bosnian Canton (Srednjobosanski kanton), no monitoring of the impact of traffic noise on urbanity was previously carried out, and accordingly the issue was not recognized in local strategies. The results of the survey that was conducted in the observed region will show that the population is aware of the impact of traffic noise in urban areas, the impact on public health, and improvement measures will be presented, which is only the beginning of supplementing the LEAP (Local environmental action plan) strategy of the observed region when it comes to noise. from traffic in urban areas.

2 EMISSIONS FROM THE ASPECT OF NOISE

According to Huddart L., the quality of life of the inhabitants of a city is closely related to its environment, however, all cities face a worrying degradation of the environment, with a high level of pollution. The report of the World Health Organization (WHO) indicates that environmental noise is the second leading cause of disease, after air pollution, and not only as an environmental nuisance, but also as a public health problem of the modern world.

In 2002th, the European Parliament defined the concept of noise in the environment as unwanted or harmful external sound caused by human activity, including noise emitted by vehicles, road, rail and air traffic and industrial activities ("DIRECTIVES 2002/49/EC", 2002)[1]. Sources that create noise are part of everyday life in the city, however, no attention has been paid to environmental noise pollution because its effect is not immediate and obvious, but latent. The report on noise in the environment warns that noise in urban areas is a threat to health, excess sound that changes normal environmental conditions in a certain area is not cumulative or transmitted, has a serious impact on people's quality of life and as such is not adequately controlled. Significant attention should be paid to reducing the noise level

[1] https://www.piarc.org/en/PIARC-knowledge-base-Roads-and-Road-Transportation/Road-Administration/Environment/Act-on-Road-Traffic-Noise

from traffic in cities because there is a danger that the noise in the environment will remain the same or will worsen. The reason for this is the constant increase in the number of vehicles[2].

2.1 Impact of traffic noise on public health

Next to emissions from the atmosphere, noise ranks second in terms of impact on citizens' health. The number of people who are exposed to noise in urban areas is increasing, and the intensity of traffic noise is associated with health problems, which mostly affects increased stress, stroke or cardiovascular diseases. Laws that protect citizens from noise caused by traffic are completely inadequate. As solutions for traffic noise in urban areas, the provision of quiet public transport, reduced speed, the use of buildings as effective sound barriers, and the use of green barriers are proposed, which is considered a good urban plan. The emphasis is still on planning and construction in urban areas. Long-term exposure to traffic noise affects sleep disturbances, effects on the cardiovascular system, metabolic system, as well as cognitive impairment, especially in children.

Without noise mapping, it is not possible to solve the negative impact of noise, as well as reduce the risk to the health of the population. A noise map is a presentation of data on the existing or predicted noise situation using noise indicators. The map also indicates the exceedance of any relevant prescribed limit value, the number of people affected by noise in a certain area or the number of housing units exposed to certain noise indicator values in a certain area. There are also strategic noise maps intended for a comprehensive assessment of the population's exposure to noise from various noise sources or for comprehensive predictions for a specific area[3]. A noise map is necessary in order to identify areas with high noise values, assess the extent of the impact on the population, and foresee preventive measures or adequate infrastructure solutions that will reduce the impact of noise on the health of the exposed population. Along with the noise map, an action plan with measures to reduce the impact of noise is drawn up. The process of urbanization and the increased need for mobility increase the risk of population exposure to noise[4]. Noise-related problems cannot be adequately assessed and solved if noise maps or action plans required by the Directive are not created in cities, roads, airports, and railways.The impact of noise on public health in SBK, BiH is generally neglected. This problem, which is located elsewhere, has not yet been found in the strategic and planning documentation in BiH in the field of environmental protection or spatial planning[5]. At all levels, it is necessary to create a legal framework that will enable the creation of strategic traffic noise karate and action plans, which enables better planning in terms of protecting the population from the impact of noise.

Currently, what is being done in Bosnia and Herzegovina, when it comes to actions related to the protection of citizens from the impact of traffic noise, is the drafting of legal regulations that will enable the creation of noise maps, strategic noise maps, noise reduction action plans, and noise monitoring[6].

The above should contribute to better management of this problem, all with the aim of reducing the population's exposure to

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noise and improving the quality of life in the long term.

3 GREEN DAMS IN URBANITY AND THEIR ROLE

The role of green dams in regulating the flow of traffic on the living environment in the city is great considering that according to the Strategy of adaptation and low-emission development of BiH from 2020-2023. year wants to achieve a reduction in gas emissions, where the results are expected through the electrification of transport. A big role would be in the application of electric or hybrid cars. However, as a bigger goal in the future, better training of railway traffic or greater activation of water traffic is planned, both at the international and intercity level. In addition to the goal and trend of reducing gas emissions and reducing the impact of traffic on the greenhouse effect, it would indirectly affect the reduction of other factors that affect the quality of healthy living in urban areas, where physical noise pollution has been increasingly evident lately, which it greatly affects the environment of healthy living, and the same arises from the process of transport-traffic.As a good practice, green city dams are singled out, which reduce noise by 6 dB and even up to 10 dB, depending on the density and width of tree planting. Noise reduction is greatly influenced by soil, leaves, absorption, plant vegetation and the like.

According to the relevant researchers, the methods used for monitoring noise in the urban environment are weekdays, weekends, mornings, afternoons when there are crowds due to people's work, bridges, the proximity of tunnels, highways and the like, of course where the highest concentration of traffic is.

3.1 The importance and role of green dams

The role of green dams, i.e. the arrangement of trees, the density of planting, the height of trees, the slope of the terrain and the coverage greatly influence the noise, the spread of noise caused by traffic in urban areas. Given the fact that sound can be reflected and dispersed by plant components such as trunks, branches, trees, leaves, and sound is absorbed or destructively interferes with sound waves where the ground cover plays the main role. In addition to the characteristics of the vegetation, the distance from the source of the sound waves also plays a big role.

Green areas, such as rows of trees or green dams along roads, can play a significant role in reducing traffic noise. Green dams have the following role:

- Sound absorption: The leaves of trees and bushes can absorb sounds, especially high frequencies. This reduces the overall noise level emitted by the traffic.
- Sound barrier: A dense green dam can act as a physical barrier to sound, reducing the transmission of noise to surrounding areas.
- Other effects: Green dams can also improve air quality, which can contribute to the general well-being of the community.
- Aesthetic and psychological effects: Green areas are aesthetically pleasing and can help reduce noise-related stress, which can have a positive effect on the mental health of people living next to roads.

Studies have shown that the presence of greenery along roads can reduce noise by several decibels, which can be a significant factor for the urban environment. In addition, green areas contribute to other aspects of sustainability and quality of life in cities. The plants that are recommended as green dams in urban areas are: all types

of fir, myrtle, ficus, evergreen ash, bamboo, which is divided into groups in the following work. The mentioned types of plants that are used for green dam purposes in urban areas for the effects of noise reduction caused by traffic also play a big role in absorbing toxins in the air, so they are useful and necessary for environmental protection. In addition to the above, there are also cover plants, which make up the earth's cover, whose function is to prevent noise from traveling from the source of the waves, i.e. from traffic in urban areas. The main characteristics of plants when selected for green dams are: thick leaves and dense growth, abundant, thick and large branches, significant height at maturity, width and depth and evergreen growth.

3.1.1 Green dams in noise suppression

Designing and noise protection measures along roads is a demanding process, and it includes numerous or even unavailable input data. Traffic greenery is planted along roads as a special green strip or isolates the area during the implementation of main routes of road and railway traffic within city centers. In addition to the above, traffic greenery should be decorative, resistant to urban pollution, anti-allergenic, etc. Noise suppression facilities are built from "inanimate" and living plant material, and can be: greened earth embankments (with gentle green slopes), greened steep embankments (supporting structures with a large slope, filled with earth and green), green walls for noise protection (structures are made of metal, wooden, glass, concrete walls, and contain plants on one or both sides[7].

Beck (1965, 1968) investigated some peculiarities of dendro-species in relation to the effects of noise reduction, who categorized plants into six groups. The first group is the most unfavorable, and the sixth is the most favorable. The types of the third and fourth groups are especially suitable. Some of the mentioned species are not used for noise reduction in our country, most of them are non-native and can be used in horticulture.[8]

III-group: „*Betula pendula, Alnusincana, Cornussanguinea, Cornus alba, Pterocaryafraxinifolia, Forsythia intermedia, Sambucusnigra, Loniceramaackii, Cratageusprunifolium, Loniceraladebourii, Populuscanadensis, Corylusavellana, Tilia cordata*.“

IV-group: "*Philadelphuspubescens, Carpinusbetulus, Syringa vulgaris, Fagus silvatica, Ilex aquifolium, Ribesdivaricatum, Quercusrobur*”

V-group: "*Populusberolinensis, Viburunum lantana, Viburunumrhytidophyllum, Tilia platphyllos*."

Group VI: "*Acer pseudoplatanus."*

Sometimes the noise cannot be completely removed, but it can be "masked" using more pleasant sounds (gurgling water, rustling leaves, music, etc.). Plants, especially trees, have the characteristic of attracting birds and other animals, whose singing and chirping contribute to mitigating unpleasant sounds (e.g. aspen, birch, apple tree, acacia, liriodendron, bamboo, etc.).[9] Protection procedures can be focused on the biological-technical procedures of afforestation and the raising of plantations

[7]Cvejić, J. (2010). Inžinjerskabiologija. Beograd: Biolološki fakultet. de Toledo, M.C.B., Donatelli, R.J., Batista, G.T. (2012). Relation between green spaces and bird community structure in an urban area in Southeast Brazil. Urban Ecosyst 15, 111-131.

[8]Spasojević, S. (2016). The role of the barriers in traffic noise protection. U: Ž. Živković, ur. Book of proceedings. International May Conference on Strategic Management - IMKSM2016 May 28 – 30, 2016, Bor: Technical faculty, University of Belgrade, 139-142

[9]Klepac, D., Meštrović, Š. (1981). Upotreba drveća i grmlja u uređivanju čovjekova okoliša. Šumarski list 1-2, 38

in order to mitigate the impact of the wind. The choice of plant species depends on different climate zones, biological and ecological characteristics of the species, but also the composition with landscape elements.[10]

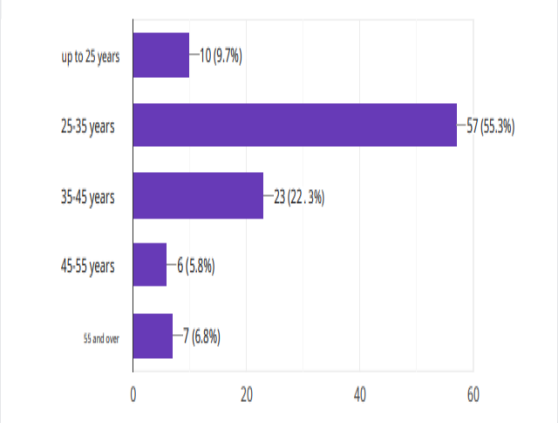
4 ANALYSIS OF THE SURVEY FROM THE ASPECT OF NOISE IN URBANITY

Considering that during the investigation of this issue we did not have access to empirical data that would give us an overview of the state of the noise problem in urban areas, we conducted a survey "The impact of traffic noise on the environment of healthy living in urban areas". The goal is to analyze the survey to get a picture of the impact of traffic noise on citizens.

The survey questionnaire was composed of 12 questions that were intended for the population. Most of the questions were asked in the form of a Likert scale, therefore the survey questionnaire is predominantly of the closed type of questions. A pilot study was conducted with the aim of determining the clarity of the questions in the survey questionnaire, during which two people were interviewed. The survey was conducted online. All answers received were analyzed using a descriptive analysis method.

4.1 Research results

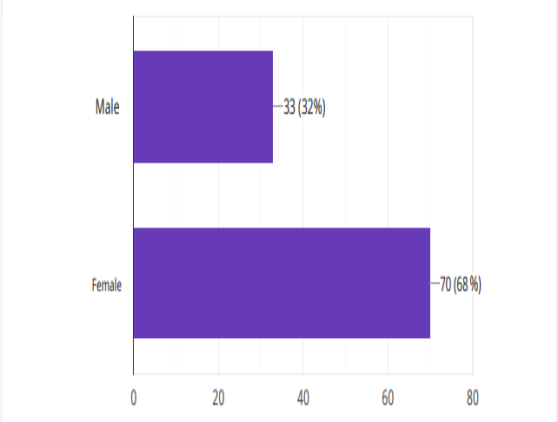
103 responses were collected through the survey. The analysis determined that the survey was completed by citizens from the following areas: Travnik, Vitez, Bugojno, Novi Travnik, Turbe, Vitez, Živinice, Donji Vakuf, Zenica, Tuzla, Jajce Sarajevo. The majority of respondents are from the area of the Central Bosnian Canton with their place of residence in Travnik. Below is a presentation of the obtained results in the form of a graph. Graph 1 shows the responses to the first survey question.



Graph 1. Age structure of respondents

More than half of the respondents, ie 55.3%, are in the age group between (25-35) years, 22.3% between (35-45) years, followed by 9.7% under 25 years, 6.8% between 55 and over and 5.8% between (45-55) years.

Graph 2 shows the responses to the second survey question.



Graph 2. Gender structure of respondents

The gender structure of the respondents shows that there were more women 68% and 32% men.

[10]Tomašević, A. (1996). VjetrozaštitaSinjskogpolja. Šumarski list, CXX (1-2), 19-34.

Graph 3 shows the responses to the third survey question.

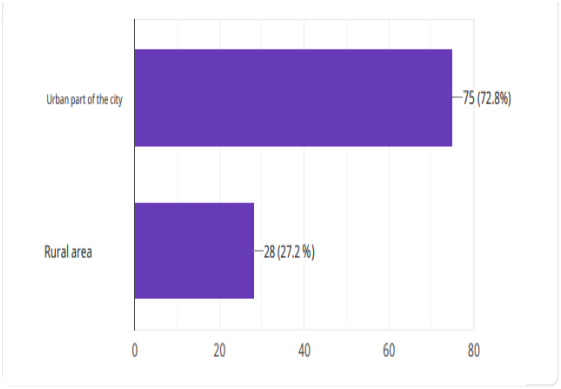


Chart 3. Structure of respondents according to place of residence

Most respondents live in the urban part of the city, 72.8%, while 27.2% of respondents live in rural areas.

Graph 4 shows the responses to the fourth survey question.

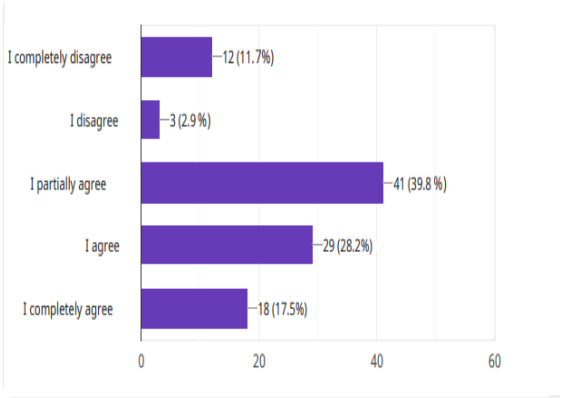
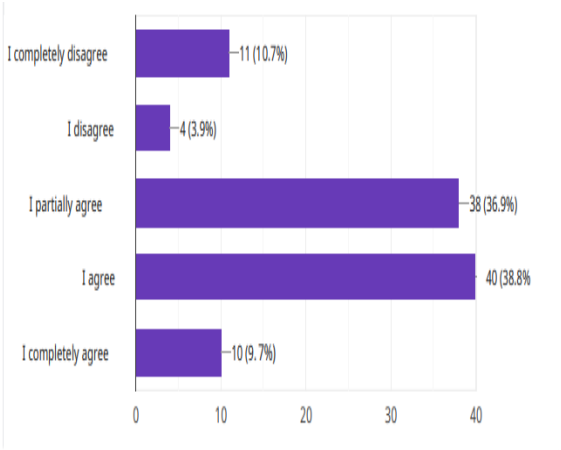


Chart 4. The display answers the question "Noise caused by traffic is a problem today"

The results showed that the majority of respondents (39.8%) partially agree with the statement that traffic noise is a problem today, then 28.8% of respondents agree, while 17% completely agree. For 11.7% of respondents, noise is not a problem, and they completely disagree with the above statement. Looking at the results, we can conclude that most respondents are aware of the problem of noise caused by traffic.

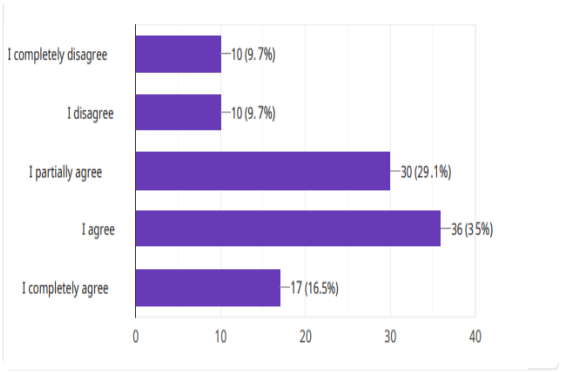
Graph 5 shows the responses to the fifth survey question.



Graph 5. Display of answers to the question "Noise caused by traffic impairs the quality of life"

That noise caused by traffic impairs the quality of life is confirmed by the majority of respondents, 38.8% who agree, 36.9% partially agree, while 9.7% completely agree. 10.7% of respondents completely disagree with this statement, and 3.9% disagree.

Graph 6 shows the responses to the sixth survey question.

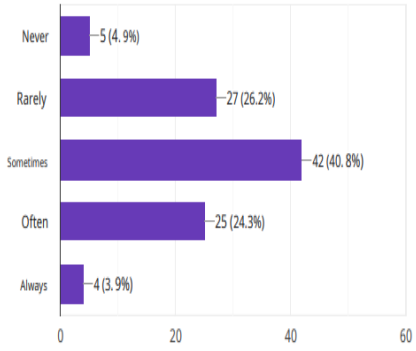


Graph 6. Display of answers to the question "Noise caused by traffic has a harmful effect on health"

The majority of respondents, 35%, agree that noise caused by traffic has a harmful effect on health, and 29.1% partially agree, while 16.5% of respondents completely

agree. 9.7% of respondents strongly disagree and disagree.

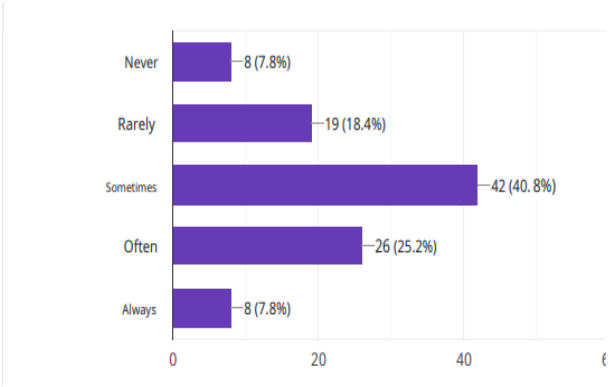
Graph 7 shows the responses to the seventh survey question.



Graph 7. Display of answers to the question "Noise caused by traffic affects my efficiency"

The majority of respondents (40.8%) have the opinion that sometimes noise affects their efficiency, and for 24.3% it is often and 3.9% always. The attitude of 26.2% of respondents is that noise rarely affects their efficiency, and 4.9% never.

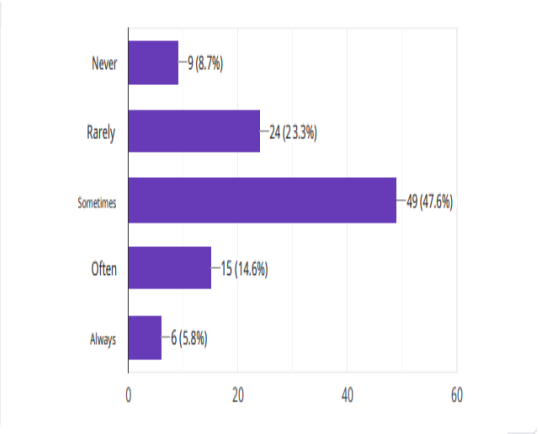
Graph 8 shows the responses to the eighth survey question.



Graph 8. Display of answers to the question "Noise caused by traffic affects the reduction of one's own concentration"

The opinion of the majority of respondents, 40.8%, is that sometimes traffic noise affects their concentration, while for 25.2%, it is often, and for 7.8% of respondents, always. That noise never affects the reduction of one's own concentration is the opinion of 7.8%, and rarely 18.4%. chart 9.

Graph 9 shows the responses to the ninth survey question.



Graph 9. Display of answers to the question "Noise caused by traffic makes me feel restless"

Noise caused by traffic sometimes causes restlessness for the majority of respondents 46.6%, while for 14.6% sometimes and 5.8% always. While for 23.3% rarely, and for 8.75% never.

Graph 10 shows the responses to the tenth survey question.

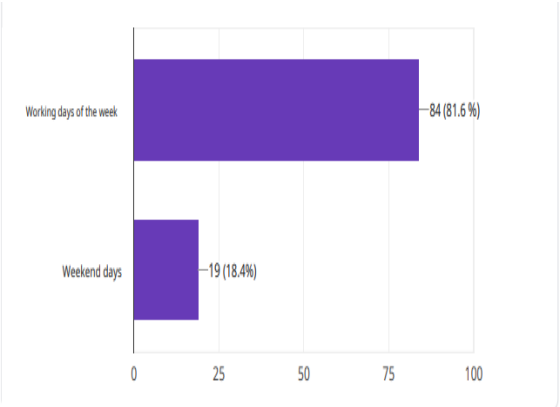
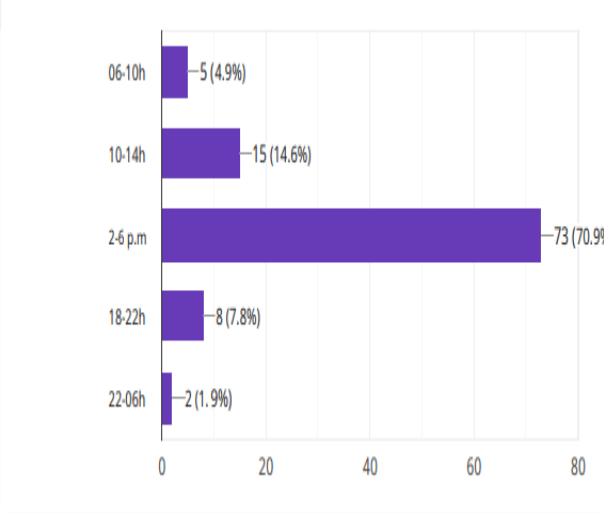


Chart 10. Display of answers to the question "Days of increased presence of traffic noise"

For the majority of respondents, 81.6% of weekdays have an increased presence of traffic noise, and 18.4% for weekend days.

Graph 11 shows the responses to the eleventh survey question.



Graph 11. Display of answers to the question "Time of increased traffic noise"

For the majority of respondents, 70.9% of the time of increased traffic noise is in the period from 14:00 to 18:00, then for 14.6% it is from 10:00 to 14:00, for 7.8% from (18:00 to 22:00), for 4.9% from (6:00 to 10:00) and for 1.9% from (22:00 to 06:00). Looking at the results of the survey, we can say that the majority of respondents are aware of the noise problem and 39.8% of respondents partially believe that noise caused by traffic is a problem today. Approximately the same percentage of respondents, 38.8%, partially agree with the thesis that noise caused by traffic impairs the quality of life. It can be said that the respondents are aware of the negative impact of noise on people's health, considering 35% of affirmative answers. The obtained results show us that traffic noise is a problem for the population, which should be a guide for solving it.

Analyzing the answers about the impact of traffic noise on efficiency and concentration, it was observed that noise sometimes has an impact on the respondents (40.8%). Also, for the majority of respondents (47.6%), traffic noise sometimes causes restlessness.

CONCLUSION

When it comes to noise caused by traffic in urban areas, there are numerous methods that can be applied to reduce the impact of noise and to increase the environment of healthy living. In addition to affecting the quality of the healthy living environment, noise also has a great impact on the health of citizens. The analysis of the conducted survey "Impact of traffic noise on the environment of healthy living in urban areas" shows that respondents are aware of the problem of traffic noise, and that it affects their efficiency, concentration and sometimes causes restlessness.

It can be safely said that the absorption of sound waves is not made by a couple of trees, but one should not lose sight of the psychological and aesthetic effect provided by green barriers. That is why it is important to develop knowledge and skills about the way and application of trees in urban areas as a green barrier to reduce noise. With sustainable and careful planning, and by connecting experts from different disciplines, cities could develop effective strategies to combat noise, thus contributing to the creation of healthier and more pleasant urban environments.

Local community management should integrate noise reduction strategies into urban plans of local communities. Promoting public transport, cycle paths and pedestrian zones can reduce traffic noise in urban areas. Building sound barriers along roads can significantly reduce traffic noise. Plants, trees and green areas can act as natural noise absorbers. Increasing green areas/dams in cities can help reduce noise. These approaches can be combined to create a more pleasant and healthy environment in urban areas.

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REGENERATE AGRICULTURE AS AN ALTERNATIVE TO THE INDUSTRIAL REVOLUTION

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Summary

The industrial revolution in agriculture, launched with great momentum in the second half of the 20th century, changed the way food is produced globally. Despite the increase in productivity, this model of agriculture has numerous negative consequences for the environment, biodiversity and socio-economic aspects of rural communities. In this paper, we explore the concept of regenerative agriculture as an alternative to industrial agriculture, highlighting its potential for sustainability and a just transition. Regenerative agriculture promotes the restoration and preservation of ecosystem health through the integration of biological diversity, soil restoration, and natural cycles into agricultural practice.

Keywords: *industrial agriculture, regenerative agriculture, sustainability, biodiversity, socio-economic justice, transition, ecosystem, soil restoration, agricultural practice*

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1 INTRODUCTION

Industrial agriculture, often referred to as agribusiness, stands at the intersection of traditional farming practices and modern industrial processes. It represents a pivotal evolution in the agricultural sector, where technological advancements and efficient production methods converge to meet the growing demands of a global population. This article explores the multifaceted landscape of industrial agriculture, examining its contributions to productivity, sustainability challenges, and its transformative impact on rural economies worldwide. By delving into the complexities of this industry, we gain insight into its role in shaping the future of food production and addressing critical global challenges.

The industrial revolution in agriculture, which began with a strong momentum in the second half of the 20th century, transformed the way food is produced around the world. However, despite the increase in productivity, this model of agriculture brings with it numerous negative consequences for the environment, biodiversity and socio-economic aspects of rural communities. In this paper, we explore the concept of regenerative agriculture as an alternative to industrial agriculture, with an emphasis on its potential for sustainability and a just transition.

1. INDUSTRIAL AGRICULTURE

Industrial agriculture is characterized by mechanization, intensive use of synthetic chemicals such as pesticides and artificial fertilizers, and monocultures. This approach is aimed at maximizing yield per hectare, often at the expense of soil health, biodiversity and long-term ecosystem sustainability. Although industrial agriculture brought cheap food and increased production, it simultaneously contributed to environmental degradation, loss of natural resources and economic impoverishment of small farms.

Key problems in industrial agriculture include soil, water and air pollution, loss of biological diversity, and increased sensitivity to climate change. In addition, centralization and concentration ownership of resources in the hands of large corporations has created an imbalance in the bargaining power of small farmers. Industrial agriculture, also known as agribusiness, represents the integration of agricultural production with industrial processes. This sector plays a crucial role in modernizing agriculture by providing efficient methods to process raw materials from primary agricultural production into final products that can be distributed and sold.

One of the main objectives of industrial agriculture is to increase productivity through the use of technology and modern farming methods. This includes the application of machinery, the use of high-yield hybrids, and genetically modified organisms (GMOs) to enhance yields and disease resistance, as well as optimizing resource use such as water and fertilizers.

The processing of agricultural products is a key component of industrial agriculture. This process involves various operations such as cleaning, sorting, packaging, and preserving products to extend their shelf life and enhance their market value. Examples of industrial agricultural products include juices, canned food, oils, flour, and dairy products.

Moreover, agribusiness provides opportunities for rural development by creating jobs and stimulating local economies. Integrating agricultural production with industrial processes also contributes to food security and reduces food losses, which is crucial in the face of global challenges such as climate change and population growth.

However, industrial agriculture is not without challenges. Some of the main issues include environmental impacts due to intensive use of pesticides and fertilizers, as well as the need for sustainable approaches to minimize ecological footprints and potential health risks.

In conclusion, industrial agriculture is a critical segment of modern agriculture that combines technological advancements with traditional farming methods to optimize production, increase profitability, and ensure the sustainable future of agriculture. Balancing industrial demands with environmental imperatives remains a key challenge for further development in this important economic sector.

2 REGENERATE AGRICULTURE AS AN ALTERNATIVE

Regenerative agriculture represents a comprehensive approach to farming that focuses on restoring ecosystem health, preserving soil, and enhancing biodiversity, while simultaneously providing sustainable food yields. This approach goes beyond conventional or even organic agriculture by emphasizing the integration of farming practices with natural processes.
One of the key principles of regenerative agriculture is soil conservation as a vital habitat for plants and microorganisms. This is achieved through agroecological practices such as crop rotation, soil cover crops, diverse crop planting, and the use of natural fertilizers. These practices improve soil fertility and reduce the need for chemical inputs, thereby minimizing negative environmental impacts.

Regenerative agriculture also emphasizes minimal soil disturbance to preserve its structure and prevent erosion, thus safeguarding soil from degradation and promoting its long-term sustainability.

Another crucial aspect of regenerative agriculture is the integration of livestock and crop production into systems that support nutrient cycles and reduce greenhouse gas emissions. The use of agroforestry and silvopasture can further contribute to soil conservation and biodiversity enhancement.

Ultimately, regenerative agriculture is not just about food production but a holistic approach that supports ecosystem health, community well-being, and economic resilience. Promoting these practices can have long-term positive effects on the environment, climate change mitigation, and the sustainability of global agriculture.

Regenerative agriculture represents a paradigm that strives to restore and preserve the health of the ecosystem through the promotion of biological diversity, soil renewal and the integration of natural cycles into agricultural practice. The main principles of regenerative agriculture include minimal use of chemicals, crop rotation, reduction of soil erosion, promotion of healthy livestock and reuse of resources within the local ecosystem. Regenerative agriculture represents a revolutionary approach to agriculture that emphasizes soil health as a fundamental link in the sustainability of the entire ecosystem. While traditional approaches often focus on maximizing yield through the intensive use of agrochemicals and mechanical operations such as deep plowing, regenerative agriculture with innovative methods tends to restore the biological activity of the soil, increase biodiversity and reduce the ecological footprint. Regenerative agriculture represents an innovative approach to agriculture that focuses on the restoration and preservation of ecosystem health through the integration of biological diversity, the restoration of soil fertility, and the promotion of natural cycles.

This agricultural practice opposes the traditional model of industrial agriculture, which often results in environmental degradation, loss of biodiversity and socio-economic challenges in rural communities. Key principles of regenerative agriculture include minimal use of synthetic chemicals such as pesticides and artificial fertilizers, crop rotation to preserve soil fertility, keeping the soil covered year-round to prevent erosion, and integrating livestock into agricultural systems to improve nutrient circulation and soil renewal.

The goal of regenerative agriculture is not only to increase productivity, but also to create more resilient ecosystems that can withstand climate change and ensure the sustainable use of natural resources for future generations. This practice also encourages local communities through the development of local food markets and the reduction of economic inequalities in rural areas.

This paper will explore the key principles of regenerative agriculture, their economic and ecological implications, and examples of successful implementations.

The central principle of regenerative agriculture is the reduction of soil disturbance, such as deep plowing, which negatively affects soil structure. Healthy soil is characterized by well-formed aggregates that allow air and water infiltration, and are key to retaining moisture and nutrients. Soil disturbance destroys these aggregates, reduces soil porosity and promotes anaerobic conditions that negatively affect soil microbiological activity. In regenerative agriculture, methods such as no-till systems and cover crops are used instead of aggressive plowing, which helps preserve soil structure and stimulate biological activity (Prescott et al., 2020).

An important aspect of regenerative agriculture is keeping the soil covered throughout the year. By growing cover crops and leaving crop residues on the soil surface, erosion is prevented, microorganisms are protected and moisture retention is encouraged. The continuous presence of living roots in the soil also contributes to the nutrition of soil biology, which is crucial for its fertility and health (Chapman, 2020).

Regenerative agriculture promotes the diversity of both plant and animal species. Through the mixing of crops, rotational grazing and the integration of livestock into agricultural systems, greater resistance to pests and diseases is achieved and the circulation of nutrients in the soil is improved. The diversity of plant communities and crops contributes to a better use of resources and a reduction in the need for chemical inputs (Soil Association, 2018). Animals play a key role in regenerative agriculture by contributing organic matter and microorganisms to the soil, which is essential for its fertility. Grazing animals are especially important because of their contribution to the nutrient cycle and maintaining the balance in the ecosystem. With proper management, livestock can positively affect soil structure, increase biodiversity and reduce the need for artificial fertilizers and pesticides (Brown, 2018).

Economically, regenerative agriculture can reduce the cost of inputs such as fertilizers and pesticides and increase profitability in the long run. Studies show that farms that apply regenerative techniques are less sensitive to input price fluctuations and achieve more stable and long-term sustainable profits (LaCanne & Lundgren, 2018). Ecologically, regenerative agriculture contributes to restoring biodiversity, reducing soil erosion and increasing water retention, thereby improving ecosystem resilience to climate change (Clark et al., 2019).

The example of the White Oak Pastures farm in Georgia illustrates the successful application of regenerative principles. This farm successfully integrates multiple types of livestock and crops, uses a group grazing system and has its own slaughterhouse that minimizes waste and contributes to the local economy. In addition to increasing profitability and resilience to climate change, the farm has become an engine of local development by employing large numbers of workers and encouraging sustainable food consumption (Brown, 2018).

Regenerative agriculture promises numerous advantages over industrial agriculture, including increased resilience to climate change, conservation of natural resources, improved biodiversity, and improved soil and water health. In addition to environmental benefits, this agricultural practice can improve economic opportunities for local communities through the development of local markets and the reduction of input costs.

The implementation of regenerative agriculture requires a just transition that takes into account the socio-economic and cultural specificities of rural communities. This includes support for small farms through education, access to financial resources, political support and strengthening of local food markets.

Furthermore, regenerative agriculture encourages farmers to adopt practices that promote water efficiency and conservation. Techniques such as rainwater harvesting, contour farming, and agroecological water management help mitigate drought risks and enhance overall water use efficiency on farms.

A significant benefit of regenerative agriculture is its potential to sequester carbon dioxide from the atmosphere and store it in the soil, thus contributing to climate change mitigation. Healthy soils rich in organic matter not only support higher crop yields but also act as a carbon sink, helping to reduce greenhouse gas levels in the atmosphere.

In addition to environmental benefits, regenerative agriculture fosters resilience in farming communities by diversifying income streams and reducing reliance on external inputs. By promoting local food systems and direct-to-consumer marketing, it enhances food security and strengthens community ties.

Challenges remain, including the need for broader adoption of regenerative practices, overcoming initial investment costs, and educating farmers about the benefits and techniques involved. Policy support and incentives can play a crucial role in scaling up regenerative agriculture and overcoming these barriers.

In conclusion, regenerative agriculture represents a promising pathway towards sustainable food production, environmental stewardship, and resilient farming communities. By prioritizing soil health, biodiversity, and climate resilience, it offers a transformative approach to addressing global agricultural challenges in the 21st century. Continued research, innovation, and collaboration are essential to fully unlock the potential of regenerative agriculture and ensure its widespread adoption worldwide.

Moreover, regenerative agriculture promotes biodiversity conservation by creating habitats that support a wide range of plant and animal species. Diverse crop rotations and intercropping methods not only enhance soil health but also provide ecological niches for beneficial insects, birds, and other wildlife, contributing to natural pest control and ecosystem balance. The holistic approach of regenerative agriculture extends beyond individual farms to encompass landscape-level planning and management. This includes efforts to

restore degraded lands, protect watersheds, and enhance ecological corridors that connect fragmented habitats, thereby promoting resilience in the face of environmental changes and preserving biodiversity. Economically, regenerative agriculture offers potential benefits through improved farm profitability over the long term. By reducing input costs, enhancing soil fertility, and diversifying income streams through value-added products like organic crops or grass-fed meat, farmers can achieve greater economic stability and resilience to market fluctuations. Socially, regenerative agriculture fosters community engagement and empowerment by promoting local food systems, supporting small-scale farmers, and enhancing food sovereignty. It encourages collaboration among farmers, researchers, policymakers, and consumers to create sustainable food networks that prioritize health, equity, and social justice. However, the transition to regenerative agriculture requires commitment and collaboration across sectors. Farmers need access to training, technical support, and financial incentives to adopt new practices. Policymakers play a crucial role in creating enabling environments through supportive policies, research funding, and market incentives that reward sustainable practices.

In conclusion, regenerative agriculture represents a paradigm shift towards farming practices that not only sustainably produce food but also restore ecosystems, support biodiversity, and enhance community well-being. Embracing regenerative principles offers a pathway to address the interconnected challenges of food security, climate change, and environmental degradation, ensuring a resilient and prosperous future for agriculture and society as a whole.

CONCLUSION

In conclusion, regenerative agriculture offers hope for a sustainable future of agriculture that is balanced between ecological, economic and social aspects. With a just transition to this model, we can build more resilient and sustainable agricultural systems that will support the long-term well-being of both farmers and communities that depend on agriculture. Regenerative agriculture is an advanced approach to agriculture that not only optimizes food production but also preserves and restores ecosystems. Through the implementation of principles such as reducing soil disturbance, maintaining soil cover, increasing biodiversity and integrating animals into agricultural systems, regenerative agriculture paves the way for a sustainable and profitable agricultural sector. Continued research and application of these principles is key to building resilient and environmentally friendly agricultural systems in the future. Regenerative agriculture is not only an approach to food production, but also extends the vision of preserving resources and ecosystems for future generations. Integrating these principles into agricultural practices can have a profound and positive impact on the environment, society and economy. Industrial agriculture represents not just a technological revolution in rural settings, but a crucial pillar for maintaining food supply stability in a rapidly changing world. The integration of advanced technologies with traditional farming methods enhances productivity and processing efficiency, yet poses challenges related to environmental sustainability and social responsibility. As industrial agriculture expands, it is imperative to focus efforts on balancing economic interests with the imperative of environmental protection and natural resource conservation. Only by doing so can we ensure that agribusiness plays a positive role in the future of the global agricultural system, providing food security and prosperity to rural communities worldwide.

APPLICATION OF NOISE PROTECTION WALLS ALONG ROAD "A" TRANSVERSAL IN SARAJEVO

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Summary

The research focuses on the efficiency of sound barriers in protecting against traffic-induced noise, with a specific focus on the example of barrier construction along the "A" highway in Sarajevo. The study aims to analyze the results of measuring daily and nightly noise levels at five different locations along the route, using standard methods and tools for noise measurement. The methodology involved constructing walls made of steel supporting columns and transparent panels of varying heights, and conducting control measurements of daily and nightly noise levels. The research results indicate that sound barriers are effective in reducing noise in the vicinity of roadways, especially during the daytime. However, nighttime noise values were slightly higher than the maximum allowable values, indicating the need for additional measures to control noise during nighttime hours. The importance of proper planning, construction, and maintenance of sound barriers is emphasized to ensure a better living environment for urban residents and reduce irritation caused by traffic noise.

Keywords: *traffic noise, urbanity, sound barrier, synthetic barriers, green barriers*

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1 INTRODUCTION

The primary source of noise in urban environments is traffic. Considering that traffic (road, rail, air) accounts for more than 80% of harmful sound occurrences, various measures have been developed over the years to protect or reduce noise emissions on roadways. Reductions in noise benefit nearby residential, commercial, and public areas by providing a better living environment, reducing irritation, and improving sound quality.

The most effective means of protection against traffic noise are sound barriers. Sound barriers are effective in shielding against excessive noise along roadways and can also limit the spread of dust and smog. Additionally, they provide a degree of privacy by shielding from the view of drivers and improve living conditions for residents and workers near roadways.

Sound barriers are characterized by excellent acoustic characteristics, resistance to high static and dynamic loads, corrosion, and weather influences. They are durable, easy to install, and maintain.

This paper will examine the application of sound barriers along the "A" highway in

Sarajevo, aimed at reducing the impact of traffic noise on surrounding residential units. The focus will be on the methodology of constructing the barriers and the results of control measurements of daily and nightly noise levels at five different locations along the route.

2 CONSTRUCTION OF SOUND BARRIERS ALONG THE "A" HIGHWAY IN SARAJEVO

After the construction of the "A" highway, which passes through two Sarajevo municipalities, Novi Grad and Ilidža, there arose a need for additional protection against traffic noise generated during its use, which undesirably affects the surrounding, mostly residential units. Noise protection is based on the installation of steel load-bearing HEA columns onto existing concrete walls, followed by the assembly and mounting of transparent noise protection panels. The height of the panels varies, depending on the height of the structures in front of which they are installed. Thus, we have different heights ranging from 1.5m, 2.0m, 2.5m, 3.0m, 4.5m, 5.0m, and 5.5m, depending on whether the panels are placed in front of individual houses or multi-story collective residential buildings, as depicted in Image 1.

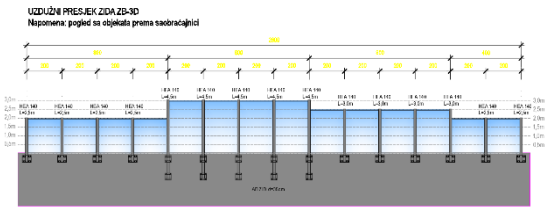

Image 1. Section of the longitudinal profile of the noise protection wall on the "A" highway

Depending on their height, the attachment points to the concrete walls will vary, either through one or two anchor plates. A draft of a section of the longitudinal profile of the wall is provided in Image 1. Besides the top crossbeam used for wall bracing, a mid-crossbeam is present on walls over 5.0m for additional stability.

By choosing this type of noise protection, not all noise is completely blocked but rather reduced to a more tolerable level. Effective barriers are considered those that reduce noise levels by 5 to 10 decibels. Traffic noise protection barriers reduce sound through absorption, transmission, and reflection back or by forcing sound to travel a longer path over and around the barrier. Therefore, the barrier must be sufficiently high and long, and the selected material must be strong and dense enough (at least 20kg/m2). Any material type is

equally effective in terms of sound insulation if it has this density.

3 METHODOLOGY OF MEASUREMENTS

After the completion of construction work on the noise protection walls, in order to verify the achieved results, it is necessary to conduct control measurements following the selection of characteristic sites. In total, five different locations were selected, and measurements were conducted over three different days for both daytime and nighttime noise levels, all in accordance with the requirements of standard BAS ISO 1996-1:2005 and BAS ISO 1996-2:2008. Monitoring was carried out in compliance with the Law on Noise Protection ("Official Gazette of the Sarajevo Canton" No. 23/16) and the Law on Noise Protection of the Federation of Bosnia and Herzegovina ("Official Gazette of the FBiH" No. 110/12). Measurements were conducted at five locations according to the following Image 2.

Image 2. Position of measurement points

Measurements were conducted towards the sources of noise, lasting for 60 minutes for daytime noise and 30 minutes for nighttime noise, with monitoring of meteorological conditions.

The noise measurements were performed using an SVAN 977 noise measurement device from the Polish manufacturer SVANTEK, with a calibrator model SV 33, and a TFA meteorological station of the SINUS type. Data processing software used included SvanPC++3.3.26 and Supervisor 1.7.13. The devices are depicted in Image 3.

Image 3. Noise measurement device, calibrator, and meteorological station

4 MEASUREMENTS REPORT

As previously mentioned, measurements were conducted at 5 locations, with data regarding coordinates, altitude, and distance from the sound barrier provided in Table 1.

Table 1. Measurement Locations

Mjerno mjesto	N	E	NV (m)	Udaljenost od zvučne barijere (m)
MM 1	43°49'58.29"	18°20'12.58"	506	3
MM 2	43°50'4.57"	18°20'16.32"	506	9
MM 3	43°50'7.57"	18°20'21.13"	508	6
MM 4	43°50'8.47"	18°20'26.22"	510	4
MM 5	43°50'7.35"	18°20'29.37"	513	12

The abbreviations and units of measure used in the research are as follows:

- dB (decibel) - 1/10 Bel is a unit for measuring sound,
- dB (A) (decibel - A scale) is an international measurement scale of sound or noise level that takes into account the variability of the human ear,
- Leq dB (A) - (equivalent noise level) is the average energy value of variable noise equivalent to the continuous noise level measured over a duration of 15 minutes during periods from 06-22 [h] (daytime) and 22-06 [h] (nighttime),
- L_{max} dB (A) is the maximum value of measured noise in a given period,
- L_{min} dB (A) is the minimum value of measured noise in a given period,
- L_n dB (A) is the sound pressure level that is above the stated n% of the time within the measurement period,
- L1 dB (A) is the noise level exceeded 1% of the time within the measurement period.

During the measurements, noise generated by traffic on the "A" highway, traffic on secondary roads, and noise from surrounding settlements along the highway route was recorded. The equivalent noise level was recorded continuously for 60 minutes for daytime and 30 minutes for nighttime noise. Based on the measured noise levels, the relevant equivalent level is calculated and expressed in dB(A).

4.1 Measurement point MP1

Measurement point MP1 is located west of the roadway, in the immediate vicinity of a residential building on Hajrudina Šabanije Street. The measurement location is between the building and the sound barrier. The distance from the facade at the measurement site is 1.8 meters. The location of the measurement point is shown in Image 4, while Images 5 and 6 depict the measurement point and the noise protection wall.

Image 4. Depiction of measurement point MP1

Image 4. Depiction of measurement point MP1

The results of daytime and nighttime noise level measurements for measurement point MP1 are provided in Table 2, while Table 3 presents the meteorological parameters prevailing during the noise measurements. During the measurement period, the weather was clear and precipitation-free. The roads and surrounding ground were dry, making the soil conditions suitable for noise measurement. Image 7 depicts the noise measurement diagram for a 60-minute interval, while Image 8 shows the diagram of nighttime noise measurement for a 30-minute interval.

Table 2. Results of noise level measurements for measurement point MP1

Tabela 3.2. Rezultati mjerenja dnevnog i noćnog nivoa buke za mjerno mjesto MM 1

Parametar	Vrijednost	
	Dnevna buka	Noćna buka
Ref (min)	60	30
Leq dB(A)	56,3	50,7
Lmin dB(A)	39,7	34,0
Lmax dB(A)	83,7	67,6
L90 dB(A)	47,5	39,2
L50 dB(A)	56,3	47,6
L10 dB(A)	62,5	58,7
L5 dB(A)	63,9	60,5
L1 dB(A)	66,5	63,8

The meteorological parameters during the measurements were favorable.

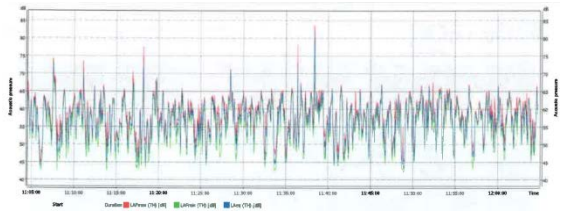

Image 6. Diagram of daytime noise measurement for measurement point MP1

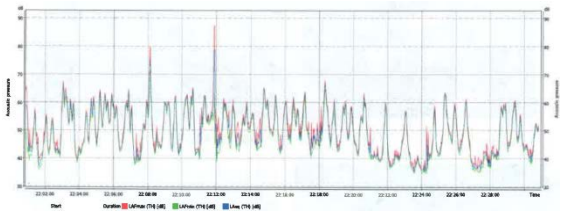

Image 7. Diagram of nighttime noise measurement for measurement point MP1

4.2 Measurement point MP2

Measurement point MP2 is located on Branislava Nušića Street on the west side of the A highway, next to the fence of a residential building. The location of the measurement point is shown in Image 9, while Images 10 and 11 depict the measurement point and the noise protection wall.

The results of daytime and nighttime noise level measurements for measurement point MP2 are provided in Table 4, while Table 5 presents the meteorological parameters prevailing during the noise measurements. During the measurement period, the weather was clear and precipitation-free. The roads and surrounding ground were dry, making the soil conditions suitable for noise measurement. Image 12 depicts the noise measurement diagram for a 60-minute interval, while Image 13 shows the diagram of nighttime noise measurement for a 30-minute interval.

Image 8. Depiction of measurement point MP2

Image 9. Depiction of the sound barrier at MP2

Table 3. Results of noise level measurements for measurement point MP2

Parametar	Vrijednost	
	Dnevna buka	Noćna buka
Ref (min)	60	30
Leq dB(A)	59,4	53,1
Lmin dB(A)	44,6	35,2
Lmax dB(A)	76,8	66,0
L90 dB(A)	51,7	41,8
L50 dB(A)	57,2	50,7
L10 dB(A)	62,7	60,9
L5 dB(A)	64,3	63,5
L1 dB(A)	67,8	67,5

The meteorological parameters during the measurements were favorable.

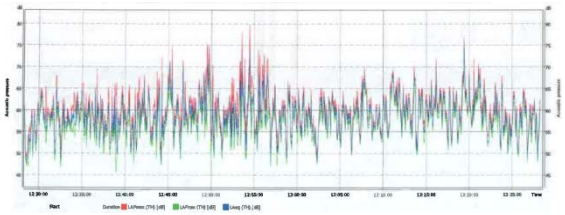

Image 10. Diagram of daytime noise measurement for measurement point MP2

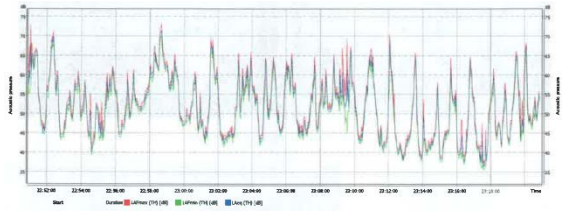

Image 11. Diagram of nighttime noise measurement for measurement point MP2

4.3 Measurement point MP3

Measurement point MP3 is located on Branislava Nušića Street on the west side of the A highway, next to the fence of a residential building. The distance from the sound barrier at the measurement site is 6.0 meters. The location of the measurement point is shown in Image 14, while Images 15 and 16 depict the measurement point and the noise protection wall.

The results of daytime and nighttime noise level measurements for measurement point MP3 are provided in Table 5, while Table 6 presents the meteorological parameters prevailing during the noise measurements. During the measurement period, the weather was clear and precipitation-free. The roads and surrounding ground were dry, making the soil conditions suitable for noise measurement. Image 17 depicts the noise measurement diagram for a 60-minute interval, while Image 18 shows the diagram of nighttime noise measurement for a 30-minute interval.

Image 12. Depiction of measurement point MP3

Image 13. Depiction of the sound barrier at MP3

Table 4. Results of noise level measurements for measurement point MP3

Parametar	Vrijednost	
	Dnevna buka	Noćna buka
Ref (min)	60	30
Leq dB(A)	57,6	51,5
Lmin dB(A)	43,8	37,0
Lmax dB(A)	66,6	63,4
L90 dB(A)	51,5	40,3
L50 dB(A)	56,8	47,0
L10 dB(A)	60,8	56,1
L5 dB(A)	61,8	57,7
L1 dB(A)	64,8	60,3

The meteorological parameters during the measurements were favorable.

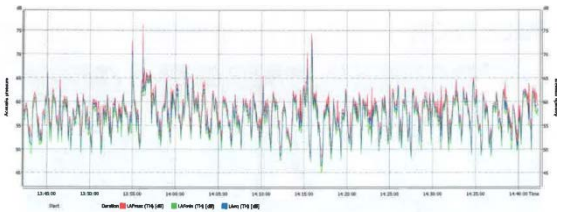

Image 14. Diagram of daytime noise measurement for measurement point MP3

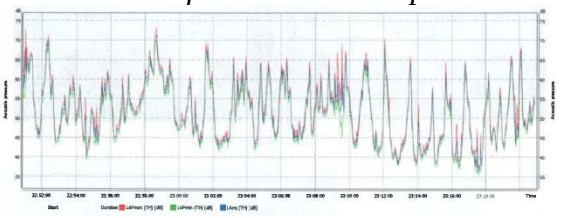

Image 15. Diagram of nighttime noise measurement for measurement point MP3

4.4 Measurement point MP4

Measurement point MP4 is located on Ramiza Salčina Street in the immediate vicinity of a residential building. The distance from the sound barrier at the measurement site is 4.0 meters. The location of the measurement point is shown in Image 20, while Images 21 and 22 depict the measurement point and the noise protection wall.

The results of daytime and nighttime noise level measurements for measurement point MP4 are provided in Table 8, while Table 9 presents the meteorological parameters prevailing during the noise measurements. During the measurement period, the weather was clear and precipitation-free. The roads and surrounding ground were dry, making the soil conditions suitable for noise measurement. Image 22 depicts the noise measurement diagram for a 60-minute interval, while Image 23 shows the diagram of nighttime noise measurement for a 30-minute interval.

Image 16. Depiction of measurement point MP4

Image 17. Depiction of the sound barrier at MP4

Table 5. Results of noise level measurements for measurement point MP4

Parametar	Vrijednost	
	Dnevna buka	Noćna buka
Ref (min)	60	30
Leq dB(A)	59,1	52,6
Lmin dB(A)	39,5	34,3
Lmax dB(A)	71,3	66,1
L90 dB(A)	50,7	40,1
L50 dB(A)	60,9	53,7
L10 dB(A)	65,8	61,9
L5 dB(A)	66,8	63,3
L1 dB(A)	69,1	65,5

The meteorological parameters during the measurements were favorable.

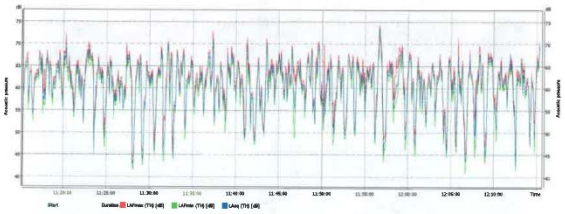

Image 18. Diagram of daytime noise measurement for measurement point MP4

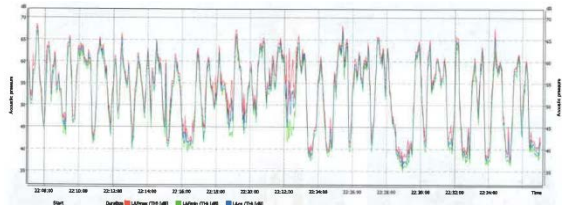

Image 19. Diagram of nighttime noise measurement for measurement point MP4

4.5 Measurement point MP5

Measurement point MP5 is located on Branislava Nušića Street, on the eastern side of the A transferzale. The distance from the sound barrier at the measurement site is 12.0 meters. The depiction of the measurement point location is shown in Image 24, while Images 25 and 26 depict the measurement point and the noise protection wall.

The results of daytime and nighttime noise level measurements for measurement point MP5 are provided in Table 10, while Table 11 presents the meteorological parameters prevailing during the noise measurements. During the measurement period, the weather was clear and without precipitation. Roads and surrounding terrain were dry, making the ground conditions suitable for noise measurement. Image 27 shows the noise measurement diagram for a 60-minute interval, while Image 28 displays the nighttime noise measurement diagram for a 30-minute interval.

Image 20. Depiction of measurement point MP5

Image 21. Depiction of the sound barrier at MP5

Table 6. Results of noise level measurements for measurement point MP5

Parametar	Vrijednost	
	Dnevna buka	Noćna buka
Ref (min)	60	30
Leq dB(A)	55,3	48,9
Lmin dB(A)	44,0	32,6
Lmax dB(A)	59,9	60,3
L90 dB(A)	49,9	40,2
L50 dB(A)	54,2	47,1
L10 dB(A)	58,7	54,3
L5 dB(A)	60,3	55,8
L1 dB(A)	66,3	59,1

The meteorological parameters during the measurements were favorable.

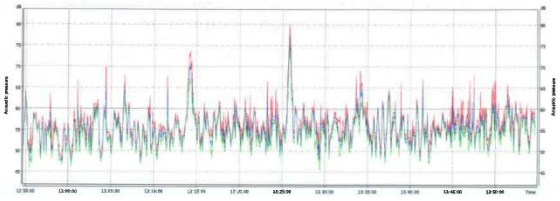

Image 22. Diagram of daytime noise measurements for measurement point MP5

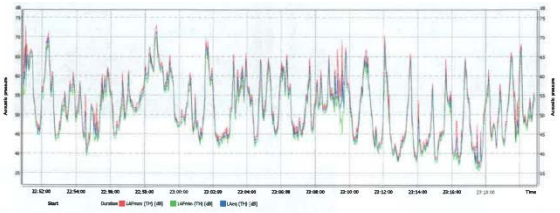

Image 23. Diagram of nighttime noise measurements for measurement point MP5

5 REVIEW OF MEASUREMENT RESULTS

In Table 12, the results of all measurements are presented for both the daytime and nighttime variants. Subsequently, the maximum permissible noise levels specified in the Law on Noise Protection of the Sarajevo Canton ("Official Gazette of the Sarajevo Canton" no. 23/16) for Zone IV, as indicated in Table 13, are provided. Zone IV encompasses commercial, business, residential, and residential areas along traffic corridors, as defined by the Spatial Plan of the Sarajevo Canton (2003-2023).

Table 7. Measurement results and maximum permissible values

Mjerno mjesto	Izmjerene vrijednosti						Najviše dozvoljene vrijednosti nivoa buke			
	Dan			Noć			Zona	Dan	Noć	L1 dB(A)
	Leq dB(A)	U dB(A)*	L1 dB(A)	Leq dB(A)	U dB(A)*	L1 dB(A)		Leq dB(A)		
MM 1	56,3	± 2,4	66,5	50,7	± 2,9	63,8	IV	60	50	75
MM 2	59,4	± 2,4	67,8	53,1	± 3,3	67,5	IV	60	50	75
MM 3	57,6	± 2,4	64,8	51,5	± 3,4	60,3	IV	60	50	75
MM 4	59,1	± 2,4	69,1	52,6	± 2,9	65,5	IV	60	50	75
MM 5	55,3	± 2,4	66,3	48,9	± 2,9	59,1	IV	60	50	75

Table 8. Permissible noise levels in different zones

Tabela 1.1. Dozvoljeni nivoi vanjske buke u različitim zonama

Područje (zona)	Namjena područja	Najviše dozvoljeni nivo vanjske buke (dBA)		
		15 min Leq		Vršni nivo
		Dan	Noć	L1
I	Bolničko, lječilišno	45	40	60
II	Turističko, rekreacijsko, oporavilišno	50	40	65
III	Čisto stambeno, vaspitno-obrazovne i zdravstvene institucije, javne zelene i rekreacione površine	55	45	70
IV	Trgovačko, poslovno, stambeno i stambeno uz saobraćajne koridore, skladišta bez teškog transporta	60	50	75
V	Poslovno, upravno, trgovačko, zanatsko, servisno (komunalni servis)	65	60	80
VI	Industrijsko, skladišno, servisno i saobraćajno područje bez stanova	70	70	85

CONCLUSION

Measurement uncertainty U is provided as an expanded measure of uncertainty for a confidence level of 95% and a coverage factor k=2. Correction of results due to residual noise is not determined as the total noise level from all sources was measured.

Based on the measurement results, considering the measurement uncertainty, it is concluded that the daytime noise at the measurement locations does not exceed the maximum permissible noise values for Zone IV where the measurement was conducted during the day, while for the nighttime regime, the measured values are slightly higher than the maximum allowable values.

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