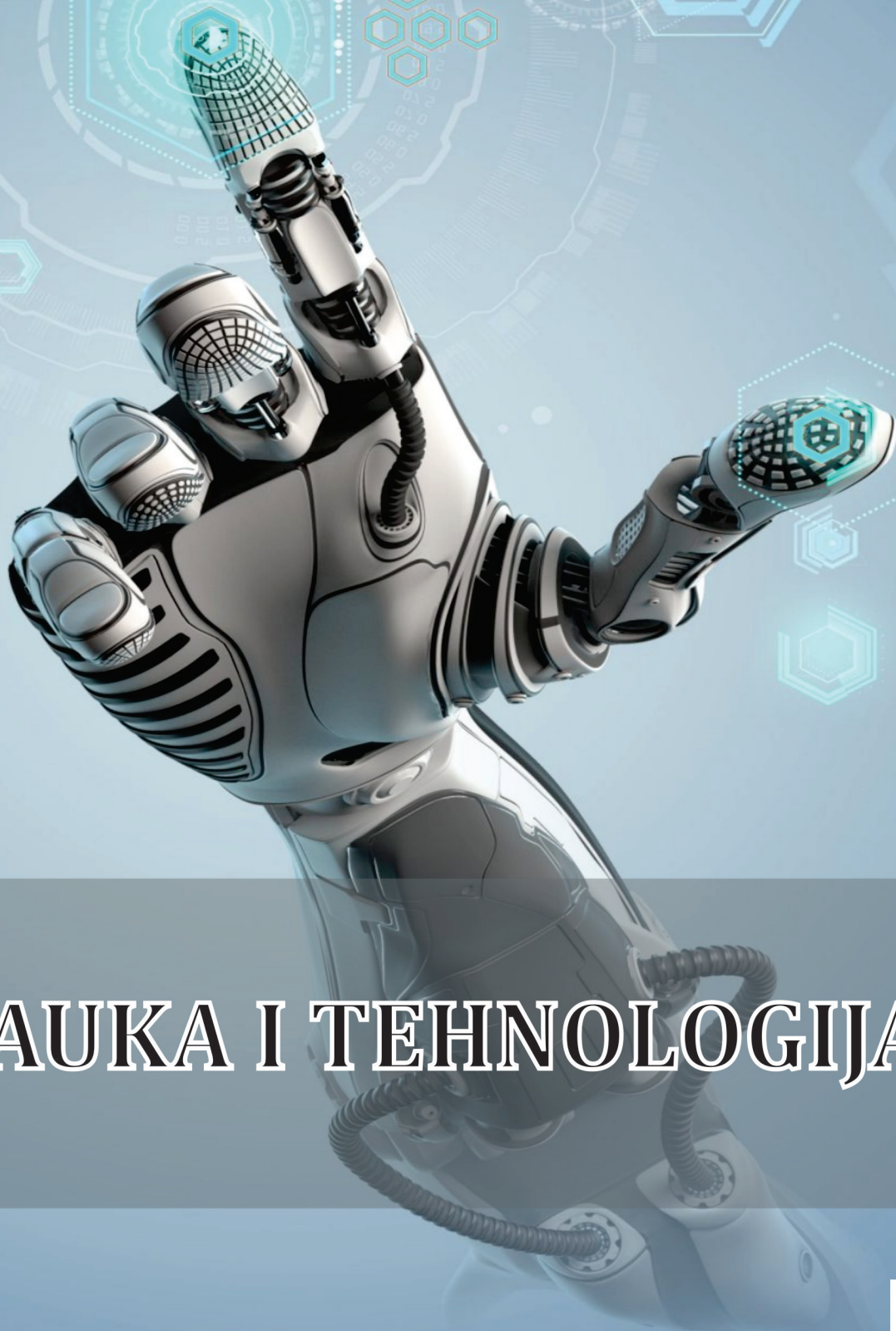


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INTERNATIONAL UNIVERSITY TRAVNIK IN TRAVNIK

72270 Travnik
Aleja Konzula – Meljanac bb
Tel: + 387 30 540 597
Fax: + 387 30 540 587

www.iu-travnik.com

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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, Lens.Org, ErihPlus, Road, OpenAlex, EconBiz and Ceeol. 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. 2, 2024, we are proud to present a diverse array of papers that reflect the broad scope of our journal:

1. **"Additional support measures in the Kobilja Glava tunnel"** by Nadir Halilbegović analyzes the application of additional support measures in the construction of the Kobilja Glava tunnel, aimed at ensuring the tunnel's stability and safety due to specific geological conditions.
2. **"Concreting in special conditions"** by Zlatica Kuliš explores the challenges and techniques of concreting under specific construction conditions, such as extreme temperatures, high humidity, underground conditions, or project-specific requirements.
3. **"Economic impact of the circular economy on the development of tourism offerings in relation to environmental and energy efficiency example: development of a tourism vehicle - electric carriage"** by Duško Stić analyzes the economic impact of the circular economy on the development of tourism offerings, with a particular focus on ecological and energy efficiency. Through the example of developing electric carriages, the author explores how the application of the circular economy in the tourism sector can reduce the ecological footprint, improve sustainability, and lower energy costs.
4. **"Risk management in the context of the problem of integral water management"** by Ivica Opačak, Šemsudin Dedić and Tihomir Vujčić they explore risk management in the context of integrated water management. They focus on the challenges and approaches related to the optimal use of water resources, taking into account ecological, economic, and social aspects.
5. **"Electronic government in the Republic of Serbia"** by Jovan Šarac and Nedeljko Krajišnik They explore the implementation and development of e-government in Serbia. They analyze how the digitalization of public services can improve efficiency and transparency in government institutions, as well as enhance communication between citizens and the authorities.

6. **Biases in the Development of Artificial Intelligence Algorithms**" by Rudof Petrušić explores the issue of bias in the development of artificial intelligence algorithms. They focus on how biases can be present in the data used to train AI systems, as well as in the algorithms themselves. The author analyzes how these biases can lead to unfair or discriminatory decisions and discusses the ethical and social implications.
7. **"Arduino IoT Functions in the Smart Power Grid System"** by Sofiu Vehebi explores the application of Arduino and Internet of Things (IoT) technologies in smart power grid systems, focus on the role of Arduino in data collection, energy consumption monitoring, and real-time energy distribution optimization. The author analyzes how the integration of IoT functionalities can improve efficiency, reduce energy losses, and enable better control and management of energy in smart grids.
8. **"Contemporary Construction and Its Impact on the Old Urban Structure of the City of Prizren"** by Vesnera Serif, Senida Hocko Serif and Veis Serif explore the impact of contemporary construction on the old urban structure of the city of Prizren. They focus on the challenges that modern infrastructure development brings in the context of preserving cultural heritage and traditional urban construction. The authors analyze how new buildings, changes in urban planning, and the expansion of the city affect the characteristic elements of the old town core, and consider possible strategies for balancing development and the preservation of historical values.

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

ADDITIONAL SUPPORT MEASURES IN THE KOBILJA GLAVA TUNNEL

Nadir Halilbegović¹

¹PPG d.o.o. Sarajevo, e-mail: n.halilbegovic@ppg.ba

Scientific article

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Abstract

The paper presents specific aspects of the construction of the Kobilja Glava tunnel, which is being built as part of the I Transversal, section Vogošća-Sarajevo, with an emphasis on the use of additional support measures. Due to the poor characteristics of the rock mass – marl, significant subsidence was regularly monitored during excavation in the tunnel's tubes, both inside the tunnel and on the surface of the terrain. In specific geological sediments with poor geological and geotechnical characteristics, there is a need for the use of additional support measures, such as temporary invert, "elephant foot," support sail, etc., aimed at stabilizing the tunnel, preventing further movement, and preventing the encroachment into the designed profile of the secondary lining.

Keywords: tunnel, construction, monitoring, elephant foot, temporary invert, support sail

JEL classification of work: L74 Construction



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1 INTRODUCTION

The physical-mechanical properties of the rock mass in which a tunnel is constructed have a significant impact on the construction process. Accordingly, the physical-mechanical properties of the rock mass directly influence the selection of tunnel construction methods.

In accordance with the standard BAS EN 1997-1:2017, tunnels fall into the third geotechnical category, which involves unusually large risks or exceptionally demanding soil conditions or loads. Although extensive research and complex analyses are carried out during the design phase, predicting the geotechnical behavior of such a structure is difficult, so the standard allows the use of the so-called observation method, where the project is monitored during construction.

Therefore, during tunnel construction, continuous geotechnical monitoring of the tunnel, the surface above the tunnel, and surface structures is conducted. This method helps identify stress and deformation redistributions in the rock mass surrounding the future tunnel and monitors the stability of the tunnel and all existing structures throughout all phases of construction.

In Mission G32, conducted during excavation and other works on the primary tunnel lining, support measures are planned to ensure the stability of the tunnel during excavation.

Despite these measures included in Mission G32, post-monitoring results showed the need for additional support measures to stabilize the tunnel. An overview of the additional support measures is provided in the following text.

2 REGULAR MONITORING DURING CONSTRUCTION PHASE

Regular monitoring and quality control during the construction phase is one of the most important segments in the proper implementation of NATM tunnel excavation, aiming to "control" the impact of deformations in the rock mass on the primary support system.

During regular monitoring, the following criteria need to be compared to assess deviations from the expected behavior of the support system:

Rating 4 - In accordance with the expected behavior

Measured deformation levels range from 0-50% of the expected deformation tolerance.

The necessary action is to maintain the prescribed frequency of deformation measurements.

Rating 3 - Slight deviation from expected behavior

Measured deformation levels range from 50-75% of the expected deformation tolerance. The necessary action involves increasing the frequency of deformation measurements at critical profiles to determine deformation trends, speed of change, and prioritized deformation vector directions. A visit to the critical zone in the tunnel and reconnaissance of the lining condition (cracking of the primary lining, condition of anchor strain plates, and other signs of increased primary lining mobilization) (Figure 1).



Figure 1. Condition of IBO anchor strain plate/crown (photo by N. Halilbegović, 2024.)

Rating 2 - Deviation from expected behavior

Measured deformation levels range from 75-90% of the expected deformation tolerance. Necessary actions include increasing the frequency of deformation measurements at critical profiles, determining trends, speed of change, and prioritized deformation vector directions. A visit to the critical zone and reconnaissance of the lining condition (cracking, anchor plate condition, etc.) (Figure 2). If necessary, additional support measures are implemented based on numerical analysis and frequent monitoring of rock mass behavior.

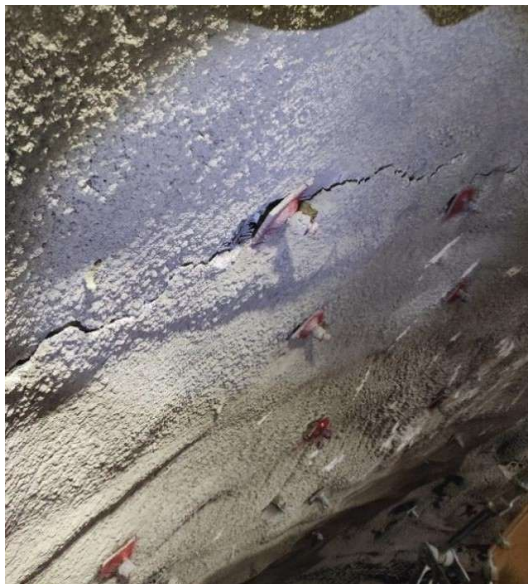


Figure 2. Cracks in the shotcrete/crown (photo by N. Halilbegović, 2024.)

Rating 1 - Significant deviation from expected behavior

Measured deformation levels exceed 90% of the expected deformation tolerance. Necessary actions involve increasing measurement frequency, determining trends and speed of deformation, and visiting the critical zone in the tunnel to check the condition of the lining (Figure 3). If required, additional support measures are implemented based on numerical analysis, and frequent monitoring of the rock mass behavior is performed. Geodetic profiling is done to determine minimal tolerance for transitioning to the sub-profile.

If necessary, the installation of longer anchors is performed next to anchors with damaged strain plates. Local repairs to the primary lining are carried out at locations where larger cracks have appeared.



Figure 3. Condition of steel arch - grillage/crown (photo by N. Halilbegović, 2024.)

2.1. Deformation Measurement

Deformation measurement is also a very important segment of monitoring during construction according to NATM. It is essential that deformation measurements, both in the tunnel and on the surface, be continuous without interruption. In poor rock environments such as clays, reference points (measurement profiles) for deformation measurement are installed

every 5 meters in the crown and every 10 meters in the bench. This approach enables timely information on the actual conditions during tunnel excavation. 3D optical measurements are used for deformation monitoring. Electronic total stations with integrated coaxial distance measurement are generally used for 3D observation. The points are observed using specially designed reference points that have a well-defined central point.

Depending on the type of work, two types of reference points are used, such as bi-reflective reference points and prism reference points (Figure 4). Bi-reflective reference points have reflective foil on both sides. They are used for distances up to 140 meters and are used to monitor the normal cross-section. The reference point is positioned freely, and readings are taken based on several cross-sections and reference points. Polar coordinates of the reference point represent original readings that define the cross-section. Absolute 3D coordinates of the cross-section are calculated from the polar coordinates.

The purpose of 3D measurement is to:

1. Verify geological surveys,
2. Adapt the support system to actual conditions,
3. Verify the correctness of all support measures.



Figure 4. Prism reference point/crown (photo by N. Halilbegović, 2024.)

3 ADDITIONAL SUPPORT MEASURES IN THE KOBILJA GLAVA TUNNEL

In specific geological environments, environments with poor geological and geotechnical characteristics such as marls, there is a need to use additional support measures such as: temporary invert, "elephant's foot", support sail, etc.

3.1. Temporary invert

In soft rocks such as marl, where we have large deformations and subsidence both in the tunnel and on the surface of the terrain, a temporary invert (temporary foot vault) is performed as an additional underground system of measures (Figure 5 and 6).

The technology for performing a temporary invert consists of excavation and transport of the excavated material to the landfill and installation of shotcrete on the previously reinforced surface. Shotcrete is installed with a pump for shotcrete, the so-called robot. As a rule, the thickness of shotcrete (C25/30) can be from 20 to 30 cm, depending on the quality of the rock mass of the treated section of the tunnel, and the reinforcement is carried out in two layers of reinforcing mesh (Q257) with mutual overlaps of min 30 cm (in practice it is an overlap of two cubes), the overlap must be realized both longitudinally and transversely at the joints of the nets. The reinforcing meshes are connected to each other with 3 mm thick steel wires. After concrete has been installed in the temporary invert, work on that position is suspended for a minimum of one hour, followed by backfilling of the temporary invert in order to allow access to machines for continuing work on other positions, as required by the basic principles of NATM.

It is important to point out that the distance of the face of the tunnel excavation from the temporary invert must not be more than 3m, because otherwise the installation of a

temporary invert with the role of taking over current pressures does not make sense.

The purpose of installing a temporary invert is to take over pressures and deformations until the complete closure of the ring is performed by performing a permanent invert, more precisely in preventing further increase in displacement as well as preventing entry into the designed profile of the secondary lining. When excavating the permanent invert, together with the excavated material, the temporary invert is removed and transported to the landfill.



Figure 5. Excavation of the temporary invert (photo. N. Halilbegović, 2024)



Figure 6. Installation of shotcrete on pre-reinforced II reinforcement zone/temporary invert (photo. N. Halilbegović, 2024)

3.2. "Elephant's Foot"

"Elephant's foot" as an additional support measure is applied on the contact part of the calote and the step (Figure 7). The technology of performing the "elephant's foot" consists of a slightly deeper excavation in the side of the calotte than usual in order to form a space for its installation. The "elephant's foot" is prepared on the construction site, by welding additional reinforcing bars for the pulley (lattice support) and according to the previously agreed detail that defines the thickness of the reinforcing bars, the method of welding them for the pulley and the overlap (Figure 8). Reinforcing bars that are used as an integral part of the "elephant's foot" must have appropriate certificates, and after the welding process, and before installation, the welds are additionally tested.

The purpose of installing the "elephant's foot" is to prevent the further increase of displacement as well as to prevent entry into the designed profile of the secondary lining. It is often the case in soft rocks and poor soils that micro piles are additionally installed under the "elephant's foot".

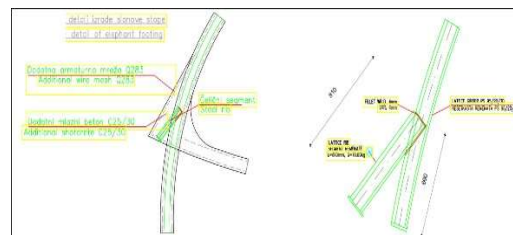


Figure 7. Detail of making the "elephant foot"



Figure 8. Detail of the "elephant's foot" installation (photo: N. Halilbegović, 2024)

3.3. Securing the face of the excavation - support sail

Securing the face of the excavation, as one of the additional support measures, includes the protection of the active face of the calotte by installing shotcrete on a previously installed zone of reinforcing mesh, additionally reinforced with IBO anchors (Figure 9).

The front protection technology consists, first of all, of the formation of a support core during excavation, which is reinforced with one zone of reinforcing mesh (Q257) (Figure 10). After installing the reinforcing mesh, shotcrete (C25/30) is usually installed in a thickness of 5 cm. The face of the excavation is then additionally strengthened by installing IBO anchors (fi32mm), length 12m1. A total of 8 anchors are installed. Anchors must be activated no later than 24 hours after installation.

It is important to point out that the face of the excavation secured in this way is left until the excavation of the next step of the

calotte, where during the excavation of the calotte the secured face is also removed. If the rock mass is of lower quality, the reinforced supporting sail with anchors can be kept during the excavation of two to three new steps of the calotte, in such a way that the central part of the calotte is left during the excavation, while one halo around the supporting sail is excavated, just enough to can access the installation of load-bearing elements of the primary substructure.



Figure 9. Installation of shotcrete on the pre-reinforced face of the excavation/top heading (photo by N. Halilbegović, 2024)



Figure 10. Support sail/top heading (photo. N. Halilbegović, 2024)

CONCLUSION

Tunnels are highly specific and complex structures, making it very challenging to predict the actual geological and geotechnical characteristics of the terrain. In practice, it has been observed that the true geological characteristics of the ground are usually determined only during the excavation of the tunnel shafts.

After each step of excavation, geological mapping of the tunnel face is performed, which includes rock mass classification, typically based on the RMR (Rock Mass Rating) system. Based on this mapping, the type of primary lining is determined.

Although extensive research and complex analyses are conducted during the design phase, predicting the geotechnical behavior of such a structure is difficult. Therefore, the standard permits the use of the so-called observation method, where the project is monitored during construction. Continuous geotechnical monitoring of the tunnel will be conducted during construction.

The paper discusses specific aspects of the construction of the Kobilja Glava Tunnel. Due to deformation and subsidence of the terrain resulting from poor characteristics of the rock mass—limestone—additional support measures had to be implemented, such as temporary invert, elephant foot, and support core, with the aim of stabilizing the tunnel and preventing further movement as well as encroachment into the designed profile of the secondary lining.

While it is crucial to carry out geotechnical investigations and complex analyses of the stress-deformation state of the rock mass on the tunnel lining before starting the excavation, primarily to dimension the appropriate support system to ensure tunnel stability during excavation, it is equally important to control the influence of stress and pressure from the surrounding rock mass on the tunnel lining during the construction phase. This is achieved by

adapting the excavation and lining technologies to the actual conditions on-site, in line with the core principles of NATM (New Austrian Tunneling Method).

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CONCRETING IN SPECIAL CONDITIONS

Zlatica Kuliš¹

¹International University Travnik in Travnik - Faculty of Polytechnic Sciences,
e-mail: zlatica.kulis@gmail.com

Professional paper

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Abstract

Concreting in special conditions refers to the application of specific techniques and methods of concrete works in conditions such as extreme temperatures (low and high), high humidity, underwater works, aggressive environments, under high pressure or in areas with increased seismic risks. In such conditions, the concrete must be adapted to ensure the necessary strength, durability and safety. In cold conditions, concrete with the addition of additives to accelerate hardening is used, while in hot conditions, additives that slow down the hardening process should be used. Concreting in wet conditions or under water requires the application of special techniques, such as the use of waterproof concrete or concreting in cavities under water. In addition to the main problems when concreting in these conditions, we also use appropriate protection measures for the mentioned cases. Proper preparation of materials, control of temperature, humidity and installation technology are key to achieving the desired performance of concrete structures. In addition to the above, attention must also be paid to temperature and humidity control, as well as quality preservation during the entire concreting process.

Keywords: *concreting, extreme temperatures, humidity, pressure, aggressive environments*

JEL work classification: *L7*



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1 INTRODUCTION

Concreting is a key stage in construction works when building buildings, and concrete is one of the most important building materials we use. In special conditions, concreting becomes challenging due to various factors that make it such as extreme temperatures, humidity, the presence of aggressive substances, and complex geological and climatic conditions. Regarding the above, different special conditions that affect concreting and the techniques that are applied in order to achieve the desired result in the specified conditions must be analyzed.

2 SPECIAL CONDITIONS IN CONCRETING

1.1. Extreme temperatures

Concreting in conditions of very low or very high temperatures requires special measures to prevent premature hardening or cracking of the concrete.

1.1.1. Concreting at low temperatures

In winter conditions, low temperatures can cause water in the concrete to freeze, which hinders the hydration process. This can lead to poor strength, poor concrete quality and cracking due to ice expansion. In addition, freezing of concrete can cause the formation of micro-cracks and reduce the long-term durability of concrete. Also, too rapid cooling of concrete occurs when concrete cools too quickly, and thermal stresses can occur that cause cracking, which is especially problematic in concrete structures that require high strength. For these conditions, various additives are used, such as means to accelerate hardening, and the use of heated aggregate and water, as well as the application of special installation methods

and technology. With all the necessary protection measures, concreting at low temperatures can be carried out safely and efficiently, which enables construction even in the most difficult conditions.

1.1.1.1. Measures to protect concrete at low temperatures.

In order to protect the concrete in these conditions, it is necessary to use the following:

Heating the water: The water used in the mixture must be heated before adding it to the concrete. It is ideal to use a water temperature of around 50-60°C.

Aggregate heating: Aggregates, such as sand and gravel, can also be heated to increase the temperature of the mix.

Curing of cement: In some cases, warm cement can be used, because warm cement reacts faster with water and helps the concrete harden faster.

The use of additives to accelerate the hardening: they speed up the cement hydration process, thus reducing the risk of water freezing before the cement is fully hydrated, and anti-freezing additives such as calcium chloride, which help prevent the mixture from freezing and accelerate the hardening of the concrete.

Thermal blankets and insulation: After pouring the concrete, protect the surface of the concrete from freezing with thermal insulating blankets, geotextiles, plastic films or special heating cables.

Plastic sheets and geotextiles: These materials can help keep the concrete warm and prevent freezing during the curing process.

Site heating: In some cases, it may be necessary to use portable heaters or heating systems to raise the temperature of the environment and concrete at the site.

Concreting during the day: If possible, concreting should be done during the day when temperatures are higher. However, if

concreting must be carried out at night, additional protection and heating measures are required.

Temperature monitoring: It is important to monitor the temperature of the concrete to ensure that it does not fall below the critical 5°C before initial strength is achieved. This can be achieved by installing a temperature sensor in the concrete mix.

Temperature of the concrete mixture: The recommended temperature of the concrete mixture in cold conditions is between 10 and 20°C, in order to allow proper hardening.

1.1.2. Concreting at high temperatures

In hot conditions, the concrete mixture hardens faster, which can lead to cracking and poor quality concrete. The use of cold aggregates, shading of concrete surfaces, and the addition of additives that slow down the hardening of concrete can help in these conditions. Concreting at high temperatures also presents a specific challenge in the construction industry. High temperatures can affect the quality of concrete, accelerate the hardening process, reduce the working life of the concrete mixture and cause numerous damages to the finished structure. Given these risks, it is necessary to apply special techniques and protective measures to ensure optimal concrete properties.

1.1.2.1. The main problems in concreting at high temperatures

Concrete hardening too quickly: When the temperature rises, the rate of cement hydration increases, which means that the concrete can harden too quickly. This can lead to a reduction in the working time required to evenly distribute the concrete, thus increasing the risk of non-uniform concrete properties.

Cracking of concrete: Rapid hardening of concrete can cause the formation of thermal

stresses within the mass of concrete itself. These stresses can cause cracking of the concrete surface, which can lead to a decrease in the quality and longevity of the building.

Loss of water in the concrete mixture: High temperatures can cause rapid evaporation of water from the concrete, which reduces the amount of water needed for hydration. This can lead to a reduction in concrete strength and an increase in porosity, which increases the risk of reinforcement corrosion and reduces weather resistance.

Uneven hydration: High temperatures can cause uneven hydration, whereby the outer layers of concrete harden faster while the inner layers remain soft, which can lead to uneven strength properties.

1.1.2.2. Measures to protect concrete at high temperatures:

Use of cold materials

Aggregate Freezing: Using cold aggregate can help reduce the temperature of the concrete mixture. The aggregate can be stored in cool places or even frozen to reduce the effect of high temperatures on the mixture.

Water cooling: Water used for mixing concrete should be cold, and in hot conditions ice water can be used to control the temperature of the concrete mixture.

Retarders: The use of additives that slow down the hydration process is known as the use of retarders. These additives extend the hardening time of concrete, which enables better control of the concreting process in conditions of high temperatures.

Plasticizers: The plasticity of concrete can be improved by using plasticizers, which allows better workability of the concrete mixture and reduces the risk of cracks due to rapid water evaporation.

Reduction of ambient temperature: If possible, concreting should be carried out in the early morning or late evening hours to avoid temperature peaks during the day.

Shading of concrete surfaces: Concrete that has been poured should be protected from direct solar radiation by using different shading materials such as plastic films, canvas or even special roofs.

Application of water mist:

In areas with extreme temperatures, water mist can be used to wet the concrete surface. This procedure helps to reduce the rate of water evaporation from the surface of the concrete, which prevents premature drying and allows proper hydration of the cement.

1.2. Concreting in conditions of high humidity and underwater conditions

Concreting in conditions of high humidity or underwater conditions requires the use of special types of concrete that are resistant to water, special approaches and techniques to ensure the long-term strength and resistance of the concrete. Such concretes contain additives that increase water tightness, such as silicate or acrylic coatings, and the use of concrete with a high cement content for better water resistance. Concreting in underwater conditions, whether it is for foundations in water areas, building ships, underwater platforms or dams, requires very specific techniques due to the constant contact of concrete with water. The quality of concrete can be seriously compromised if the concrete is not poured properly under underwater conditions, as water can adversely affect the concrete's curing process. The use of additives, adequate protection of concrete from excessive moisture retention, and the application of various insulation techniques can significantly help prevent problems. In underwater conditions, specialized underwater concrete, the use of concrete forms and pipes, and additives that increase the concrete's resistance to water and salt, are key to ensuring the quality and stability of concrete structures.

1.2.1. The main problems when concreting in conditions of high humidity

Excessive water retention: High humidity can slow the evaporation of water from concrete. If water remains in the concrete for too long, it can slow down the cement hydration process, resulting in a decrease in concrete strength. Depending on the conditions, excessive water retention can also cause greater porosity in concrete, reducing its long-term resistance to moisture and other adverse conditions.

Decrease in strength: If concrete contains too much moisture, its strength may decrease. This is particularly problematic in situations where it is necessary to achieve strength quickly, such as structures that are subject to heavy loads in the early stages.

Distortions and deformations of concrete: High humidity can lead to deformations of concrete during the hardening process. In extreme conditions, distortion of concrete structures can occur due to excessive moisture intake, especially in combination with high temperatures.

1.2.2. Measures to protect concrete in conditions of high humidity

Control of temperature and humidity: When concreting in conditions of high humidity, it is important to ensure adequate monitoring of the temperature and humidity of the environment. Concrete should be protected from excessive exposure to moisture during the hardening process, but also prevent evaporation of water from the concrete mixture.

Use of moisture-reducing admixtures: Additives that reduce moisture retention in concrete can be used to ensure optimal hydration. Also, moisture control agents, such as retarders, can be used to prevent excessive moisture absorption.

Concrete insulation: Protection of concrete from direct contact with water and moisture

can be achieved by using protective materials such as plastic foils or blankets that allow controlled evaporation and preservation of adequate humidity of the concrete mixture.

1.2.3. The main problems in concreting under underwater conditions

Effect of water on hydration: In underwater conditions, concrete can come into contact with large amounts of water that can cause dilution of the mixture, thereby interfering with the normal process of cement hydration. Water can wash away some of the cement, reducing the strength of the concrete and its resistance to aggressive conditions.

Osmotic pressure: In some cases, water coming from an underwater environment can cause osmotic pressures in the concrete, which can result in cracking or spalling of the concrete over time. This phenomenon is particularly worrisome in areas with high water salinity, such as seas or oceans.

Problems with concrete placement: In underwater conditions, the concrete must be placed in a form that prevents expansion or shearing of the concrete mix due to water movement. If concrete is poured in the wrong way, segregation can occur, in which heavier aggregates fall to the bottom while lighter materials rise, negatively affecting the quality of the concrete.

1.2.4. Measures to protect concrete in underwater conditions

Use of underwater concrete: Underwater concrete is a special type of concrete used for concreting in underwater conditions. This concrete must be formulated to have the proper consistency, strength and water resistance. Underwater concrete often includes additives that increase its density and help prevent segregation and dilution of the mixture when it's in contact with water.

Use of concrete formwork: In underwater conditions, special concrete formwork is

often used, which enables precise shaping and placing of concrete. These forms help to stabilize the concrete mixture while it hardens. Formwork can be metal or plastic and is often used for concreting in the depths of the sea or at high altitudes.

Use of microsiliates and other additives: Microsiliates or other additives can be added to concrete to improve its resistance to moisture and reduce the risk of erosion or reaction with salt water. These additives increase the density and strength of concrete, which enables its greater stability in underwater conditions.

Concreting using concrete pipes: Concreting at sea often involves the use of concrete pipes that allow the concrete to be placed under underwater conditions. These pipes allow the concrete to be poured underwater and to form within a closed frame, thus preventing contact with large amounts of water before the concrete has reached the required strength.

Control of concrete temperature: In conditions where underwater concrete must be placed in very cold water (such as underwater dams in cold rivers), the concrete must be heated or admixtures that accelerate concrete hardening are used to prevent freezing of the concrete mixture.

1.3. Concreting in aggressive environments

Concreting in aggressive environments presents special challenges. In industrial areas or near the sea, concrete can be exposed to aggressive chemicals, such as sulfuric acids, chlorides and other corrosive compounds. Such conditions can lead to corrosion of reinforcement, weakening of concrete, cracking or erosion of the surface layer, which requires special approaches in the selection of materials, design and protection of concrete. Then special concretes resistant to chemical attacks are used, such as concretes with a high content of

Portland cement, silicate concretes or concretes enriched with additives that reduce porosity. Proper maintenance and application of protective systems, such as durability additives and concrete injection, can further ensure the long-term stability of concrete structures and reduce future repair costs.

1.3.1. Main challenges when concreting in aggressive environments

Corrosion of reinforcement: Corrosion caused by chlorides. In environments with a high salt content, such as coastal, seawater or industrial areas, chlorides can penetrate the concrete and come into contact with the reinforcement. This causes corrosion of the steel in the concrete, reducing its strength and stability.

Alkali-silicate reaction (ASR): In some environments, especially those with high alkali content, a reaction can occur between the alkali in the cement and the silicate minerals in the aggregate, leading to the formation of gels that absorb water, creating pressure within the concrete and causing cracks.

Sulfuric acid and sulfates: In areas where sulfates are encountered, such as industrial plants, wetlands, or underground conditions, sulfates can react with hydrated calcium in concrete, forming harmful compounds that cause the concrete to expand and degrade.

Biological and Microbiological Threats: Microorganisms, such as bacteria and fungi, can thrive in moist environments and cause concrete to deteriorate. For example, bacteria that cause corrosion of concrete in drainage systems can cause physical damage to the material.

High temperatures: In industrial environments with high temperatures, such as steel, cement or petrochemical facilities, concrete must withstand temperature shocks that can cause cracking or weakening of the concrete. These high temperatures also accelerate corrosion processes and

consequently reduce the durability of concrete structures.

1.3.2. Measures to protect concrete in aggressive environments

Use of special concrete mixes: Sulfate-resistant cements: For concreting in conditions where there is a risk of sulfate corrosion, a special cement (sulfate-resistant cement) is used. This cement reduces the risk of concrete degradation due to the reaction of sulfate with calcium in the concrete.

Use of high-density concrete: Low-pore, high-density concrete can reduce the penetration of aggressive substances such as chlorides and acids. High-density concretes also better tolerate aggressive chemicals and can be resistant to acids, making them ideal for chemically induced attacks.

Concrete with reduced pore content: Reducing the porosity of concrete by using fine aggregates, lower amounts of water in the mixture, and the use of plasticizing additives can improve resistance to chemical attack.

Protection of reinforcement: Corrosion protection of reinforcement: In aggressive environments it is very important to protect reinforcement in concrete. This can be achieved by using protective coatings on the reinforcement, such as epoxy coatings, or by using stainless steel reinforcement that is resistant to corrosion.

Use of Chloride Barriers: Placing physical barriers in the concrete or using special chloride protection systems also helps prevent reinforcement corrosion. Barriers can include layers of protection or the use of concrete with additional additives that make it difficult for chloride to penetrate into the concrete.

Increasing the durability of concrete: Additives to improve durability: Additives such as silicone, polymer or micro-silicate additives can improve the resistance of concrete to aggressive environments. These

additives increase the density of concrete and reduce the permeability of aggressive substances, such as sulfates or chlorides.

Injection systems: In cases where aggressive substances have already infiltrated the concrete, injecting the concrete with specialized compounds can help restore and protect damaged areas.

Proper maintenance: Maintenance of concrete structures in aggressive environments is essential for their longevity. Regular inspection of concrete, repair of cracks, protection of surfaces from chemical attacks and prevention of water penetration can extend the life of structures.

1.4. Concreting under high pressure

Concreting under high pressures is a challenge in the construction industry, especially in projects that require high strength and resistance of concrete to mechanical forces. High pressure can occur in various conditions, such as deep underwater facilities, underground facilities (eg mining and energy plants), tall industrial facilities, and even under conditions of heavy loads in building structures. Concrete used in such conditions must be specially designed to withstand high mechanical stresses and requires special materials, production techniques and quality control. Through the application of these measures, it is possible to successfully concretize in challenging conditions of high pressure, which enables the construction of stable and long-lasting facilities in industry, underwater and underground works.

1.4.1. The main challenges in concreting under high pressures

Deformations of concrete under high pressures: High pressures can cause significant deformations of concrete, even to the point where microcracks can occur within the concrete, reducing its strength and

durability. The concrete must have sufficient strength to withstand these deformations without compromising the stability of the structure.

Risk of porosity: Under high pressures, concrete can become more porous because the increased force can cause the aggregate or cement paste to move within the mix. This can lead to a decrease in the concrete's resistance to water, moisture and chemical attacks. Also, increased porosity reduces the strength and durability of concrete.

Effect on hydration: High pressure can interfere with the natural process of cement hydration. If the concrete is not properly controlled during the initial setting stage, the high pressure can lead to a decrease in the setting of the cement, resulting in a decrease in the strength of the concrete. This is particularly problematic in underwater conditions, where it is necessary to ensure proper hydration of the concrete.

Increased risk of cracks and voids: If the concrete is not properly mixed or does not contain the correct proportion of fines and additives, the high pressure can cause cracks to develop. This can be particularly pronounced in very humid environments, where water can penetrate the concrete and cause additional damage.

1.4.2. Measures to protect concrete under high pressure

Use of high-strength concrete: High-pressure concrete must be specially designed to withstand high compressive forces without degradation. Usually, high-strength concrete is used (eg concrete class M50 and above) which contains aggressive aggregates such as granite and slate, as well as additives such as microsilicates or fibers, which increase its density and reduce porosity.

Use additives to strengthen concrete: In high-pressure conditions, special additives and fibers are often used to improve pressure resistance and reduce porosity. For example,

steel, glass fiber or polymer fibers can be added to increase the ductility of the concrete and reduce the likelihood of cracking under high pressures.

Increasing density and reducing porosity: Concrete is often adapted for high pressures by reducing its porosity. By using very fine cement paste, special aggregates and additives, concrete is made more compact and resistant to the penetration of water and other aggressive substances, which is key to its longevity.

Control of concrete hardening: In high pressure conditions, it is important to ensure that the concrete hardens properly. By using chemical additives to speed up or slow down the hardening, the hydration time of the concrete can be adjusted to enable its optimal hardening despite the external conditions. Also, temperature control is needed to prevent water from evaporating too quickly from the concrete.

Use of specialized concrete forms: In constructions that are under high pressure, specialized concrete forms are often used, which enable an even distribution of the force on the concrete. Formwork can be designed to withstand high pressures and increase the stability of concrete structures during the construction process.

Increasing the thickness of concrete layers: In many structures exposed to high pressures, the thickness of concrete layers can be increased to improve its ability to withstand high forces. This is particularly important in underwater or deep underground conditions, where the concrete must withstand high pressures from water or earth.

3 TECHNOLOGY OF CONCRETING IN SPECIAL CONDITIONS

Preparation of the concrete mixture: For special conditions, it is necessary to adjust the concrete mixture in accordance with the

conditions on the construction site. This includes the selection of special additives, aggregates and water, and careful monitoring of the ratio of ingredients to achieve the desired properties.

Concrete temperature control: In conditions of extreme temperatures, it is necessary to use techniques that enable temperature control during the concrete process. In cold conditions, this includes the use of heated equipment, while in hot conditions, cold water and aggregates should be used, as well as the application of concrete protection from direct solar radiation.

Timely execution and protection of concrete: For successful concreting in special conditions, it is important to monitor the conditions during the entire process. This includes concrete temperature monitoring, timely placing and rolling of concrete, and ensuring protection against rapid drying or freezing.

4 CHALLENGES AND SOLUTIONS

Excessive rapid hardening of concrete: In hot conditions, concrete can harden too quickly, which can lead to poor structural properties. The use of concrete hardening retarders and application of concrete cooling using ice water or shading can help reduce this problem.

Concrete Cracking: Extreme temperatures, improper mixing of concrete and improper curing can cause concrete to crack. The use of appropriate additives, such as plasticizers and stabilizers, can significantly reduce this probability.

Problems with transporting concrete: In special conditions, it is often difficult to transport concrete to the construction site, especially in hot and humid conditions. The use of concrete pumps and silos can help transport concrete more efficiently to remote or hard-to-reach locations.

CONCLUSION

Concreting in special conditions represents a serious challenge in the construction industry. Understanding specific conditions such as extreme temperatures, high humidity, aggressive environments and high pressure is essential to achieve the quality and safety of concrete structures. The application of appropriate technologies, materials and methods of protection enables successful overcoming of these challenges. Innovations in concrete technology and constant research enable even more efficient approaches and solutions for concreting in demanding conditions.

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ECONOMIC IMPACT OF THE CIRCULAR ECONOMY ON THE DEVELOPMENT OF TOURISM OFFERINGS IN RELATION TO ENVIRONMENTAL AND ENERGY EFFICIENCY

Example: DEVELOPMENT OF A TOURISM VEHICLE - ELECTRIC CARRIAGE

Duško Stić¹

¹Stianno d.o.o. Zagreb, Republic of Croatia

e-mail: drdskonzultant@gmail.com

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Abstract:

The circular economy, when applied to the development of tourism offerings, enhances sustainability through waste reduction, rational resource use, and innovative solutions such as electric carriages. This paper explores the impact of the circular economy on tourism, with a specific focus on sustainable practices such as recycling, the use of renewable energy sources, and the promotion of environmentally friendly modes of transport.

The key contribution of this work is the concept of developing electric carriages, which combine tradition, technology, and sustainability. The introduction of electric carriages into tourism offerings creates a synergy between historical heritage and contemporary ecological demands, thereby increasing the attractiveness and economic potential of tourist destinations.

Keywords: *circular economy, sustainability, electric carriages, tourism, innovations*



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1 INTRODUCTION

On the western slopes of Medvednica, hidden from prying eyes in a green oasis of peace and quiet, there is a renovated old farm, only a twenty-minute drive from the center of Zagreb. This unique property, located on almost 8,000 square meters on the edge of the Medvednica Nature Park, serves tourist purposes through an innovative concept of circular economy.

The estate includes indigenous traditional houses for the accommodation of guests, a unique indigenous object, i.e. an event gallery with fifty seats for various events, a wellness/spa zone with a hydromassage pool and an infrared sauna located in a century-old barn, a glamping zone for camping in a luxury tent.

A total of 16 accommodation units in authentic, renovated buildings equipped with modern technologies. Most of the accommodation is in converted log cabins, while the glamping area includes two buildings built on load-bearing structures from old wooden beams. The first glamping facility is in operation, and the second is in the final stages of construction, and it is a two-story glamping facility that will be the first facility of its kind in the world.

Photos 1: Property overview

Entrance metal door with elements found on the property / Renovated house from 1840
Glamping tent / Spa/wellness area (sauna and hydromassage pool)



Source: Author's photo library

The special charm of the estate is made up of unique handmade items, from furniture to chandeliers and artistic details. Every object has a story - a chair is not just a chair, and a table is not just a table. They are complemented by collectible artefacts from various parts of the world, which give the space additional value. The property combines tradition, sustainability and luxury, providing guests with an unforgettable experience.

Photos 2: Interior decoration of the house (table, fireplace, wooden staircase and wall, room with wooden bed and canopy)



Source: Author's photo library

One of the main attractions of the property is the collection of carefully and thoroughly restored historical royal electric carriages, which bears witness to the rich history and serves as the central theme of this work.

Photos 3: Electric carriages on the estate - 3 that we present in this paper and others in preparation for the future tourist offer



Source: Author's photo library

2 DEVELOPMENT OF ELECTRIC CARRIAGES THROUGH THE DEVELOPMENT OF CIRCULAR ECONOMY

2.1 The origin of the idea of an electric carriage

The idea arose based on the information from the IUT congress, where the topic of historic carriages in private ownership was discussed, we started researching the possibility of buying such a carriage through a company. After the successful acquisition, the carriage was transported to the Republic of Croatia, where preparations for its repair and restoration began. The goal was to adapt it for tourist purposes, with the use of grants from various sources, thus expanding the company's business activities.

The key inspiration of the project is the preservation and revitalization of the original historical carriages, which are at the transition between functional means of transport and museum exhibits. The goal is to infuse them with the "spirit of the new age" through contemporary design and adaptation, while preserving their historical and cultural value. The project combines tradition and innovation, using long-standing professional competence in combination with modern technological solutions, thus creating a unique product with an emphasis on sustainability and historical heritage.

The author of this work, together with his collaborators, actively participated in all phases of project development, which includes planning, restoration, implementation of new technologies and continuous improvement of the project in accordance with modern ecological and technological standards.

The restoration process included reparation and mechanical and electronic equipment of

the carriage, whereby all original parts were preserved, and a dozen excellent craftsmen and artisans participated in the process, who worked together to restore the carriage to its former glory.

The restored carriage is now adapted to the tourist offer, including tourist rides, promotional activities, weddings and other events. Thus, it became not only an attractive part of the tourist content, but also a symbol of the preservation of cultural heritage in a modern context.

2.1.1 Synergy of tradition, technology and sustainability

A new type of vehicle - a new value - was created with the basic principles of the circular economy, a thorough conservation renovation, and the imputation of previously unseen technological solutions. By installing an electric drive and using the most modern joystick control technologies, GPS guidance and internal video communications, we have achieved a synergy of the past, present and future within an authentic historical vehicle. Our priority was to keep the shape and appearance of the vehicle as authentic as possible, and to use the most necessary interventions to affect the authenticity and originality as little as possible.

Electric carriages are fully in accordance with the strictest environmental standards, but also with the demands of animal protection associations and activists, that horses are no longer used in urban environments that are not at all suitable for them.

Carriages are also a powerful "marketing tool". They are extremely attractive when driving and extremely interesting for the media, in general for people to take pictures and share impressions via social networks. Due to its uniqueness and all of the above, the inclusion of electric carriages in the tourist offer provides users with an

exclusive experience, and business associates a new competitive, marketing-economic and tourist improvement.

2.1.2 Characteristics of the electric carriage

As the driving system of the carriage, instead of a horse-drawn carriage, an electric motor was installed. The energy source is non-flammable accumulator batteries, while the control method is solved by a modern electro-hydraulic system using a joystick - a miniature handle for guidance.

Photos 4: Management system



Source: Author's photo library

While the drive and control system are contemporary, all other elements of the carriage remain true to the original, preserving the authenticity of the era when horse-drawn carriages were used. When it is in motion, the historic sound of the carriage is heard through the speakers, and when the horn is pressed, the sound of the horse swaying is heard. In the passenger compartment, four screens are installed that display the attractions of the driving location in six languages, providing added value to the tourist experience. The space once intended for tools (chest) has been converted into a cooler for drinks, thus maintaining functionality with a modern addition.

About 2,000 hours of work were spent on the restoration of one carriage, including about half a kilogram of gold for the gilded parts – the carriage is covered with gold leaf. The entire development process, from

initial renovation to today's usability, took approximately five years.

Photos 5: The interior and gilded details of the Royal Chariot carriage



Source: Author's photo library

2.1.3 Three carriages for the Republic of Croatia

The project has the working title "THREE CARRIAGES FOR THE REPUBLIC OF CROATIA", and the plan is to implement it with the support of the City of Zagreb, from which we received approval for the position for various tourist routes. Support for the project came from the Tourist Board of the Republic of Croatia and the Tourist Board of the City of Zagreb, as well as the Ministry of Tourism of the Republic of Croatia, which granted non-refundable incentive funds on two occasions, all for the purpose of increasing the diversity of the tourist offer of the City of Zagreb and the Republic of Croatia in general.

So far, a total of six carriages have been acquired, two of which have been fully restored and are in tourist function, while the third is in the preparatory phase for restoration, and the rest will be restored in the foreseeable future, which further expands the offer and potential of the project.

2.1.3.1 Royal Chariot

The carriage is an original example of a royal carriage from the first half of the 18th century from our region "Royal Chariot". Ban Josip Jelačić and His Imperial and Royal Majesty Franz Joseph I rode in it.

The carriage has been completely restored and is ready for functional use, with mostly own funds being used for its restoration, with significant support from the Ministry of Tourism and Sports and a smaller amount from European Union funds.

It is estimated that the market value of this unique carriage is around 400,000 euros. This value is based on its multiple attributes – market attractiveness, functionality, historical significance and environmental friendliness, which makes it an extremely attractive and competitive product on the sustainable tourism market.

At the same time, it gives the project the greatest charm, and it is planned to drive in the upper city of Zagreb.

Photos 6: Carriage Royal Chariot



Source: Author's photo library

2.1.3.2 Victoria

The origin of the name of this carriage is uncertain, as is the time when its production began. Thus, its dating is determined differently between the end of the 16th and the 18th century. It is certain that it was popular in the 18th century, but in the 19th it became even more popular. In the Victorian days, i.e. in most of the 19th century, the carriage was a status symbol of

its owner's success. The popularity of the carriage was not only limited to Europe, but it had the same popularity in America.

The plan is for the carriage to serve as a tourist route, providing visitors with a unique experience of traveling from the estate to the historic Zagorje castles. By incorporating an electric drive, the modernized Victoria carriage would combine the charm of tradition with the principles of sustainability, providing an environmentally friendly and unforgettable way to explore the cultural and architectural heritage of the region.

Photos 7: Victoria carriage



Source: Author's photo library

2.1.3.3 Landauer

The Landauer carriage is a classic type of carriage that was popular in the 19th and early 20th centuries, especially in Europe. This carriage was named after a German carriage manufacturer, and became a symbol of luxury and elegance of that era. It was used by the high social elite, and was a frequent sight on the streets of European cities such as Vienna, London and Paris. Today, Landauer carriages are rare and considered collectors' items.

This carriage will be used for tourist purposes, especially for organizing weddings, where it will contribute to a festive and romantic atmosphere. In addition, it can be used for various occasions such as festive events, historical reconstructions, themed tourist tours, and filming and promotions. This kind of application enables the preservation of tradition, while at the same time offering

visitors a unique and unforgettable experience.

Photos 8: Carriage Landauer



Source: Planwagen - the most popular horse-drawn carriage for tourist transport - GLINKOWSKI - CARRIAGES

CONCLUSION

The presented paper is based on the knowledge and experience gained through various scientific, business and entrepreneurial research and through a series of business and legal processes related to the registration and realization of the project, and points to the successful implementation of the principles of circular economy in the development of tourist vehicles, especially electric carriages, which combine historical heritage with modern technological solutions. The restoration and adaptation of historic carriages, with the use of renewable energy sources and innovative systems such as electro-hydraulic steering systems, highlight the importance of sustainable development in tourism. The project is continuously aligned with the European green transition guidelines, The project of arranging and equipping the carriage was not finished; it continues to be continuously supplemented and improved

in accordance with European regulations and guidelines of the green transition, which achieves a significant contribution to the preservation of the environment and increasing the competitiveness of tourist destinations, and complements the tourist offer of the Republic of Croatia.

Future plans, such as the integration of a regenerative battery charging system, further strengthen the potential of this model as an example of a successful synergy of tradition, innovation and sustainability.

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RISK MANAGEMENT IN THE CONTEXT OF THE PROBLEM OF INTEGRAL WATER MANAGEMENT

Ivica Opačak¹ Šemsudin Dedić² Tihomir Vujčić³

¹High School Matija Antun Reljković, Slavonski Brod, Republic of Croatia

e-mail: ivopac2019@gmail.com

²Parliamentary assembly of Bosnia and Hercegovina, Sarajevo Bosnia and Hercegovina

e-mail: semsudin.dedic@parlament.ba

³International University Brčko District BiH, Brčko, Bosnia and Hercegovina

e-mail: tihomir.vujcic72@gmail.com

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Summary

The paper analyzes the issue of integral management of water as a natural good, through the segment of potential risks in the field of water management. The construction of a theoretical model, which respects the interaction of people and their environment, requires practical solutions in order to integrate different requirements and forms of action in water management. The increasingly widespread consideration of the impact of climate change affects the building of social awareness of the problem of ecological management of natural resources. It also contributed to the understanding that it is not good to ignore resource management issues, and that it is one of the most prominent policy issues at all levels of management. Through the paper, the issues of understanding the economic factors of water resources management, which in practice become social and cultural issues, and the problems of the complexity of their quantification and measurability, as well as the vision of the environment, are considered as issues that cannot be separated from economic activities.

Keywords: water resources management, risk, solutions

JEL classification: O13, O33, Q01, I10



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1 INTRODUCTION

Social and economic development, as well as the impact of climate change, have forced considerations of river flows and water quality, their pollution, problems of irrigation and flood defense, different scenarios of climate change, hydrological patterns of river ecosystems and numerous other issues. Understanding the complexity of water management, and the relationship between hydrological and biological processes, at the scale of watersheds, is a prerequisite for ensuring the desired water quality, biodiversity and sustainable development. The aforementioned directs policies towards the harmonization of the natural resource management system, with the aim of ensuring sustainability, and through the development of managerial techniques to deal with threats to ecosystem health. For this purpose, it is necessary to develop mechanisms that will remove threats to the ecosystem, such as various sources of pollution, floods, droughts, etc., and to expand the possibilities of using the ecosystem and its characteristics, as well as the development and application of appropriate management tools. The desire to ensure sustainable development and the race for wealth, as a result, caused the disruption of the ecosystem, where its balance was permanently disturbed and caused the necessary need for the harmonization of measures and solutions. The effort is to stabilize and improve the quality of natural resources, primarily water, through integrated regulations. There are numerous viewpoints of the same problem, the preservation of the ecosystem from the point of view of water, which should be viewed through the prism of different values determined by generally

accepted and religious beliefs, social and territorial determinations, and economic, political, legal and moral value systems. In this context, water is seen as a regenerative substance of the ecosystem, subject to pollution, which is a symbol of wealth and productivity, a source of energy and as a common good and right of all people. The diversity of the context of observing the need for water resource management indicates the requirement to include science in the study and provision of a systematic model of water management, through the appreciation of the interaction of people in relation to their environment.

2 THE RISK MANAGEMENT SYSTEM FOR PROTECTION AND MANAGEMENT OF WATER RESOURCES

The risk management system includes a series of activities, from their recognition to their characterization and assessment. Ecological risk assessment is based on the assessment of their probability and danger to human health, safety and functioning of the ecosystem [1]. The importance of water management and its protection is also reflected in the inclusion of the aforementioned matter in the environmental policy, through directives on water, which include groundwater, drinking water, bathing water, environmental quality standards, municipal water treatment, nitrates, and floods [2].

Each individual can provide his personal contribution to water protection in numerous ways. First of all, it is only necessary to change established habits a little, and with the rational use of water,

prevent the creation of large amounts of waste water at the source itself. In order to ensure biological decomposition, it is necessary to use biodegradable detergents, and to use a water softener instead of a fabric softener, in order to use soft water to reduce the consumption of detergent and protect the washing machine, and to ensure that the resulting waste water is more acceptable for waterways. It is necessary to take care of what is dumped into the sewage system, because all of it will ultimately end up either in a wastewater treatment plant or, quite often, in a watercourse. By using natural fertilizers, instead of artificial ones, and by avoiding waste disposal near sources of drinking water and watercourses, we will prevent the penetration of unwanted substances into the water. It is preferable to leave water conservation to natural mechanisms, so that forests near the source are not cut down, and that we control soil erosion on our own property by planting plant cover and stabilizing areas prone to erosion. By using official disposal sites for hazardous waste, such as used motor oil, we will ensure that it does not end up near water resources and pollute significant amounts of water. It is estimated that one liter of used motor oil pollutes over a million liters of water. It is similar with the disposal of used batteries, whether they contain zinc, cadmium, or mercury, which are dangerous pollutants, where the amount of polluted water ranges from 3,000 hL per one battery.

Understanding the importance of water for plant life is necessary to understand that plants are most easily supplied with water, and that plants easily absorb substances from water, whether they are useful or unwanted substances. This is especially pronounced for plants that often cannot

easily reach water on land, because they have difficulty extracting it from the soil to a sufficient extent. For terrestrial plants, water is one of the ecological factors, while for aquatic plants it is their living environment. In terrestrial plants, water comes from the roots of the plant to the leaves. This process is established by transpiration, during which a certain amount of water constantly evaporates from the transpiration surfaces. With the movement of water through the plant, it stands upright under water pressure, while a plant that loses a large amount of water due to drought, withers and leans over. The circulation of water in the plant is also called the water regime of the plant, which essentially consists of three processes, receiving water from the soil, transporting water in the tissues of the roots, tree and leaves, and evaporation of water through above-ground organs, transpiration. The relationship between the water taken in and the water evaporated is called the water balance of the plant. Evaporation of water also cools the plant, which is an important prerequisite for plant survival in a tropical climate. Water is extremely important for the life of animals. Water is the original living environment in which life originated, so their mutual connection is understandable, especially for animals whose living environment is water. Water is a component of the organism of animals, where its content in the organism of animals varies from 50 to 93%, and the content of water is the highest in aquatic organisms. Mammals can hardly tolerate water loss, and are at risk of death when their body's water content drops by 15 to 20%, although some animals can survive a water loss of up to 80%. In the process of evolution, some organisms have adapted to the problem of lack of water, surviving by moving into a

latent, anabiotic state, in which they can survive for a long time. The importance of water for the human species is also evident in the fact that the body of an adult has a water content of 40 to 75%, and as such it represents one of the basic conditions for human survival and life on Earth. Depending on the climatic conditions, water consumption for maintaining the life of adults ranges from 3 to 12 liters per day. Therefore, water is by far the richest component of all living organisms and has fundamental importance in maintaining both the structure and function of all tissues, i.e. cells as the basic units of living matter. Not drinking water can significantly worsen the general condition of the organism, and can quickly lead to death. If water is not taken in, death occurs after a few days, as the organism loses 10 to 20% of its entire fluid volume. In case of no food intake, life is maintained for several weeks, despite the loss of all fat tissue and about 50% of tissue proteins. The proportion of water in the human body is different in different tissues, i.e. organs. It can be said that the largest amount of water in the body is found in the skin and muscles, and the least in the skeleton and adipose tissue. An adult male weighing 70 kilograms contains 9 liters of water in the skin, 22 liters in the muscles, 2.45 liters in the skeleton, 4.65 liters in the blood and 0.7 liters in the fat tissue. Although the heart, lungs, kidneys and brain contain a high proportion of water, their proportion in the mass of the organism is smaller.

Persons involved in the process of environmental risk assessment, regardless of the position they occupy, in the implementation of decisions aimed at elimination, retention or reduction to an acceptable level, should have

communicative interaction. In the mentioned concept, it is necessary to identify and evaluate the risk, and to select and implement procedures aimed at reducing the risk, both for human health and for the entire ecosystem. The risk management process is based on scientific achievements and takes into account social, economic, ethical, political and legal aspects. In particular, it is necessary to promote the changes necessary for radical changes in the value of water and the way water is used. Water management requires thinking about water as a global common good, which can only be improved through collective action, both in individual countries and through cross-border cooperation, so that the benefits of water management are visible to everyone [3]. For the purpose of risk management, it is necessary to carry out a risk assessment, which is at the same time an integral part of it and a tool for risk management. The goal of risk management is their reduction, where in addition to the risk of environmental pollution, various socio-economic risks appear. As one of the components of risk management, control and monitoring include management improvements and assessments of the current status. Scientific methods of risk assessment make it possible to determine the probability and level of risk, including ecological and human effects, as well as acceptable levels of risk, which are largely socially determined. As risk tolerance decreases with limited access to information and with the feeling of powerlessness and that everything is controlled by external forces, every management decision must also take into account the time aspect of risk, which can last much longer than the current management process. Through the process

of achieving the goals of risk management, it is necessary to make decisions about the acceptability of risks, and when the need is assessed, to implement the measures necessary to suppress them. The risk zones range, depending on the dependence of the exposure and the magnitude of the damage caused, from normal to prohibited. In the acceptable risk zone, it is understood that there is a low probability of its exposure and harmful effects, in the case of water resources, limited persistence of contaminants, reversibility of damage and low potential of social conflict. The increase in the probability of occurrence of risks, as well as the negative effects that their occurrence can cause as a result, imposes the need to observe the potential risk in the sphere of the increasing probability of occurrence, that is, the damage it can cause by its manifestation, and it is necessary to make decisions to take certain measures in order to prevent its occurrence, or to reduce the potential damage it causes. When positioning the risk, taking into account the possible harmful consequences of its occurrence, as well as the probability of occurrence, it is necessary to include the effects on the ecosystem and human health, the probability of occurrence and evaluations depending on the type of effects. So, for example, for the risk of extreme floods, a frequency of once a year is considered very high, while from the aspect of bathers' exposure to the risk of low pollutant concentrations during swimming, once a year is most likely negligible, and is recorded as an extremely low risk event, for which it is not necessary to take any preventive actions. For the purpose of risk assessment, it is necessary to create a risk matrix, in which all recognizable risks are mapped. It is a tool used to illustrate

different risks, in order to develop a risk management model. The matrix as a risk management model is the basis for the need to make decisions based on the quantification of risks, i.e. the probability of their occurrence, as well as the harmful consequences they can cause. Therefore, the risk indicators for water resources management must be selected as sufficient and appropriate, from the aspect of management objectives, and must be accepted by the interested public and allow the risk to be ranked and the places to be prioritized. Risk management is motivated through the inclusion of fundamental human values, documented in the form of directives or legislation, then the satisfaction of human needs, in terms of social activities related to water and water resources, but also through social expectations and perceptions, to preserve or improve the quality of life [4]. With the purpose of appropriate risk management, it is necessary to define the desired goals of risk management, which include the need to meet regulatory criteria, economic sustainability, ensuring the quality of the environment and the development of nature and the preservation of the environment and the quality of human life. All the stated objectives lead to the avoidance or reduction of risks and unwanted impact on the environment, which is achieved through the implementation of various risk management options. If there are indicators of the existence of a risk or its occurrence is certain, it is necessary to state that they are a necessary tool for connecting risks with management options. Observing the risk indicators and risk management options of water resource pollution, we distinguish two points of view, first the site-specific approach, and second the river basin approach. Failure to meet the criteria does

not affect risk management at the level of the river basin, while exceeding them is an indicator of non-compliance with other management goals. Risk indicators at the local level should include the concentration of contaminants, which can influence the choice of priority hazardous substances through different behavior. The same applies to ecotoxicological effects, where the inclusion of different routes of exposure facilitates the assessment of the risk of contaminant transfer from sediment to water. Also, by choosing indicator living species, especially sensitive to changes in the environment, risks can be indicated and their ranking according to their essential function. The approach to river basin pollution risk management depends on site-specific regulations, such as bathing water, drinking water and habitat protection directives. In the case of a river basin, indicators are taken into account that provide information about a locality but also about the risks that exist downstream, comparing hydrological situations with the observation and monitoring of the level of suspended particles and the movement of the number of fish, regardless of the fact that their abundance can be manifested differently on the whole river system. Risk assessments at the local level and at the level of the river basin must be interactive processes, which lead to prioritization and directing funds to those places, with the greatest expected effects in terms of risk reduction in the river basin. As such, they imply the identification of specific contaminants of the river basin and those contaminants that threaten the goals of river basin management. The identification process involves locating contaminated localities along the watershed, from which sediments are transported downstream and under certain conditions, such as low water

levels and floods, lead to exposure of the location to harmful substances. As a result, it is necessary to use different risk management options, such as reducing the existing emissions of contaminants that tend to bind to sediment, reducing the exposure of organisms to contaminants, reducing the effect of accumulated contaminants, changing the purpose of land use in a given location, and evaluating the location within the framework of river basin management. The aforementioned includes the application of measures in case of non-fulfillment of regulatory criteria, analysis of sediment transport and application of suspended particle transport models, exchange of knowledge and technologies with interested organizations located downstream and upstream along the river course, and to facilitate communication with the interested public and involve them in risk management processes. In order to better manage the quality of the environment and the development of nature, it is necessary to analyze the risks of ecosystem preservation, especially from the perspective of ecological ethics and loss of awareness due to poor or non-management. The appearance of risk as an unwanted event can lead to damage to human health, extinction of species, destruction of habitats, disruption of ecological functions and deterioration of water quality. We can observe risk indicators and conflicts with other goals through two levels, local and river basin level. Thus, at the local level, they can be manifested as inputs of contaminants into the environment, various ecotoxicological effects, changes in biodiversity, loss of species, species invasion, increase in lesions and necrosis in fish, changes in hydrodynamics and eutrophication, while at the level of the

river basin, these are changes in migration of fish species, loss of indicator species, changes in biodiversity, different physical and chemical parameters, imbalance of nutrient cycles, etc [5]. For this purpose, different risk management options are being developed, which can be viewed from the same aspect. Local-level management options may include pollution source controls, river basin management guidelines, land use changes, exposure reduction, adsorptive barriers, leaching, capture, in-situ treatments, natural dilution, and habitat compensation. Risk management includes activities such as control of pollution sources, reduction of diffuse pollution, trend monitoring, revision of industrial and agricultural regulations, identification of responsible contaminants, application of the "polluter pays" principle or injured party pays to speed up solutions, cross-border cooperation, and implementation of a management plan across the board basin area. When dealing with risk, with the aim of better risk management, we should be guided by questions such as whether we need to collect more data, whether we should carry out remediation actions, and how to choose the most profitable remediation and achieve the goals of remediation, whereby the answers to the questions will give us suggestions for action, and whether it is necessary to collect more data. The process of risk management, from the point of view of collecting sufficient data, for the purpose of basic risk assessment, implies that all relevant facts, which contribute to a certain problem, have been taken into account and analyzed. Then, in order to make a decision on the implementation of certain actions, remediation, it is necessary to recognize which actions can and should be applied,

depending on different parts and localities, at the time of occurrence of the risk, but also in the future. In order to find out if the most cost-effective and effective remediation has been chosen, it is necessary to provide answers to additional sub-questions, which would channel the appropriate solutions. Through this step, it is defined when the engineering and institutional controls during the selection of remediation options are contrary to removal or treatment, and it justifies the remediation chosen as optimal, by assessing the comprehensive impact on the environment. finally, it is important to determine whether the defined goals of the remediation have been met.

CONCLUSION

The rapid development of technologies has introduced us to a world full of surprises and novelties, which require appropriate scientific theoretical approaches and the application of good practices, in order for the development to take place in the correct way. Demanding approaches to the use of natural resources is the challenge of the future and the basis of the development of civilization, especially in the area of water use and water resources. It was noticed that in this context there is no best way, but approaches are used through the concepts of trial and error, through which numerous problems in the management of water resources are solved through interdisciplinary cooperation. In addition to the inclusion of scientific disciplines, it is crucial to ensure institutional, social and political support, in order to create the necessary tools for implementing valid management decisions and achieving the desired goals. Water resource management must never become an end in itself. It has a

significant role to play in bridging the growing gap between theory and practice, and science and human society are gaining more and more importance as the use of water in various ways around the world intensifies. The use of water resources leads to more and more numerous, complex and unexpected problems, which require a special field of interest and necessity of application. As the management of water resources has become one of the most topical issues, attention is being paid to modern strategic eco-management, which plans the concept of ecologically sustainable socio-economic development, having an impact on all spheres of human activity. The above requires a change of opinion, approach and behavior of all social factors, so as not to cause long-term consequences for nature and people. For this purpose, it is necessary to study the consequences of water resources management and to recognize aspects of the manifestation of human activity on water resources. Complementary, harmonized and integral strategic planning for the sustainable use of water resources ensures the fulfillment of strategic decisions, primarily through the analysis of the state of water resources, in order to identify the risks arising from the use of water in time, and, according to the assessment of the impact of their use on the environment, predict the trends of changes in the state and undertake all necessary activities related to

the conservation of water, as an important natural resource.

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ELECTRONIC GOVERNMENT IN THE REPUBLIC OF SERBIA

Jovan Šarac¹ Nedeljko Krajišnik²

¹Union-Nikola Tesla University of Belgrade, Faculty of Business Studies and Law in Belgrade

e-mail: jovan.sarac@fbsp.edu.rs

²International University Travnik in Travnik, Faculty of Law Travnik in Travnik

e-mail: nedeljko.krajsnik@iu-travnik.com

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Summary

The progress of the Internet and the increasing use of information technologies have led to major changes in the internal organization of the state administration and the public sector as a whole. In addition to the legal framework, the introduction of electronic administration presupposes an organized approach of the state and other segments of society, but also the resolution of many technical issues. This type of organization of public administration affairs ultimately enables significant savings in the state budget, but also increases transparency, efficiency and responsibility in decision-making procedures of public importance. It is estimated that this will ultimately lead to faster economic growth. The Republic of Serbia entered the electronic administration reform process in an organized manner, by adopting appropriate strategic documents and achieved significant results in a relatively short period of time. Administrative bodies in the Republic of Serbia have developed a large number of online services. As a rule, these services are provided through the e-Government portal and portals of administrative bodies and local self-government bodies. Although the Republic of Serbia has done more in this regard than other countries in the region, the reform of electronic administration is an ongoing process. The next challenge the country faces is adapting the electronic government system to the challenges posed by artificial intelligence.

Keywords: *electronic administration; computer technologies; State administration reform strategy; administrative procedure; electronic administration services*

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1 INTRODUCTION

Traditionally, state administration jobs had little to do with modern technologies and were performed in government offices. The progress of the Internet and the increasing use of information technologies have led to major changes in the internal organization of the state administration and the public sector as a whole. This led to the need for new personnel who have new knowledge that was not available in the state administration until then.

Today, many government jobs are performed with the help of these technologies, and sometimes remotely. This system, in addition to the availability of information remotely, also enables the provision of simpler administrative services, such as issuing certificates, issuing permits, submitting applications, etc.

High-quality web presentations are of particular importance for high-quality electronic administration. The web presentation of the authority is the official presentation of the authority, on which publish basic information about its work, which is created for all government bodies according to a unique methodology. In the technical sense, it represents a set of data and information that are available to users via computer networks with the help of special computer programs. Web presentations are connected to databases through which administrative bodies provide certain online services.

Bearing in mind the numerous legal and technical issues that need to be resolved, the introduction of electronic administration requires an organized approach by the state and other segments of society, in terms of

creating normative and technical assumptions for the introduction of these technologies. It also presupposes a reorganization of the government sector as a whole. That is why a large number of countries, in order to enter this process as organized as possible, bring strategic documents, which are most often called the e-Government Reform Strategy.

2 THE CONCEPT OF ELECTRONIC GOVERNMENT

There are different theoretical definitions of e-government. Electronic administration (e-administration, eng. E-Government) represents the systematic use of information technologies in the function of supporting administration bodies in order to provide information and provide services to its users.

According to the definition from the Strategy for the Development of Electronic Administration of the Republic of Serbia, "... electronic administration is the use of information and communication technologies (ICT), which provide opportunities for citizens and the economy to communicate and cooperate in business with the public administration, using electronic media (internet, mobile phone, smart cards, kiosks, etc.)"¹.

Electronic administration is divided into three segments: electronic administration, electronic democracy and electronic justice. Electronic democracy is a system that enables voter registration, voting and other election-related actions via the Internet and mobile phone. Electronic justice presupposes the application of electronic communication in court proceedings through the court portal.

¹ Public administration reform strategy in the Republic of Serbia 2021-2030 ("Official Gazette of RS", No. 42/21 and 09/22)

In a narrower sense, e-government includes only electronic administration. In the following text, we will mainly talk about electronic administration in the narrower sense, although the same rules and principles are applied in electronic justice as well.

The importance of this issue is shown by the fact that it was dealt with by all the most important international organizations, including the United Nations, the World Bank and the European Union, which, among other things, produced a large number of studies on electronic administration, in general and in connection with its application in individual to the states. According to the definition of the World Bank: "Electronic government aims to enable easier, cheaper, more transparent interaction between government and citizens, government and companies, as well as government agencies themselves"². The European Union defines electronic administration as: "The use of information and communication technologies, and especially the use of the Internet as an instrument for achieving better administration."³

The goals of the introduction and development of electronic administration are, first of all, providing faster, simpler and cheaper services to citizens, increasing the transparency of public administration work, and enabling the efficient exchange of information between administrative bodies and other subjects. The use of these technologies in the administration enables direct and indirect benefits, both for the administrative authorities and for citizens and business entities that use these services. The direct benefit consists in reducing the costs of providing these services, including the

reduction of administration, as well as in the faster and more efficient collection of taxes, customs duties and other public revenues.

This form of business organization ultimately enables significant savings in the state budget. The indirect benefit consists in increasing transparency, efficiency and accountability in decision-making procedures of public importance, which ultimately leads to faster economic growth. According to some estimates, the savings from the introduction of this technology in developed countries amount to hundreds of millions of euros.⁴

The Republic of Serbia entered the electronic administration reform process in an organized manner, and achieved significant results in a relatively short period of time. Nevertheless, the reform of electronic administration is a constant process. One of the goals proclaimed by the Public Administration Reform Strategy in the Republic of Serbia is: "Providing quality administration services to citizens and businesses with an emphasis on improving administrative procedures and simplifying their application through the use of information and communication technologies, while gradually eliminating the classic way of providing services for which there is a possibility complete implementation via online service (gradual removal of paper use)"⁵. It should be emphasized that this is a job that never ends, because this area is developing rapidly, so it assumes the constant upgrading of existing solutions as well as the creation and use of new services. The fortunate circumstance is that all innovations in this area are compatible with earlier solutions and, as a

² World Bank, E-government guideline, <https://documents1.worldbank.org>

³ eGovernment in Europe, European Commission. Retrieved 21 October 2009, <https://ec.europa.eu>

⁴ More details: Centeno, C., van Bavel, R., Burgelman, J-C. E-government in the EU in the

next decade: The vision and key challenges, <http://www.jrc.es/home/publications/publications.html>

⁵ Public Administration Reform Strategy in the Republic of Serbia 2021-2030 ("Official Gazette of RS", No. 42/21 and 09/22)

rule, a simple transfer of procedures and data is possible.

E-governance assumes the flow of information, communication and various transactions between different entities. Informing is a one-way acquisition of data. Communication is any exchange of information or data between a limited number of natural and legal persons via an available information and communication network. A transaction is a transfer of things and rights between a limited number of natural and legal persons. Electronic administration includes three types of relations: relations between administration and citizens, relations between administration and companies, and relations between different administrative bodies.

In the relationship between administration and citizens (G2C), the interaction of citizens and administration is established through access to government services and the performance of appropriate administrative services, including automatic decision-making. In the relationship between administration and companies (G2B), mutual online communication is established, which includes various administrative services such as registration, payment of taxes, duties and contributions, issuance of import and export permits, submission of various reports, etc. Electronic administration also assumes the mutual electronic interaction of different government bodies and agencies (G2G) through mutual access and data exchange, including the automatic interaction of databases, which are maintained by different bodies, as well as electronic communication in appropriate administrative procedures in which several administrative bodies participate. Informatics has developed to such an extent that no form of communication and data exchange between different entities in the technical sense is any longer a problem. In most countries, the problem is represented by various legal

restrictions that can only be overcome by amending the law, as well as the large financial resources required for the introduction of various e-government services.

3 USE OF COMPUTER TECHNOLOGIES IN ADOPTING ADMINISTRATIVE ACTS

Computers can be used in administration in different ways and to different extents. Some administrative jobs, due to their simplicity, are naturally suitable for automation, while others are not.

With the development of computer technologies, especially programming, it has reached the stage where it is possible to program the computer in such a way that, in simpler cases where identical actions are repeated, it makes certain legal decisions. As a rule, it is about issuing extracts from various records, issuing certificates, certificates, permits, etc.

Decisions made in this type of procedure are usually not administrative acts. At this stage of the development of this technology, automatic decision-making is also possible in the so-called abbreviated administrative procedure, i.e. in the direct decision-making procedure, especially in the area of taxes and fees, pension and disability insurance, etc. According to the law, the authority can directly decide on an administrative matter if the factual situation can be established on the basis of data from official records, and the party does not have to make a statement in order to protect its rights and legal interests.

In the technological sense, these procedures are also extremely complex. In addition to appropriate databases and application software, it is necessary in any case to provide a system for identifying citizens, e.g. chipped ID cards, or electronic signature, as

well as secure electronic communication. It is also necessary to pass appropriate laws to avoid legal obstacles for these activities.

The problem that arises is the situation when the computer performs an action for which it was not programmed. The question arises whether the decision made in this way binds the administrative body. Today, the general opinion is that automatic systems do not have a will of their own, that they only serve as a means of communication for their owners, and that the actions they perform are actually carried out by their owners, i.e. administrative bodies. Bearing in mind the above, the decision made in this way is considered to be the decision of the owner of the program, that is, the automatic system, and only binds them. In computer science, it is considered that a computer rarely performs an action for which it was not programmed, but that this is possible due to the effect of a virus or a bug in the program. In electronic administration, the decision of the authority that was made due to the effect of a virus, or due to an error in the program, cannot in any case be binding on the administrative authority.

In more complex cases, such as e.g. special examination procedure computers, i.e. computer programs, cannot be used to make automatic decisions. In these procedures, computers can be used for searching, collecting and processing data on facts that are legally relevant in that procedure, accessing data of state authorities, finding laws and other general acts and relevant administrative and judicial practice, and for technical processing of legal acts. In this procedure, data related to a regulation or a court decision, and sometimes to a scientific and professional article, are most often searched, collected, and selected. In a similar way, data related to the factual basis of a

specific administrative case can be collected and processed. In these cases, computers do not serve to make automatic decisions, but only to prepare them. The computer, therefore, only provides technical and informational assistance to the official in the administrative body conducting the procedure. The decision-making itself is the responsibility of the person who leads the administrative procedure in that administrative matter. He should pay particular attention to the reliability of the sources to which the computer refers.

For example, if it is a regulation, and it is on the website of the Official Gazette, there is no reason to doubt the reliability of the source in this case. Today, it is possible for this type of procedure to be automated to a significant extent, most often in such a way that certain phases are automated. However, even in that case, regardless of the degree of automation, the decision is made by the official of the authority that conducts the procedure. It is unlikely that this type of procedure will be fully automated in the foreseeable future. It is certain that in administrative proceedings where a free assessment of evidence is required, this will never be possible.

Therefore, one should clearly distinguish the situation in which the computer makes a decision in a specific administrative matter, from the one in which the computer serves only as an auxiliary tool. The difference between these two situations is summarized by Dimitrijević⁶: "An administrative act passed through a computer represents a relatively planned and computer program-determined logical form of reasoning for the appropriate model of a standard typical situation, while administrative-legal decision-making in these cases becomes a

⁶ Dimitrijević, P., *Upravni akt i savremena tehnologija*, Ekonomika, Niš, 1995, page 100

planned and controlled activity (in the social, legal and technical sense)"

It should be emphasized that the use of computer technologies, even in the case of automatic acts, does not change the legal nature of the legal act, that is, that they still remain acts of the authorities that are the owners or users of the computer programs. The legal basis for the adoption of an administrative act is contained in the general legal norm, that is, in the law and other regulations. As in the procedure of traditional decision-making and in the procedure of automatic adoption of an administrative act, the general legal norm is applied to an individual case. The only difference is that the decision-making process is programmed and instead of a human being, the "decision" based on formalized information is made by a computer, i.e. a computer program. In this case, the so-called reformation of laws and legal norms contained in them. Reformalization of law means that one (legally) formalized system is translated into another, also formalized system, which, however, is not of a legal but of a mathematical kind. Therefore, the reformalization process represents a suitable mathematical activity that is carried out on the basis of suitable mathematical law.⁷ Nevertheless, the reformalization process and the related mathematical activity serve as a means of making an individual decision, in accordance with the general act in a specific administrative matter.

3.1 Electronic management of public records

Administrative bodies, in many cases, based on the law, have an obligation to keep official records on certain facts. These records can be kept in electronic and paper form. Computer technologies had their first significant

application in the administration precisely in the field of keeping various registers, because they enable fast collection and processing of data. The register is a unique, central, electronic database of documents prescribed as the subject of registration, as well as documents on the basis of which the registration was made.

According to the legal definition, a database is an organized and arranged set of interconnected structured data, which can contain one or more records. There are a large number of such databases maintained by administrative bodies, such as databases on citizenship, on real estate, on motor vehicle registration, on misdemeanors, on criminal acts, etc.

In the Republic of Serbia, there are: Register of Citizens, Register of Spatial Data, Address Register, Register of Real Estate Cadastre, Register of Voters, Register of Business Entities and other status registers of the Agency for Business Registers, and many others. From the perspective of Legal Informatics and Information Technology Law, these records are called databases. The content of these registers, i.e. databases, is prescribed by law and by-laws. As a rule, they are kept in electronic form. As a rule, there is an obligation of the authority that manages the respective register to ensure the connection of the register with other registers and databases, which are maintained for the territory of that country. The issue of the connection of registers and databases from the territory of several countries is regulated by an international agreement.

At the request of the parties, the authorities issue certificates and other documents (certificates, confirmations, etc.) about the facts of which they keep official records. Certificates and other documents about these

⁷ Lilić, S., Prlja, D., *Pravna informatika veština*, Belgrade, 2010, page 82

facts are issued in accordance with data from official records, and have the evidentiary value of a public document. This process is, most often, fully automated and these databases can usually be accessed online in a direct relationship between the user and the authority, that is, the database. In this case, the principle of automatic decision-making is applied.

Large systems established in this way are adaptable and can be used for other purposes. In the technical sense, it is only necessary to change the computer program and the database can be used for other purposes. For example, the Register of Citizens can be used for the purposes of the election process, provided that there is a legal basis for it.

3.2 The use of IT technologies in the administrative procedure

The field of administrative law, and especially administrative procedure, has for a long period of time been quite conservative regarding the introduction of information technology into this system. When the first Law on General Administrative Procedure was passed in 1930, as well as the Law on General Administrative Procedure from 1956, this technology was practically unknown. Provisions of administrative procedure that are significant for electronic administration are more recent.

In the Republic of Serbia, the possibility of using computer technologies was introduced for the first time by the Law on General Administrative Procedure of the then FR Yugoslavia from 1997. Bearing in mind that this is a key law, which regulates the decision-making process of administrative bodies, any reform in terms of the introduction of these technologies presupposes appropriate changes to the Law on General Administrative Procedure, as the

basic source of law in this area. In addition, it is necessary to adopt a set of laws, which regulate certain issues of importance for electronic administration. In this sense, it is necessary to pass laws regulating electronic signatures, electronic documents, electronic communication between administrative bodies and citizens, protection and security of personal data and many other issues. Of course, some questions such as electronic signature (which is used both in electronic administration and in electronic trade and banking and many other areas), are arranged uniquely for all areas where they can be used. Some countries, among them the Republic of Serbia, have passed special laws regulating the most important issues in the field of e-government. In any case, the normative part of the reform presupposes the adoption of a set of new and amendment of existing laws.

3.2.1 Notification of authorities and parties by electronic means

The Law on General Administrative Procedure from 2016 created the legal prerequisites for the establishment of an efficient system of electronic administration in connection with the implementation of general administrative procedure.⁸ This law stipulates that all actions of parties and authorities can be carried out electronically. The administrative body has the obligation to publish on its website notices about the possibility and method of electronic communication between the body and the party and the possibility of submitting electronic documents to the body, as well as for the body to send electronic documents to the party. It is foreseen that the party communicates with the authority electronically if they agree to it beforehand or if it is determined by a special regulation. The law provides for the possibility of establishing an electronic registry office. The

⁸ Law on General Administrative Procedure ("Official Gazette of the RS", No. 18/16, 95/18 -

authentic interpretation and 02/23 - decision of the US)

electronic office is organized in accordance with the rules on office business. The electronic office is an information system for the management of electronic documents, with the aim of receiving, opening, viewing and distributing mail, recording items, combining documents, delivering items and documents to internal organizational units, sending mail, separating items, as well as their storage and archiving.⁹

If the electronic document sent to the foreigner is not legible, he can request that the authority deliver the document to him in another suitable form. If the electronic document sent by the party to the authority is not readable, the authority may require the party to submit that document in another suitable form. In a similar way, the issue of notifying the parties is regulated. It is envisaged that the party in the administrative procedure will be notified electronically, by post, by delivery or in another convenient way.

Notification by electronic means can be informal and formal. Formal electronic notification takes place in accordance with the law and must include a confirmation proving the receipt of the document. According to the law, formal notification by electronic means is equivalent to delivery. Delivery, as a form of notification, can be personal, indirect and public. Personal and indirect delivery is carried out by the authority through its official person or through a postal operator, or electronically in accordance with the law. Public submission consists of the publication of the letter on the authority's web presentation and notice board. It can also be published in writing in the official gazette, daily newspapers, as well as on their websites, or in another convenient way.

3.2.2 Acquiring data on official duty electronically

The law introduced revolutionary novelties in relation to the acquisition of data, about which official records are kept. The authority is obliged to inspect, obtain and process data on facts on which official records are kept, and which are necessary for decision-making, by official duty, in accordance with the law. If official records are maintained by another authority, the authority conducting the procedure is obliged to urgently request the data, and the requested authority to provide the data free of charge within 15 days. If the requested data can be obtained electronically, the requested authority shall deliver it as soon as possible. In the procedure initiated at the request of the party, the authority can inspect, obtain and process personal data on facts that are kept in official records when this is necessary for decision-making, unless the party expressly declares that it will obtain such data itself.

The provision regulating the direct decision-making procedure is particularly suitable for making automatic decisions. It is foreseen that the authority can directly decide on an administrative matter if the factual situation can be established based on data from official records, and the party does not have to declare in order to protect its rights and legal interests. An authority that has the technical capabilities can schedule a video conference oral hearing, which is legally equivalent to an oral hearing. In terms of evidence, the provision that stipulates that a microfilm or electronic copy of a public document and a reproduction of a copy of a public document are equal in the proof process to a public document, if they were issued by an authority within the limits of its jurisdiction, is particularly significant. The aforementioned provisions of the Law on General

⁹ Instructions on electronic office operations ("Official Gazette of RS", No. 102/10)

Administrative Procedure, although not so numerous, provide a solid and real basis for the establishment of a quality system of electronic administration. The key quality of these provisions is that every action and every document, which is performed and delivered in electronic form, is legally recognized.

In 2018, the Republic of Serbia adopted the Law on Electronic Administration, which systematically regulates all issues related to electronic administration.¹⁰ The provisions of this law also apply to electronic communication between authorities, as well as to the communication of those authorities with parties in the performance of tasks within the scope and competence of state authorities, which do not refer to administrative proceedings, unless otherwise regulated by a separate law. The law gives the meaning of all the most important terms related to electronic administration, as well as regulated issues of state administration infrastructure, electronic administrative procedures, supervision over the application of laws and penal provisions. In addition to these two laws, the Law on Electronic Document, Electronic Identification and Trust Services in Electronic Business, the Law on Electronic Commerce, the Law on Freedom of Access to Information of Public Importance, the Law on Registration of Business Entities and some other laws are of special importance for electronic administration.

4 ELECTRONIC GOVERNMENT SERVICES

Administrative bodies in the Republic of Serbia have developed a large number of online services. As a rule, these services are provided through the e-Government Portal

and portals of administrative bodies and local self-government bodies.

The e-Government portal is a national web portal and is designated as a single access point to the electronic administration of all administrative bodies in the Republic of Serbia.¹¹ Through the portal, it is possible to access the corresponding services using a search engine, in alphabetical order, as well as by clicking on the link of the administrative bodies, that is, the local self-government bodies that provide that service. The e-government strategy emphasizes the importance of using the national e-Government Portal in the development of integrated electronic services and the unification of existing services of other state administration bodies, autonomous province bodies and local self-government units. Through the portal, it is possible to access a large number of services of administrative bodies and local self-government bodies. Many of these services are practically developed to perfection.

When it comes to services intended for citizens, among the most important are: Issuance of extracts from registers, Registration and change of address, Help in finding a job, Issuance of personal documents, Tax registration, Car registration, Health services, Obtaining a building permit, Reports to the police and many others.

The most important services intended for companies are: Registration of a new company, Tax declarations including value added tax, Social contributions for employees, Customs declarations, Submission of data to the Bureau of Statistics, Environmental permits, Public procurement and many others.

Services intended for civil servants are various services, which are necessary for the

¹⁰ Law on Electronic Administration ("Official Gazette of RS", No. 27/18)

¹¹ <https://euprava.gov.rs/>

daily work of civil servants, but also for their professional training (such as distance learning).

As an example of a successful e-government service, we can take the service of the Agency for Business Registers.¹² Registration of business entities in the Republic of Serbia, which was established on the basis of the Law on the Registration Procedure in the Agency for Business Registers.¹³ The law regulates the procedure of registration, recording and publication of data and documents that are the subject of registration, records and publication in registers, and records kept by the Agency for Economic Registers. Bearing in mind that this is a special administrative procedure, the provisions of the Law on General Administrative Procedure are applied to all issues not regulated by this law.

With the establishment of the Agency for Economic Registers, one of the standards of the European Union was complied with, according to which these tasks within each state are performed by an independent regulatory body that is part of the state administration system. The register is defined as a single, central, electronic database of documents prescribed as the subject of registration, as well as documents on the basis of which the registration was made. Bearing in mind that the register should be part of the e-government system, the Agency has the obligation to ensure the connection of the register with other registers and databases maintained in the Republic of Serbia.

According to this procedure, the following are registered with the Agency: entrepreneur, partnership, limited partnership, limited liability company and joint stock company. The entire registration procedure can be carried out electronically. Electronic application to the Agency is submitted

through the user application for receiving electronic application, which ensures the receipt of electronic documents and proof of payment of the registration fee. The signing of the electronic application and documents, as well as the certification of electronic documents, is carried out in accordance with the regulations governing electronic signatures and electronic documents. The confirmation of the received electronic application is delivered to the electronic address, and the information about the received application is published on the Agency's website. Upon receipt of the application, the registrar checks whether the conditions for registration are met.

In this procedure, extremely short deadlines are foreseen. The registrar decides on the application with a decision or conclusion within five days from the date of receipt of the application. If an electronic application is submitted, the registrar's decision in electronic form is sent to the registered address for receiving electronic mail, or to the address for receiving electronic mail indicated in the application. The Agency is obliged to publish the registration data on its website. Publishing is the electronic display, on the Agency's website, of data and documents that are subject to registration and recording, decisions made in the registration and recording process, and data and documents that are not subject to registration and recording are published in accordance with regulations. Against the decisions of the registrar, the applicant can file an appeal with the Minister of Economy through the Agency, within 30 days from the date of publication of the decision. The minister decides on the appeal within 30 days, from the date of receipt of the appeal at the ministry. The procedure for issuing extracts from the

¹² <https://www.apr.gov.rs/>

¹³ Law on the registration procedure in the Agency for Business Registers ('Official Gazette of the RS', No. 99/11, 83/14, 31/19 and 105/21)

register of the Agency for Business Registers is fully automated.

CONCLUSION

The progress of the Internet and the increasing use of information technologies have led to major changes in the internal organization of the state administration and the public sector as a whole. Bearing in mind the numerous legal and technical issues that need to be resolved, the introduction of electronic administration requires an organized approach by the state and other segments of society, in terms of creating normative and technical assumptions for the introduction of these technologies.

The Republic of Serbia entered the electronic administration reform process in an organized manner, by adopting appropriate strategic documents and achieved significant results in a relatively short period of time. The Law on General Administrative Procedure from 2016 created the legal prerequisites for the establishment of an efficient system of electronic administration in connection with the implementation of general administrative procedure. The law introduced revolutionary novelties in relation to the acquisition of data, about which official records are kept. According to the law, the administrative body is obliged to inspect, acquire and process data on facts that are kept in official records and which are necessary for decision-making. In 2018, the Republic of Serbia adopted the Law on Electronic Administration, which systematically regulates all issues related to electronic administration. In the law, the meaning of all important terms related to electronic administration is given, as well as regulated issues of state administration infrastructure, electronic administrative procedures and supervision over the application of the law.

Administrative bodies in the Republic of Serbia have developed a large number of online services. As a rule, these services are provided through the e-Government Portal and portals of administrative bodies and local self-government bodies. The e-Government portal is a national web portal and is designated as a single access point to the electronic administration of all administrative bodies in the Republic of Serbia. Through the portal, it is possible to access a large number of services of administrative bodies and local self-government bodies.

In relation to this issue, the Republic of Serbia has done more than many member states of the European Union and can serve as an example for other states in the region. What is a problem is that a large number of citizens still do not use these services. Nevertheless, electronic government reform is a constant process, and the next challenge the country faces is adapting the electronic government system to the challenges posed by artificial intelligence. In this sense, changes to the current Public Administration Reform Strategy were also announced.

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BIASES IN THE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE ALGORITHMS

Rudolf Petrušić¹

¹International University Travnik in Travnik, Aleja Konzula Meljanca bb Bosnia and Herzegovina

e-mail: rudolf.petrusic@iu-travnik.com

Review article

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Abstract

One of the major issues that can have far-reaching consequences on society is bias in the development of AI algorithms. Algorithms that cannot guarantee fairness result in discrimination and inequality, and this is very evident in sectors such as healthcare, the legal system, and finance. This paper discusses the different biases arising in AI systems, their causes, impacts, and possible mitigation strategies. In the interest of fair application of AI technology, we focus on ethical dilemmas and strategies that include more transparency and diversity in data and algorithms.

Keywords: *biases, development, artificial intelligence, algorithms*



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1 INTRODUCTION

Artificial Intelligence, or AI for short, is the field of computing that focuses on creating computers that can perform tasks that typically would require human intelligence, such as recognizing speech, making decisions, and recognizing pictures and languages.

It was in the 1950s, by pioneers like Alan Turing, that thinking machines entered the hypothesis stage, paving the way for the commencement of artificial intelligence development to date. Throughout the years, artificial intelligence has developed through several stages: expert systems, machine learning, up to the dominant deep learning. (Hinton et al., 2012).

Learning about the issue of bias: Even though artificial intelligence has the potential to improve many aspects of life, the existence of algorithms becomes a big issue. Algorithms can reflect and even amplify societal inclinations because of a lack of variety in the data or due to design flaws. (O'Neil, 2016).

2 TYPES OF BIAS IN AI

The data that serves as the basis for training artificial intelligence models often contains inherent biases that can arise from historical inequalities, stereotypes, and discrimination. Namely, the data used to train recruitment algorithms can favor certain demographic groups, while marginalized groups are ignored. (Barocas & Hardt, 2019).

Algorithmic bias

Algorithmic bias occurs when the model itself, even if the data is neutral, does not make fair decisions. This can happen because of the way the algorithms are designed or implemented. For example, algorithms that use inappropriate metrics or are optimized for efficiency may ignore important factors such as fairness or balance (Angwin et al., 2016).

Model training bias

One of the key sources of availability in AI systems is the training model phase, which depends on the quality and representativeness of the data. If a model is not trained on sufficiently diverse data, its ability to make accurate and fair decisions is seriously compromised (Sweeney, 2013).

Effect of bias on results

Ethnic, gender and other social prejudices. One of the most prominent problems associated with the presence of AI is discrimination based on ethnicity, gender, age and other social factors. For example, in facial recognition systems, algorithms have shown a tendency to be more accurate in recognizing white faces compared to black faces. (Buolamwini & Gebru, 2018).

Effects in real AI applications

Bias in AI can have serious consequences in the real world. In the justice system, algorithms that assess the likelihood of recidivism can be ethnically biased, leading to unfair convictions. Similarly, in financial applications, AI can unfairly favor certain users in accessing loans, based on biased historical data. (Angwin et al., 2016).

Bias across industries

Health care

In healthcare, accessibility can have serious consequences for diagnoses and treatments. For example, algorithms that analyze medical images may be less accurate in identifying diseases in minority patients due to a lack of representation in the training data. (Obermeyer et al., 2019).

Judiciary

In justice systems, algorithms for predicting the risk of reoffending, such as COMPAS, face criticism for ethnic bias that can affect the sentencing and rehabilitation of suspects (Angwin et al., 2016).

Fintech

In the financial industry, AI is used to make lending decisions and assess risk. Bias in these systems can lead to discrimination against certain social groups, especially those with lower incomes or weaker access to capital markets (Huang et al., 2020).

3 METHODS FOR REDUCING BIAS IN AI

Transparency

One of the key ways to reduce availability in AI is to increase transparency in the development process. This includes a clear understanding of the data used, the training model, and the metrics applied to evaluate performance (Raji & Buolamwini, 2019).

Diversity of data

One of the most powerful tools for combating presence is the use of diverse representative datasets. This ensures that the AI system can handle a wide range of users and situations (Mehrabi et al., 2019).

Adjustment of algorithms

Another strategy is to adjust the algorithms themselves so that they are less sensitive to the social and demographic factors that can drive attraction. This is achieved by developing new techniques for proper learning and data balancing (Zemel et al., 2013). they understand how algorithms work and on the basis of which data they make decisions. Without adequate transparency, it is difficult to assess whether algorithms take into account relevant factors and whether there is a possibility of discrimination based on race, gender, ethnicity or other demographic characteristics (Pasquale, 2015).

AI ethics also requires accountability in system architecture. Any biases, either in the algorithms or in the data used, should be considered by researchers and developers. For example, an algorithm could be innocently designed but still support and extend inequalities in society if it has been trained on historical data reflecting those very inequalities. The concept of design ethics in the development of systems in AI is important to be brought forth to ensure technologies are not only serving the interests of the most powerful, but also contributing towards building a more equitable society.

Because of this complexity, ethical approaches to artificial intelligence involve a wide range of issues, including fairness, privacy, accountability, and security. Each of these areas requires detailed consideration and, most importantly, the active cooperation of technology experts, legislators, regulators, and technology users themselves...

4 THE NEED FOR REGULATIONS AND STANDARDS

It is high time that suitable laws and uniform standards be established, considering the increased impact of artificial intelligence in daily life, so as to ensure its equitable, responsible, and secure application. The legislative framework regarding AI should include rights such as privacy, data protection, justice, nondiscrimination, and culpability in case of harm arising out of the use of AI systems. However, the regulation of AI is complicated, as it has to be balanced between the advancements that make the technology possible and the user protection that's required.

Establishing suitable laws and uniform standards is imperative in light of artificial intelligence's increasing impact on daily life in order to ensure its equitable, responsible, and secure application. The rights to privacy, data protection, justice, nondiscrimination, and culpability for potential harm resulting from the usage of AI systems should all be covered by the legislative framework for AI. Regulating AI is a complicated topic, though, because it requires striking a balance between the advancements that make the technology possible and the user protection that is required. This regulation also sets strict guidelines for auditing, testing and mandatory certifications, as well as a clear division of responsibilities between different actors - from designers to end users.

In a similar effort, the OECD (Organization for Economic Co-operation and Development) has developed guidelines for the responsible use of artificial intelligence, which include recommendations regarding transparency, training people, avoiding discrimination and preserving human rights. The OECD called for international cooperation in the development of ethical

standards, with the aim of minimizing the negative effects of artificial intelligence, while at the same time encouraging innovation and economic growth (OECD, 2019).

Globally, in 2021, UNESCO adopted the Recommendations on Ethics in Artificial Intelligence, which provide a framework to guide countries in developing responsible and fair AI policies. These recommendations call for global cooperation and exchange of best practices in managing the ethical challenges of artificial intelligence, as well as the inclusion of different social groups in the policy development process, in order to ensure equitable access to technologies.

Challenges in the implementation of regulations

Although there is significant progress in the development of regulatory frameworks, their implementation and alignment with global standards is a major challenge. Different states have different approaches to regulating AI. While the EU favors strict regulation, there is skepticism in the United States about excessive regulation, which they believe could slow down innovation. There are also challenges related to global standards, as AI technology expands rapidly and does not respect borders. This means that every regulation should be harmonized with international laws and practices in order to avoid contradictions and disagreements between countries.

Because of these challenges, many experts argue that regulations should be flexible and able to adapt quickly to rapid technological advances. Also, there is a need for international cooperation to develop global standards, as suggested by many initiatives such as the Global Partnership for Artificial Intelligence (GPAI), which brings together countries from around the world in developing the responsible use of artificial intelligence.

User rights and protection against damage

In addition to the regulations related to the technical aspects of AI, it is important to pay attention to the rights of users. Users who rely on AI systems, whether for financial institution services, healthcare or educational services, have the right to be protected from potential damages that may arise as a result of unfair or discriminatory algorithmic decisions. Also, it is important to ensure that users have access to information about how their data is used, how decisions are made and what are the criteria for making those decisions. This information should be easily accessible, understandable and transparent.

Education and community engagement

One of the key factors in creating responsible artificial intelligence is education and community awareness. The development of educational programs that also cover the ethical aspects of artificial intelligence is crucial to ensure that future experts and decision makers are AWARE of the impact of their technologies on society. It is also important to involve the wider community in the decision-making process, allowing citizens to have a voice in the regulation of artificial intelligence, which can ensure a wider representation of interests and values.

CONCLUSION

Bias in the development of artificial intelligence (AI) algorithms is a serious challenge that goes beyond the technical aspects of technology development. AI is developing rapidly and is being integrated into almost every aspect of our lives, including health, education, employment, justice and finance. While these technologies have great benefits in terms of efficiency, productivity and innovation, they also carry the risk of profound social,

economic and political inequalities if not properly designed and implemented.

Large data sets are employed by AI systems, which often inherit and further propagate societal biases. For example, facial recognition algorithms related to security have exhibited high error rates in recognizing faces with darker skin tones, thus often causing harm to the rights of minorities (Buolamwini & Gebru, 2018). Similarly, credit-scoring algorithms in the financial domain may favor specific demographic groups more than others, thereby marginalizing the already underprivileged existing populations even more than before, and this according to O'Neil 2016. These examples now show that in artificial intelligence, access is a multidimensional issue influenced by social norms and practices, which are, in turn, likely to be furthered unconsciously by algorithms.

Irrespective of these challenges, it is important to underline that the development of responsible and innovative AI technology is possible, desirable, and indeed necessary. Therein lies a great deal of responsibility with users, lawmakers, regulators, and inventors of artificial intelligence systems. Efforts such as those developed by the OECD and UNESCO, and regulations like the EU AI Act, which provides clear-cut rules on high-risk AI systems, therefore stand to provide a guideline for the ethical handling of AI in an effort to reduce the desirability of the technology and abuse. These regulations also promote transparency, accountability and fairness, ensuring that AI is used for the benefit of all social groups, regardless of their race, gender, ethnicity or socioeconomic status.

However, international cooperation is essential to the development of valid legislation. Because AI knows no borders, international standards and guidelines should be harmonized to avoid legal conflicts and ensure users' safety around the

globe. Involvement of all relevant stakeholders in the processes of regulatory and technological developments is also important. That includes the users themselves, who are to be informed and allowed to be a part of the decision-making on AI use, and experts from other areas, like ethics, law, and sociology. This would also mean education and training on the responsible use and development of technology for the future engineer in AI, policymakers, and the general public, if such a society is ever to be created.

In addition to regulation, the focus should also be on preventive measures that will enable recognition and removal of accessibility already in the design and training phase of artificial intelligence systems. One way to achieve this goal is to develop and implement tools for auditing algorithms, such as systems for checking compliance with ethical principles and testing AI systems for potential discrimination before they are put into use. Such tools make it possible to identify weaknesses in the system and provide an opportunity for improvement before access becomes a serious problem

Bias in artificial intelligence is not a problem that can be solved by technical fixes or a uniform legislative framework alone. It is a long-term challenge that requires cooperation among all sectors of society – from academia and industry to political leaders and users themselves. Only by working together, directing technological development towards fairness and equality, can we ensure that AI technology becomes a tool that benefits all people, regardless of their personal characteristics.

In conclusion, bias in the development of artificial intelligence is a problem that must be solved through a multidisciplinary approach, with an emphasis on ethical guidelines, transparency and accountability. Considering the potential that artificial intelligence has in shaping the future, it is

important that in this process all risks of discrimination are recognized and minimized, so that the technology serves the well-being of the whole society.

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ARDUINO IOT FUNCTIONS IN THE SMART POWER GRID SYSTEM

Vehebi Sofiu¹

¹UBT- University for Busines and Technology, Faculty of Energy, Pristina
e-mail: vehebi.sofiu@ubt.uni.net

Scientific article

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Abstract

The purpose of this study is to evaluate the IoT function of Arduino within the framework of the Smart Grid system in the electric power grid. A major advantage of this function is the automatic connection of the entire energy infrastructure in the transition period to the smart grid, which integrates technologies to increase the efficiency and management of the electric grid. There are several options for monitoring, controlling and sophisticated automation of traditional energy generation operations with the Arduino system, an open hardware and software platform. Identification of Arduino functions related to the collection of sensor data for temperature, voltage, energy consumption, and other relevant variables will be the main focus of this study. Benefits and disadvantages of automation and control of electric grid devices with Arduino and the integrated grid with renewable energy. The findings of the study will help in understanding the potential and integrity issues of Arduino in the electrical industry. They will provide recommendations for its successful future implementation in this sustainable environment.

Keywords: *IoT Function, Energy Transition, Grid Integration, Energy Conservation, Sustainable Development.*



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1 INTRODUCTION

The demand for electricity in Kosovo is increasing dramatically due to technological developments that have swept the globe. Traditional fossil-fired energy has made it difficult to integrate with the automation system and its distribution. Numerous studies by several authors have shown variants of optimal solutions for different energy sources, including software ideas and proposals (Dasic et al., 2008, 2011, Damjanovic et al., 2010, Serific et al., 2010, Sofiu et al., 2011).

Due to this growing demand and the qualifying transition to sustainable development, the impact of computer networks on the design of the SMART automation network is becoming more complex due to the need to increase security, efficiency, and reliability and consider environmental and energy sustainability issues (Sofiu, V., 2017). These characteristics of an electrical grid led to its ultimate intelligence, which is now called the "Smart Grid". This is a conceptual approach that includes all intelligent elements to make the electrical distribution system more stable, reliable and efficient. An overview of "smart grids", including their features and the different effects on the electricity distribution business with qualifying traditional energy approaches, is given in this paper (Chibuikwe Peter Ohanu, Salihu Ahmed Rufai, Ugbe Christiana Oluchi, 2024). An advanced system of generation network connections for all types of generation with the automatic system increases communication reliability and significantly improves the service and quality of electricity consumption. The intelligent network with wireless infrastructure that regulates and improves the frequency infrastructure of networks with a common connection to the electricity distribution network with the Smart Grid system (Zahoor Hussain, 2016). The efficiency, security and sustainability of the power grid are enhanced by the sophisticated and controllable environment that is created

when information and communication technology is integrated with the conventional power system. This idea encompasses everything from the generation and distribution of electricity to the end user, including automation, real-time monitoring and the use of renewable resources (Chen, Z., Amani, A. M., Yu, X., & Jalili, M., 2023). Information and communication technology combined with the conventional power grid produces a sophisticated and controllable environment that increases the stability, security and efficiency of the grid. This idea encompasses everything from the generation and distribution of electricity to the end user, including automation, real-time monitoring and the use of renewable energy sources (Madani Abdu Alomar, 2023). A smart grid that connects state-of-the-art networks with various industrial processes can be considered an energy ecosystem that improves energy management in a smart and effective way. A network with smart grid intersections can create an integrated network that uses comprehensive data to monitor and manage the electrical grid using modern devices and technologies connected to the Internet of Things (IoT) (Sunawar khan, Tehseen Mazhar, Tariq Shahzad, Muhammad Amir khan, Ateeq Ur Rehman, Habib Hamam, 2024). Arduino is an open hardware and software platform with a broad and sophisticated architecture that enables the electrical grid system to function with the Smart Grid network system. Accurate real-time communication, automation of the operation process and the use of artificial intelligence are key factors to improve the operation of the electrical system in just a few steps using the applications that Arduino offers for the development of devices and technology related to the Internet of Things (IoT) (Monk, Simon, 2016). Through this research work, we hope to advance knowledge about the application of Arduino to Smart Grid system problems and its potential application in building a smart and sustainable electricity grid of the future (Pradeep K. Khatua, Vigna K. Ramachandaramurthy, Padmanathan

Kasinathan, Jia Ying Yong, Jaga, 2020). A recent and comprehensive advancement in electrical infrastructure, the Smart Grid system seeks to increase the sustainability, security and efficiency of the grid through the use of information and technology. The Smart Grid creates an integrated and interconnected grid using information and communication technology, in contrast to the conventional electrical grid (Schmidt, 2015). Process automation, energy management systems, internet-connected sensors and devices, and the use of renewable resources are all essential components of a Smart Grid system. One of the key features is the capacity for sophisticated real-time grid monitoring and control, which enables grid operators to act quickly and adapt to the demands of today's energy producers and consumers (Tanveer Ahmad, Dongdong Zhang, 2021). Global technological advances such as the Internet of Things (IoT) offer a wide range of applications in the energy sector, such as transmission and distribution, power supply, power generation, renewable energy integration, demand-side management, and environmentally sustainable development (Kabeyi, M. J. B., & Olanrewaju, O. A., 2023). To ensure the efficiency of the electricity grid with communication capabilities with all possible generations, including the characteristics of the generations with the IoT system, a fair approach is required to seamlessly integrate renewable energy sources with traditional energy and to achieve sustainable development with the smart grid (Muhammad Khalid, 2025).

2 RESEARCH METHODOLOGY

Arduino is an open hardware and software platform that has significant potential to enhance the functioning of the Smart Grid system in various ways. Utilizing Arduino in this context offers a wide range of possibilities for monitoring, automation, and efficient control of the electrical grid. This

research focuses on the current landscape of traditional energy generation and the impact of renewable energy generation, emphasizing the role of Arduino in the smart grid, which includes: - Sensors and data collection - Process automation - Real-time monitoring and reliable information - Utilization of electric machines - Safety and risk management - Interaction with consumers Generation flexibility is a crucial aspect of communication within the electricity sector, allowing for an increase in the share of renewable energy capacities. In recent years, the percentage of renewable energy sources (RES) in Kosovo's energy mix has seen a modest increase. According to European directives, Kosovo has achieved a strategic objective of 25% participation in RES, in line with the goals set in its energy strategy. However, there are significant disparities in how RES are utilized across different industries, with uneven integration of various RES technologies. Therefore, efforts are underway to seek the integration of the SMART market, ensuring that the digital approach is harmonized in real time. Arduino devices can facilitate automatic communication with wireless access for information collection. Multiple sensors, capable of tracking network conditions such as voltage, energy consumption, temperature, and other relevant data, can be connected to an Arduino. The collection and interpretation of real-time data from these Arduino devices enable an accurate assessment of network performance (Schmidt, 2015). Process of automation Arduino provides the capability to develop applications for process automation. Its advanced power management features allow Arduino to control and communicate with devices on the network through specific programming. By efficiently allocating resources and optimizing their usage, automation can lead to a significant reduction in energy consumption.

With Arduino, it is possible to build a continuous real-time monitoring system for the power grid, complete with robust data collection and real-time oversight. This

facilitates the rapid identification of issues and the optimization of operational processes. Additionally, Arduino's ability to store data and interface with other platforms enables the creation of a consistent and permanent archive, which can be utilized to analyze the long-term performance of the grid (Um-e-Habiba, Ijaz Ahmed, Mohammed Alqahtani, Muhammad Asif, Muhammad Khalid, 2024). Arduino can be connected to general energy systems, like wind turbines and solar panels, promoting the use of sustainable energy. This not only reduces dependence on conventional sources but also enhances the adoption of renewable energy. When integrating Arduino into a smart grid system, it's essential to develop security and risk management techniques to safeguard the system against potential threats and issues. The integrated security systems within Arduino enable real-time risk identification and mitigation. Additionally, Arduino can facilitate consumer interaction with the electrical grid by creating applications that allow users to monitor energy costs, track incentives for efficient energy use, and provide options for managing their energy consumption. This empowers users to make informed decisions regarding their energy usage while promoting overall efficiency in the grid (Sajad Ahmad Wani and Krishna Tomar,

2022). The connectivity and communication capabilities of Arduino can be smoothly integrated with various Internet of Things (IoT) devices, creating a comprehensive ecosystem that enhances the monitoring and management of the electrical grid. With real-time data tracking, both users and grid operators can quickly respond to unexpected changes and make informed decisions. This functionality allows for effective energy efficiency management by evaluating and improving energy use. Renewable energy technologies, such as wind turbines and solar panels, can be interconnected to promote the utilization of sustainable energy sources. It is essential to develop robust security and risk management strategies to protect the Smart Grid system from potential threats, and Arduino plays a crucial role in this effort. By leveraging its features to identify and address security threats swiftly, the overall security of the grid is strengthened. Additionally, applications designed with Arduino can empower users to track and manage their energy consumption effectively. These tools not only enhance energy efficiency but also raise awareness by providing personalized options and fostering direct communication with customers (Sajad Ahmad Wani and Krishna Tomar, 2022).

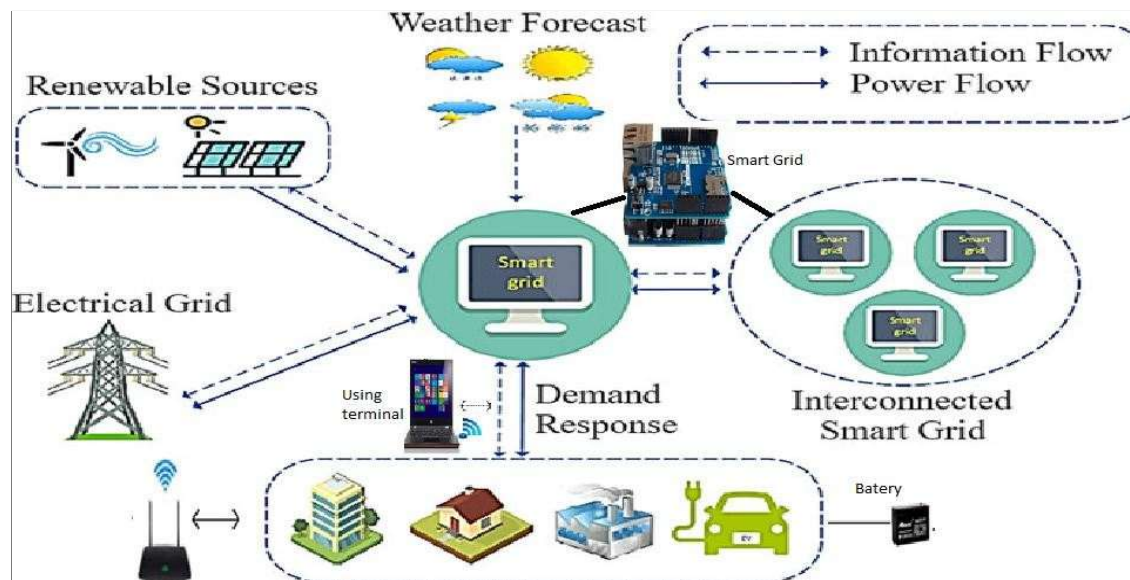


Figure 1 Managing the energy network through a smart energy system

Arduino can be effectively utilized for real-time energy monitoring and control in Smart Grid systems by incorporating several essential components and features. To gather various energy-related data, Arduino can be connected to different sensors, such as temperature, voltage, and current sensors. These sensors are connected to the Arduino's ports and pins to provide comprehensive data on the network's performance. For control purposes, devices and actuators can be connected to Arduino to manage processes within the network. When a quick response is necessary to adjust network operations, these devices activate. For instance, relays can be employed as control devices to communicate with other equipment, allowing for the isolation of specific segments of the network during emergencies. Additionally, Arduino facilitates communication with other platforms, including computers, mobile devices, and other systems connected to the Internet of Things (IoT). Through various communication protocols such as Wi-Fi, Bluetooth, and network connections, users can remotely monitor and control their energy usage. Furthermore, applications designed with Arduino empower users to effectively track and manage their energy consumption. These tools not only enhance energy efficiency but also increase awareness by offering personalized options and fostering direct communication with customers (Witt, Peter, 2016). Automatic load balancing: An artificial intelligence system can be created with Arduino to identify times when energy consumption is highest and optimize its distribution. Automatic control systems programmed with Arduino are able to respond to changes in energy usage and make adjustments in real time to maintain grid efficiency. Renewable resource monitoring: Solar and wind power generation are two examples of renewable resources whose performance can be tracked using Arduino. Depending on the availability of renewable resources, this data can be used to communicate with the grid

and modify energy distribution (Monk, Simon, 2016). Automatic Load Balancing: An artificial intelligence system can be created with Arduino to identify times when energy consumption is highest and optimize its distribution. Automatic control systems programmed with Arduino are able to respond to changes in energy usage and make adjustments in real time to maintain grid efficiency. Renewable Resource Monitoring: Solar and wind power generation are two examples of renewable resources whose performance can be tracked using Arduino. Depending on the availability of renewable resources, this data can be used to communicate with the grid and modify energy distribution (Monk, Simon, 2016). In the context of a smart grid, Arduino can be used with a variety of sensors and devices to collect data related to temperature, voltage levels, energy usage, and other relevant information. Custom sensors can be attached to the Arduino to track power usage across different segments of the network or individual devices. The purpose of voltage sensors is to keep an eye on voltage levels across the entire network. The voltage levels can be read and transmitted for further analysis using an Arduino Figure 2. By using this data to determine locations with high or low voltage, power distribution can be optimized and risk can be reduced.



Figure 2 Integrated voltage sensor

A series of temperature sensors can be attached to an Arduino to track the temperature in areas where network equipment is located. Accurate temperature

readings are provided by sensors such as the DS18B20. These sensors can be used to detect hot spots, which can affect power dissipation and the performance of electrical equipment. Arduino-connected sensors and devices are critical in improving energy monitoring and management in the Smart Grid. These devices provide necessary information and enable smart decisions for the efficiency, security, and sustainability of the electrical grid.

3 DISCUSSION OF RESULTS

Voltage and current sensors enable monitoring of grid load and detection of high voltage or overload locations. This data is used by Arduino to optimize power distribution, ensuring that each grid component uses energy most economically and efficiently possible. A comprehensive view of real-time energy usage is provided by energy consumption sensors. This data can be examined using Arduino to determine peak demand times and reduce energy costs and losses. Smart Grid reduces costs for both the supplier and the end user through energy efficiency management. Light and temperature sensors are essential for keeping an eye on the operation of renewable energy sources such as wind turbines and solar panels. The power adjustment and integration of these sources into the grid are coordinated by Arduino. Arduino can automate grid load control using relays, voltage and current sensors. The electronic system can intervene in the automatic approach by isolating specific segments of the network or using other techniques to manage the loads when the sensors are interrupted to detect high load points. Temperature sensors help detect emergency conditions, such as excessive temperatures or gas leaks. This technology has made it possible to create automated systems and applications for managing and monitoring energy in real-time. Scheduled automatic actions are events with specific conditions that can be created by IoT software to enable the Arduino to intervene when there is a

power outage at a certain time. The Arduino connects to temperature, voltage, current and other sensors to track the state of the network in real-time. It then uses this data to automatically modify network activities. The Arduino is configured to recognize emergencies, such as sudden temperature fluctuations, high voltage or unexpected usage. To address these circumstances, the automated system can immediately intervene and isolate specific segments of the network, use different resources, or modify processes to reduce risk. The resilience and efficiency of the network can be increased by using this data for additional analysis and decision-making. By connecting to sensors for temperature, voltage, current, and other variables, the Arduino continuously assesses the state of the network and uses this data to automatically modify network operations. The Arduino is configured to recognize emergencies, such as sudden temperature fluctuations, high voltage, or unexpected usage. The automated system can immediately intervene and isolate specific segments of the network using different resources or modify processes to reduce risk. Monitoring and reporting collects, tracks, and reports a variety of network performance metrics. The resilience and efficiency of the network can be increased by using this data for additional analysis and decision-making.

CONCLUSIONS

Arduino offers significant potential for automating processes and managing devices within a smart grid system due to its high flexibility, scalability, and capacity to support a wide range of applications. One of its applications is automating load control in the grid by monitoring energy usage and responding with predefined actions. To minimize the risk of voltage drops, Arduino can be programmed to turn off non-essential devices when power demand becomes excessively high. Moreover, Arduino can facilitate the monitoring and regulation of

renewable energy sources, such as wind turbines and solar panels. When the solar panel system generates a surplus of energy, Arduino can prioritize its use in the grid effectively. By connecting to sensors that measure voltage, current, and other variables, the grid's operations can be tracked in real-time, allowing for immediate reporting of any issues or irregularities. For example, if voltage levels drop in a particular area, Arduino can activate specific devices to boost voltage and stabilize the power supply. Power consumption patterns can be analyzed using Arduino, enabling adjustments in power distribution to align with current demands. Based on predicted energy needs, Arduino can effectively intervene to either increase or decrease the power supply. In terms of emergency response, Arduino can be configured to detect and respond to critical situations, such as gas leaks or voltage surges. The automated system can immediately isolate affected segments of the network, reducing risks to users and infrastructure.

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CONTEMPORARY CONSTRUCTION AND ITS IMPACT ON THE OLD URBAN STRUCTURE OF THE CITY OF PRIZREN

Vesnera Serif¹, Senida Hocko Serif¹, Veis Serif²

¹ University of Pristina, Faculty of Technical Sciences, Architecture, Kosovska Mitrovica,
E-mail: vesneraserifi@outlook.com and senidaserifi@gmail.com

² International University of Travnik, Faculty of Polytechnic Sciences, Travnik,
E-mail: serifiveis@gmail.com

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Abstract

One of the main goals of urban planning is to strive for diversity in structure, form and function in the planning and design of urban public space. Therefore, it is necessary to redefine the concept and function of urban areas, with the recommendation to preserve identity. In theoretical terms, there is a problem of planning and designing urban areas in Prizren. The example of the Abi Bazaar was chosen because of its complexity - apart from being the largest social space in the city, this complex also has high natural values. The results indicate reduced use of urban space. Based on the existing theory and insight into the process of local planning, the general recommendation for improving its quality is to improve the form /design of the complex and it is necessary to define and promote the identity of space through spatial analysis. The ultimate goal is to successfully respond to existing and potential needs of users and thus define environmental, economic, cultural and social sustainability.

Keywords: *Abi-carsija, Prizren, social space, trade, semi-atrium, urban design.*



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1 INTRODUCTION

Urban design is the process of creating a new vision of a space, and then hiring experts to realize that vision. Neizostavni su savremene metode i procesi izgradnje i upotreba savremenih materijala (Serifi et al., 2012, Jevtic et al., 2014)

Urban design, as well as all other forms of planning and design, in addition to designers and their associates, should include the users themselves in the construction process (Serifi et al., 2009, 2010, 2011, 2012). Urban design is also the joint work of different actors representing different opinions. This means that team members complement each other, exposing different knowledge and skills and being subject to criticism from well-informed clients. In this way, we will come up with a single coherent product that everyone has opted for.

Urban design combines many elements of place-making – environmental responsibility, social equity and economic feasibility, for example – to create places that are characterized by beauty and a distinct identity.

Urban design goes beyond its roots, such as traffic planning, architectural design, development economics, landscaping, and engineering. It encompasses all of these elements. In short, urban design is the process of creating a new vision of a space, and then hiring experts to realize that vision (Collaborative Urban Planning, 2025).

This paper includes an analysis of urban design at the level of Prizren. All the characteristics of urban design are given through the analysis of the Abi Čaršija complex, all the answers and all the phases, which include both the design and the urban reconstruction of the city area itself.

2 THE IMPACT OF MODERN CONSTRUCTION ON THE OLD URBAN STRUCTURE

Architecture in the urban content of Prizren in the Turkish period is shown in two different forms: as monumental and as folk

architecture. Monumental architecture found its expression in public buildings of social importance, such as: mosques, hammams, clock towers, kapali-bazaars, etc. Folk architecture has found its expression in residential buildings, bazaars and some religious buildings (turbets and tekkes).

The main feature of the territorial development of Prizren was the filling of the inherited interior of the city with new residential, commercial and communal facilities and a significant expansion of the city territory on all sides of the city periphery.

From an urban point of view, there was no public greenery in Prizren, such as parks, squares and street plantings. But there were still green areas around mosques, along Bistrica, weirs and in home courtyards. There were limited green spaces around the mosques.

Prizren's bazaar and most of the streets were paved with "Turkish cobblestones" made of river pebbles in a layer of gravel and sand. The profile of the cobblestones was symmetrical, with the channel in the axis of the street and the sides inclined towards the canal. However, some streets on the outskirts of the city were not paved at all and were muddy in rainy weather (Nikolic, 1998.).

Contemporary construction within the urban reconstruction has shown its positive and negative influences, which are analyzed in this paper, as well as urban design, which is presented at the Abi – bazaar complex.

2.1. Negative impact of urban regeneration

Until the 1960s, the urban development of the city did not significantly affect the old urban fabric in a negative sense, because the reconstruction interventions were small-scale. However, after the 1960s. By cutting the street along the right bank of the city river, on the stretch of the new green market Maraš and the formation of a smaller square on the stretch of the old bazaars of Arast and Saračana, the urban values of several old

functional units were significantly disturbed and the ambient value of the coastal strip on the stretch of the old Stone Bridge - Maraš

was disturbed (Figures 1 and 2), (Nikolic, 1998).



Figure 1: The street on the stretch of the old bridge – Maraš

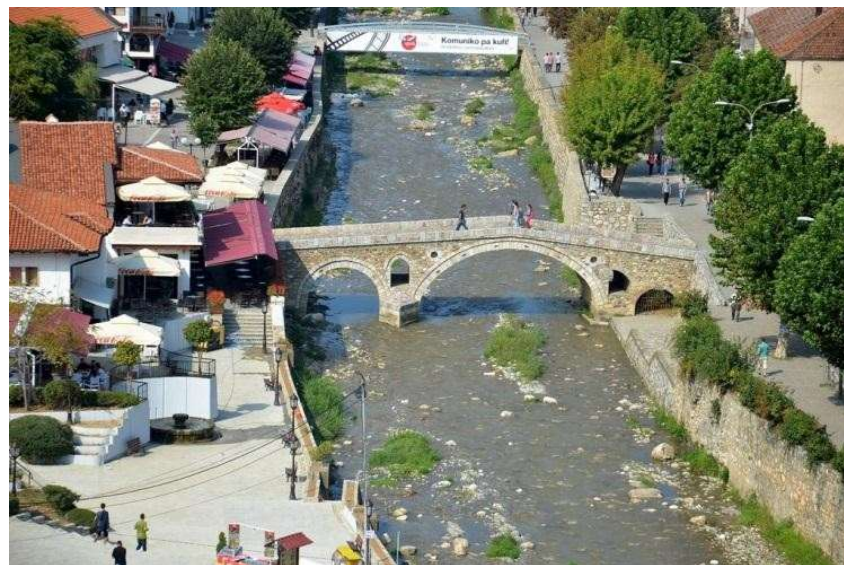


Figure 2: View of the street on the move: old bridge – Maraš

The new banistic and regulatory interventions, viewed as a whole, took place for the needs of: traffic, a new social center, housing, commercial facilities and individual public or social facilities. Apart from causing the demolition of individual buildings or in groups, they represented a new way of building, different from the existing old one. It is indisputable that the development of urban traffic and the need for new social facilities in the city have inevitably influenced the change of the

existing network of primary city streets, i.e. the construction of social facilities in the old, by location, central tissue of the city.

2.2. Positive impact of urban reconstruction – urban design

The city of Prizren, among other things, was a major cultural and commercial center. The construction of the Abi-çaršija complex (Figure 3) contributed to both urban development and urban design. The

construction of the complex has only increased the role of Prizren as a commercial

center and as such is an example of the positive impact of urban reconstruction.



Figure 3: Appearance of the Abi-bazaar

This example of urban redevelopment has a positive impact for a number of reasons. First of all, it is a novelty, not only for the commercial part of the city, but at the level of the entire city area. The construction contributed to both the commercial part and the tourist part of the base of the city.

This complex is one of the few open-air shopping malls, where visitors can enjoy the benefits of a spacious and open space and stroll through the shops and shopping center.

3 BASIC CHARACTERISTICS OF THE ABI-BAZAAR COMPLEX

The Abi Bazaar was designed by architect Ardit Jerdish. This complex owned by Irfan Fuša is located in the beautiful historic city of Prizren. The Abi Čaršija project started in September 2017. And despite many obstacles, it was realized: 29.09.2018.



Figure 4: Position of the Abi-čaršija complex in relation to the primary road

Based on Figure 4, we can see that the complex is located in a free construction zone, that the architect had full freedom, as far as the design and urban design of the site is concerned. With the unusual form of the base, the authenticity of the location itself was obtained. The idea of the designer was to construct a semi-atrium, with the aim of giving visitors freedom under the open sky.

4 THE FIRST PHASES OF THE CONSTRUCTION OF THE ABI-BAZAAR COMPLEX

Before starting the construction of a building, it is necessary to obtain a location and building permit. A location permit is the first document that must be provided before the construction of a legal facility. It is obtained on the basis of a conceptual design and contains all the data necessary for the preparation of technical documentation of the main project. The construction of this complex has encountered many problems. Namely, part of this complex exceeded the regulation line, so that part had to be demolished. However, in addition to a lot of problems, 2017. A building permit has been

obtained for the construction of this complex.

In the first phase of the construction of the complex (Figure 5), it is possible to determine the materialization, number of floors, roof and typology of buildings. As for the materialization of the structural elements of the building is: tile, gypsum block and reinforced concrete. The roof is four-sloped, which is a feature of Prizren's architecture. The number of floors is also one of the main features of a traditional Prizren house, a one-storey house. It is a gallery type of object, and a semi-atrium can also be seen in the picture.

The city of Prizren, as already shown, is a historic city, which contains the principles of traditional architecture. Figure 6 shows semicircular vaults, which, as such, point to elements of Romanesque architecture, the main feature of which is the semicircular form of massive elements. In addition, the figure shows the harmony of the main vertical structural elements (pillars) and pillars of the fence. The fusion of modern and traditional usually gives the impression of the skill of an architect.



Figure 5: Presentation of the concept and context in the first phase of construction



Figure 6: Representation of semicircular vaults

Apart from the fact that semicircular vaults are present on the structural part of the building, they are also present in the design of bridges within the complex (Figure 7).

Reinforced concrete has always been a safe stop in bridge construction.



Figure 7: The first phase of the construction of bridges within the complex

The vertical supporting structure, as it is known, transfers a vertically concentrated load to the foundation. It is a type of elongated base, the width of which is greater than the length, and therefore, in addition to the two rows of columns, which are located on the outside of the base, there is also a

central row of columns. The grid of the pillars is rectangular. The cross-section of the vertical structural elements (Figure 8) is 25x25cm. The Sheriff's Office is on the $l = 6m$, which is the ideal range for reinforced concrete.



Figure 8: Positioning of vertical structural elements

5 FINAL WORKS ON THE ABI – BAZAAR COMPLEX

The final works represented various interventions on the façade, as well as the arrangement of the entrance to the complex.

As for the entrances, in Figure 9, we can see that these are objects that symbolize the entrance gate, on which elements of Romanesque are present, in the form of semicircular openings, then various details that represent their wreath.



Figure 9: Positioning and designing the entrance of the complex

6 PRESENCE OF GREEN AND PAVED AREAS IN THE ABI – BAZAAR COMPLEX

The planning of green areas in urban areas has its own history, which can be traced through development: the concept of the organization of urban space, especially the function of housing, and through the development of the concept of land use. Green areas of urban areas are an important

factor that provides and improves the visual appearance and quality of life in urban areas. In urban areas, the importance of greenery is multiple: it improves climatic conditions, reduces the level of communal noise, increases air humidity, etc. Figure 10 shows the green area within the Abi – bazaar complex, which, in addition to its basic function, also represents the inner courtyard of the semi-atrium.

In addition to greenery, there are also paved and water areas within this complex, which are certainly attractive to visitors, but they also make up a functional system. Pedestrian paths are designed to have easy passage from the starting point to the finish line. The picture shows that the paved areas are taken care of in terms of safe use of the pedestrian zone. These are concrete slabs that are frost-resistant.



Figure 10: Display of green and paved areas of the complex



Figure 11: Display of green and paved areas of the complex from a different angle

If we look at any urban area from a bird's eye view, we will see roofs covered with layers

of asphalt, tar and gravel. Heat radiates from these dark roofs, while water flows down the

hard surfaces. Figure 11 shows the greenery located on the roof, in the function of the roof garden, the fifth façade.

The paved area is a feature of the pedestrian zone. As a rule, paving is done with hard materials, which is also the case in this case. Of all the details of the Abi – bazaar complex, the most important is the parking

space, as well as the access to the parking space. The radius of the curve at the entrance to the parking space is 6m, which is a satisfactory condition for this type of facility. The parking lot is accessed from the secondary road, which avoids overcrowding of the main road.



Figure 12: View of the parking area from the complex

If you pay attention, in Figure 13 you can see the same motif of the architect, which, in addition to being present in the form of a gate at the entrance to the complex, is also present as a "gate" of the entrance to the parking space. The same Romanesque

details are also present at the entrance to the parking space. All the motifs of the Abi-bazaar complex are connected to each other, which makes this space more authentic and one of the benchmarks of this historic city



Figure 13: Access to the parking space

CONCLUSION

Urban design, as well as all other forms of planning and design, in addition to designers and their associates, should include the users themselves in the construction process. Urban design is also a joint effort between different stakeholders with different opinions.

The urban development of the city, until 1960, did not significantly affect the old urban fabric in a negative sense, because the reconstruction interventions were small-scale. That the new banistic and regulatory interventions, viewed as a whole, were carried out for the needs of: traffic, a new social center, housing, commercial facilities and individual public or social facilities.

The Abi Bazaar was designed by architect Ardit Jerdish. This complex owned by Irfan Fuša is located in the beautiful historic city of Prizren. The Abi Čaršija project started in September 2017. And despite many obstacles, it was realized: 29.09.2018.

The construction of this complex has encountered many problems. Namely, part of this complex exceeded the regulation line, so that part had to be demolished. However, in addition to many problems, in 2017, a building permit was obtained for the construction of this complex.

The principles of both traditional and modern architecture were applied to the complex, and the presence of Romanesque architecture can be noticed, in the form of massive semicircular vaults, and this motif is repeated in almost every part of the complex.

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